

ABOUT THE TESTS OF BECKMANN AND MANDICS OF ISOTROPY OF LIGHT PROPAGATION

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The analysis of the results obtained by Beckmann P. and Mandics P. in the tests of the second postulate of special relativity has shown that light velocity is not a universal constant value.

The equipment Beckmann and Mandics used to test isotropy of light propagation in vacuum [1] included a helium-neon laser as a source of light which directed light beams to a flat mirror fixed on the gyro rotor. During the experiment the rotor changed its speed and direction of rotation. Reflected from the rotating mirror, the beams were directed to the Lloyd's interferometer. The test was performed with two different arrangements of the equipment.

In Arrangement 1 (1b in [1]) a part of the beams reflected from the moving mirror M (Fig.) reached the Lloyd's mirror through the slit S , the other part passed by the mirror to the photoplate B where, together with the beams reflected from the mirror, it formed an interference pattern.

The advantage of this arrangement was that all the moving parts were outside the interferometer and had no effect on the fringe shift in the interference pattern caused by mechanical deformation. All the parts of the equipment, except the laser and the photoplate, were in a vacuum chamber (10^{-6} torr).

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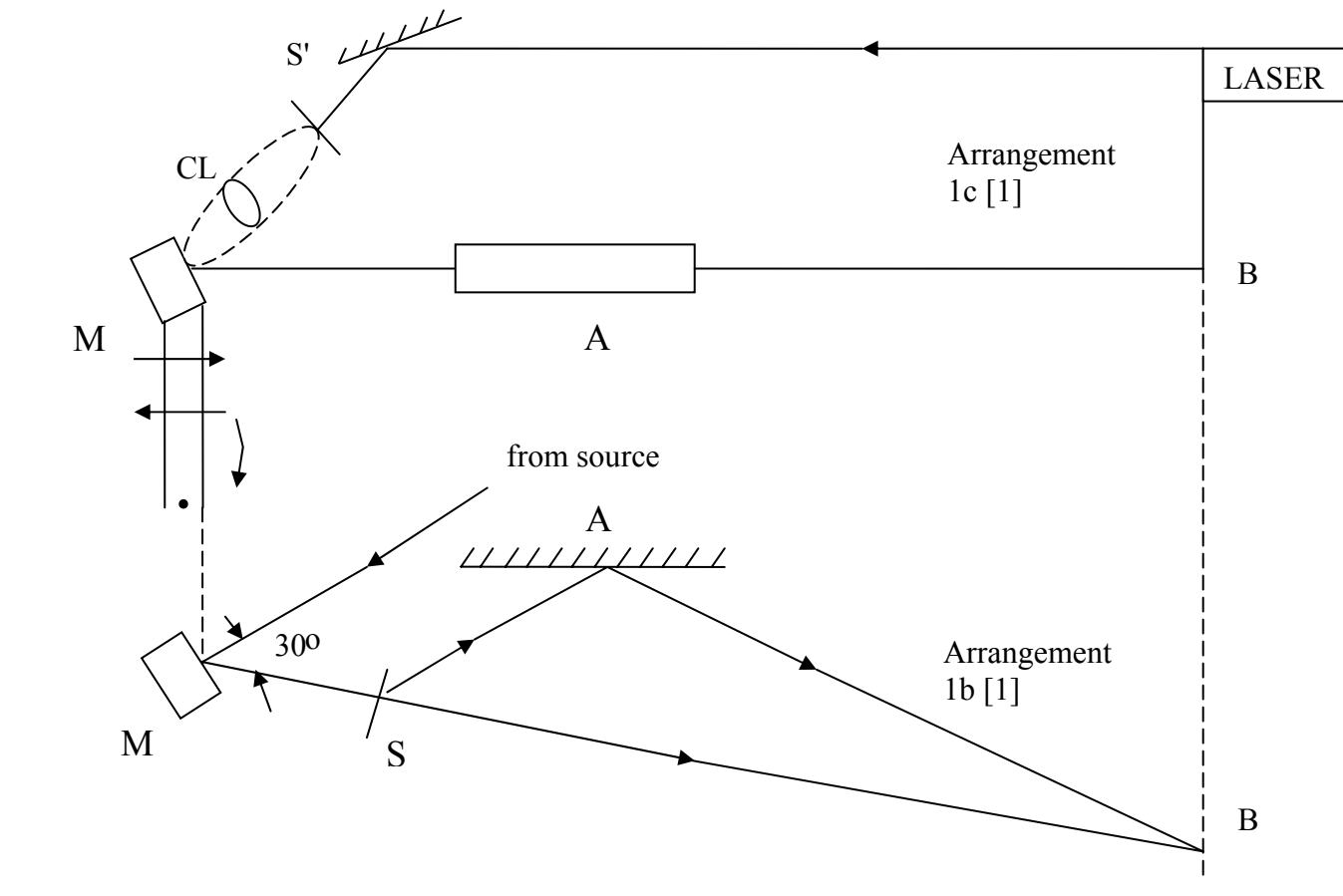


Figure. The arrangements of the equipment in the test performed by Beckmann P. and Mandics P.

S, S'^r - slits; A – Lloyd's mirror; B – photoplate;

M – mirror on the gyro rotor.

To do away with possible objections that the slit S can serve as a second stationary source of light, the researchers used Arrangement 2 (1c [1]). The light from the source passed through the slit S' , the lens CL with the focal length of 8.89 cm, and the beams came to the moving mirror M on the gyro. Then the light flux passed through the Lloyd's interferometer, and the beams reflected from the mirror A united with the ones that passed it by, forming an interference pattern on the photoplate B . The whole path of the beams lay within the vacuum chamber ($7 \cdot 10^{-7}$ torr).

In Arrangement 1c the distance from the mirror M to the photoplate was 4.25 m. The linear velocity of rotation of the mirror M changed up to $V \sim 50$ m/s.

Numerous experiments performed by Belopolsky A.A., Golitsin B.B. and Vilip I., Majorana Q. and others [2,3] have shown that the frequency of the light reflected from the moving mirror (ω_{ref}) depends on the mirror velocity.

In Majorana's experiments [3] the light, many times reflected from the moving and fixed mirrors, was directed to the Michelson's interferometer with arms of different lengths. The change in the frequency of the reflected light (Doppler effect) caused the shift of fringes.

The experiments were performed in air, the fact that, according to Fox [4], casts some doubt on the correctness of any experimental verification of light speed independence on the speed of the light source.

In general ω_{ref} , as a function of the source velocity, is written as

$$\omega_{\text{ref}} = \omega_0 \cdot \varphi(\beta, \theta_i), \quad (1)$$

where $\beta = \frac{V}{C_0}$, C_0 – light speed, θ_i - the angle between the moving direction of the mirror and that of the light beam falling on the mirror. Thus, for example, in Arrangement 1b in [1] the frequency of the beam reflected from the mirror M is

$$\omega_i \approx \omega_0 (1 \pm \beta \cos 30^\circ)(1 \pm \beta) \approx (1 \pm 1,866\beta)\omega_0, \quad (2)$$

for $\beta^2 \approx 0$, $\beta \ll 1$, ω_0 is the frequency of the light emitted by the laser.

The difference between the phases of the beams that form the interference pattern on the photoplate at the point B in Arrangement 1c is equal to (Fig.)

$$(t_{MA} + t_{AB} - t_{MB}) \cdot \omega'_i = \Delta t \cdot \omega'_i = \Delta\Phi'_i,$$

where t_{MA} , t_{AB} , t_{MB} are, correspondingly, the beam pass time from the mirror M to the mirror A , then after its reflection from A to the point B (t_{AB}) and the rectilinear motion time of the other beam from M to B (t_{MB}); ω'_i is the frequency of the beams reflected from the mirror M . The difference between the phases of the beams that reached B at the mirror velocity of $V=0$ is equal to $\Delta\Phi'_0 = \Delta t'_0 \cdot \omega_0$, where $\Delta t'_0$ is the value of Δt for $V=0$.

Similar calculations for the difference between the phases of the beams that form the interference pattern at B in Arrangement $1b$ show that (Fig.)

$$\Delta\Phi_i = (t_{SA} + t_{AB} - t_{SB}) \cdot \omega_i = \Delta t_1 \cdot \omega_i; \quad \Delta t_0 \cdot \omega_0 = \Delta\Phi_0,$$

where Δt_0 is the value of Δt_1 for $V=0$.

The experiments (Arrangements $1b$ and $1c$ [1]) have shown that the change in the speed as well as the change in the rotation direction of the gyro rotor with the mirror did not cause any shift in fringes, i.e. $\Delta\Phi_0 = \Delta\Phi_i$, $\Delta\Phi'_0 = \Delta\Phi'_i$. This is only possible in the event if the speeds of the light beams reflected from the rotating mirror (C_{ref} , C'_{ref}) are related to the frequency of these beams as

$$\frac{C_{\text{ref}}}{\omega_i} = \frac{C'_{\text{ref}}}{\omega'_i} = \frac{C_0}{\omega_0},$$

whence $C_{\text{ref}} = \frac{C_0 \omega_i}{\omega_0}$; $C'_{\text{ref}} = \frac{\omega'_i C_0}{\omega_0}$,

where C_{ref} is for Arrangement $1b$;

C'_{ref} - for Arrangement $1c$.

Thus, in the example given above (Formula 2) the light speed on all paths from the split S to the photoplate B was equal to

$$C_{\text{ref}} = C_0 \pm 1.866V. \quad (3)$$

It should be particularly pointed out that according to (3), after the reflection from A the light speed is also equal to C_{ref} (Arrangement $1b$), C'_{ref} (Arrangement $1c$).

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