Why Shamir and Fox did not detect "aether wind" in 1969?

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Up to 1960ies the measurement of the aether wind velocity by the technology of Michelson presumed that a medium placed across the path of light rays has no substantial significance (except as being an obstacle) for obtaining the expected shift of the interference fringe from the brought together orthogonal rays on the interference of the turnabout device. In 1960ties several authors began independent research on the Michelson-type interferometers with different optical media used as light carriers. J.Shamir and R.Fox declared "negative" the results of their measurements on the plexiglas (though they registered the fringe shift 1/3000 fraction of the fringe's width and determined the respective velocity of aether wind 6.5 km/s). The authors considered this result as "enhancing the experimental basis of special relativity", and their report has been published. My results of same years appeared to be positive. I managed to register on gaseous, liquid and solid optically transparent bodies hundred times greater relative shifts of the fringe (0.01-5.0) giving for horizontal projection of the aether wind velocity the value hundreds km/s. At different times of day and night at the latitude of Obninsk city I registered the changing of this velocity in the interval 140-480 km/s. Insofar as my results "weaken the experimental basis of special relativity", their publication is still refused.

I will show in the present report, basing on my experimental experience, that in reality Shamir and Fox obtained positive results. The historical precedence of misunderstanding the positive measurements of aether wind of the order 200-400 km/s, performed by Michelson and Miller in 1920-1930ies at lengthened to 32 m air light carriers, described by me in arXiv:0910.5658v3, 24 June 2010, repeated in the work by Shamir and Fox. Misunderstood was another artifact, manifesting itself in an interferometer with a solid light carrier. In the current work, I explain the nature of this artifact, hiding from Shamir and Fox their experimental success in detecting the aether wind velocity of hundreds km/s. I discussed also the inadequacy of their own interpretation of the results.

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1. RESULTS OF MEASUREMENTS ANNOUNCED IN [1]

The measured shift of interference fringe (retaining designations [1] of physical values):
- sensitivity in terms of relative amplitude of the interference fringe shift

$$\Delta < \frac{1}{3000}\,\text{fringe}, \tag{1}$$

- calculation formula for velocity v of aether wind, $\beta = v/c$

$$\beta^2 = \frac{\Delta \cdot \lambda}{2ln(1-n^{-2})}, \tag{2}$$

- parameters of the experiment

$$\lambda = 6330\ \text{Å}, \quad l = 26\ cm, \quad n = 1.49, \tag{3}$$

- shift of the interference fringe measured

$$\Delta = 1/3000. \tag{4}$$

These data give

$$\beta^2 = 4.95 \cdot 10^{-10}, \tag{5}$$

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therefrom the authors [1] obtained the velocity of aether wind

$$v = 6.64 \text{ km/s}. \tag{6}$$

In the issue, Shamir and Fox conclude their work by two statements. Since the obtained velocity of the Earth's motion in aether is much smaller than the velocity of the Earth's motion around the Sun, hence the result of the work should be considered, firstly, as negative, secondly, as enhancing the experimental basis of special relativity. This conclusion quite responded to euphoria of 60ty year PR of special relativity in 1960ies which keeps on nowadays. Let us show carefully what shaky base the results of the authors [1] rest on.

2. THE RESOLVING POWER OF THE MICHELSON INTERFEROMETER IN THE OBSERVATION OF THE FRINGE SHIFT

The resolving power of Michelson-type interferometer is measured by a minimal noticed shift δ relative to the width of the fringe. The "empirical guideline" for the dependence of δ on the length $2l$ ($2l = 2l_{\parallel} = 2l_{\perp}$) of the arm filled with air is shown by the line 1 in Fig.1. We see that the length of the flight l before the light comes to the interference screen strongly effects δ. The line 1 was obtained by me in the interval $3 \le \delta \le 1.2 \cdot 10^3$ cm for the source of light whose monochoromaticity was estimated by the half-width $\delta_s \sim 3 \cdot 10^{-5}$. Values of δ, obtained in the air by different experimenters, lay well on the linear extrapolation of 1. In particular, we have: Michelson&Morley [2] $\delta \sim 1/40$, Miller [3] $\delta \sim 1/20$, Demjanov [4, 5] $\delta \sim 1/120$, Shamir&Fox [1] $\delta \sim 1/3000$. Remark, that window 4 shown in Fig.1 defines the region of parameters $\delta \times l$ where there were performed actually all my measurements [4] on interferometers with various optical media (in particular, water 2, glass and fused quartz 3). Thus, from $\delta(l)$ measured for various optical media we come to qualitatively obvious observation: the diffusive dispersal of rays grows with the increase of the path l in the medium and become worse in a denser medium, liquid and solid. Empirical data represented in Fig.1 will help us to analyze results of the authors [1]. Using empirical curve 3 of Fig.1 we may predict that in plexiglas with

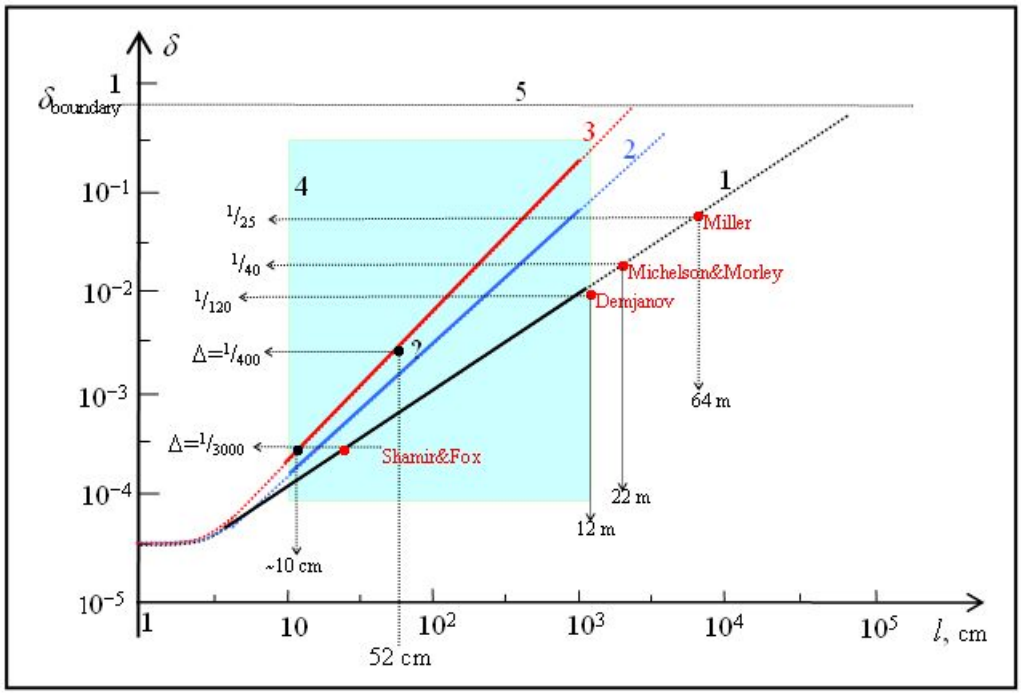

FIG. 1: The resolving power δ as a function of the path l of the visible light in the optical medium of the interferometer (5 - the boundary $\delta_{boundary}$ of the full diffusive dithering of the fringe): 1 - the air of normal pressure; 2 - the distilled water; 3 - the fused quartz; 4 - the region of parameters $\delta \times l$ where were made almost all my experiments with mentioned light carriers (see thick parts of the lines 1-3). The red points show the declared resolving power of the interferometer in four experimental works [1–3, 5] that registered a non-zero shift of the interference fringe.

arms length $2l = 52$ cm there should be the shift of interference fringe about 1/400 of the fringe's width. However,

the authors [1] have registered the relative shift 1/3000. This value of shift corresponds to the quartz arm's length 10 cm and about 15 cm for the arm filled with the air (see the black bold point on the line 3 and respective red point on the line 1 of Fig.1). The harsh contradiction between the results of [1] and data obtained by other authors indicate that Shamir&Fox measured not the shift in the plexiglas arms but the following artefact.

Most likely they measured the fringe shift from the intense and contrasting interference pattern formed by parasitic rays $S_{r\perp}$ and $S_{r\|}$ that circulate in the short air gaps $\Delta l_\perp$ and $\Delta l_\|$ between partially reflecting light rectangular butts of plexiglas rods and semitransparent plate P (Fig.2a). The part of the light, passed to plexiglas rods as the rays $S_{n\perp}$ and $S_{n\|}$, propagates in them over the more lengthy paths $l_\perp$ and $l_\|$ until the mirrors $M_\perp$ and $M_\|$, then is reflected and much weakened and diffusively dithered comes as to the plate P. Thus the intensity of the interference fringe from these useful rays $S_{n\perp}$ and $S_{n\|}$ turns out to be 10-30 times lesser that that of parasitic rays $S_{r\perp}$ and $S_{r\|}$. If the parasitic rays were not specially removed, as shown in Fig.2 and described in details in [6], then the artefact fringe formed by the interference of rays $S_{r\perp}$ and $S_{r\|}$ in the air gaps $\Delta l_\perp$ and $\Delta l_\|$ wholly suppresses the useful fringe obtained from weakened and diffusively dithered rays $S_{n\perp}$ and $S_{n\|}$. So, the useful fringe, containing all the information about the velocity of aether wind, will not be observed (that just occurred in the experiment of the authors [1]).

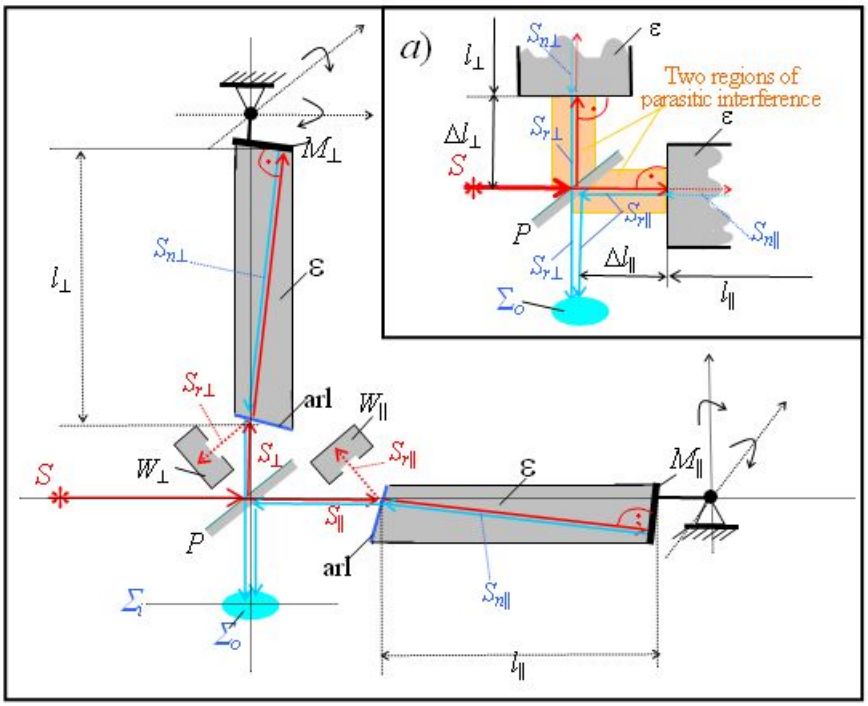

FIG. 2: The scheme of rays in the Michelson interferometer with optically transparent media as light carriers, that are placed in cuvettes (when vacuum, gases and liquids) or used as rods. The construction removes parasitic rays that impedes the observation of the basic interference (by means of traps W of reflected rays; M - mirrors; and arl - antireflection layers). a) the region of localizing the parasitic interference in the case of wrong (perpendicular to rays) arrangement of the butt of the cuvette or rod.

3. SMALLNESS OF SYSTEMATIC BIAS IN MICHELSON INTERFEROMETER IS AN INDICATION OF NO LENGTHY LIGHT PATH AND NO DENSE MEDIUM

It is known from the times of Michelson that the interference fringe shift includes in itself a bias that linearly depends on the angle of revolving the interferometer. This systematic bias should be subtracted from the full fringe shift in order to extract the harmonic part of the fringe shift containing the information about the magnitude of aether wind (Fig.3a). I have shown [4] by direct measurements that this systematic bias (in fact, the slope of the line in Fig.3a) decreases when there are reduced: the arms $l_\perp$ and $l_\|$ of the interferometer, the refractive index of light carrying media, the rate of revolving the device. When l diminishes to 10-15 cm the line E-W-E-W in Fig.3a becomes almost horizontal. On the other side, Shamir&Fox have found in their experiment almost no systematic bias of the fringe shift (see Fig.3b).

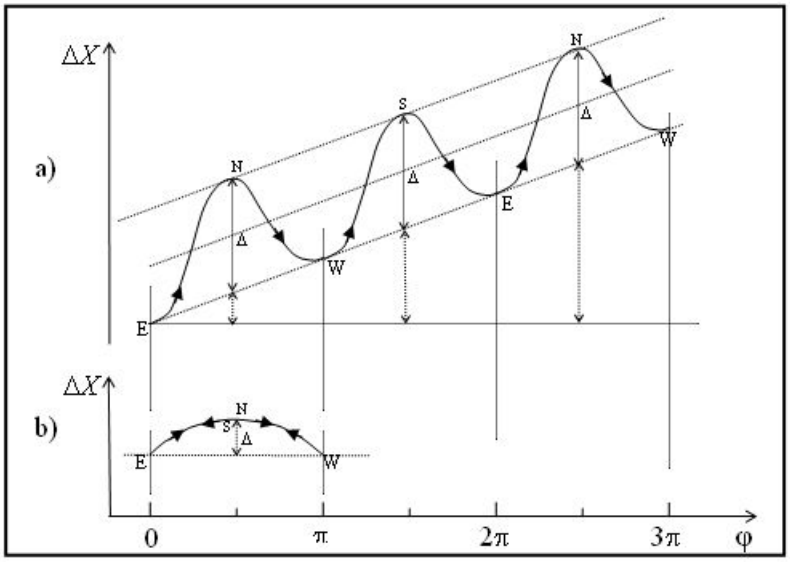

FIG. 3: The shift ΔX of the interference fringe in revolving the interferometer by the angle φ that consists of the harmonic component (containing the information on the aether wind) and systematic bias E-W-E-W, which is proportional to rotation angle: a) the interference fringe shift observed for $n > 1$ and large arm (here $2l > 100$ cm) [4]; b) the scheme from Fig.3 of [1].

These facts indicate once more that the authors [1] measured the interference fringe formed from parasitic reflections $S_{r\perp}$ and $S_{r\parallel}$ in small air gaps between rectangular butts of plexiglas rods.

Fig.2 shows the scheme of interferometer with slanted ends and traps for parasitic beams $S_{r\perp}$ and $S_{r\parallel}$. This scheme enables us to remove artefact and observe the interference fringe shift formed by the rays passed to and fro in the optically transparent solid rods (for details see [6]).

4. WHAT SPEED OF AETHER WIND DID THE AUTHORS [1] MEASURE?

So, I showed that Shamir&Fox observed the interference pattern formed by short rays in the air. The distance between the semitransparent plate P and rectangular butts of plexiglas is not indicated in [1]. However we may estimate it as not less than 5 cm and not more than 20 cm. Thus the revised parameters of the experiment should be following:

$\Delta = 1/3000,\ \lambda = 6330\,\text{Å},\ l_{\text{air}} = 7 - 10\text{cm},\ n_{\text{air}} = 1.0003.$

Substituting these values to (2) [formula (20) of [1]] gives the following velocity of aether wind

$$v = c\sqrt{\frac{\Delta\cdot\lambda}{2ln(1-n^{-2})}} = c\sqrt{\frac{\Delta\cdot\lambda n}{2l\Delta\varepsilon}} \approx 550\text{km/s}. \tag{7}$$

This experimental result says for himself.

5. MISTAKE IN THE THEORY [1] OF MICHELSON INTERFEROMETRY IN OPTICAL MEDIA

Authors [1] made a mistake in their derivation of the formula relating velocity of aether wind with the shift of interference fringe. So that their formula may describe only asymptotic case, when $n \to 1$, i.e. gases. The general formula that is valid for $1 < n < 1.75$ looks as [5]

$$v = c\sqrt{\frac{\Delta\cdot\lambda n}{2l\Delta\varepsilon(1-\Delta\varepsilon)}}. \tag{8}$$

I firstly proposed this formula for interpretation my experiment on Michelson-type interferometer in optical media [4]. Recently this formula has been derived by two different methods [7, 8].

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