Why Trimmer et al. “did not detect" aether wind in 1973?

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In 1960s several authors began independently studies of the interferometric detection of "aether wind" using in the device optical media. Shamir&Fox in 1969 made measurements on the plexiglas and declared them “negative” (whereas they registered the shift of the fringe at ~1/3000 of its width, and "determined" a corresponding to it velocity of aether wind ~6.6 km/s). In 1973 Trimmer et al. mounted at the one-armed device the glass optics and registered with a big resolution the shift of the interference fringe (at most $\sim 10^{-6}$ of its width) and determined by it the speed of "aether wind" ~3.8 cm/s. This result enhanced still more the confidence in that the attempts to detect aether are unfavorable. However, my results of the same years being favorable fell out of the common line of "negative" verdicts to aether. I managed to register on gases, liquids and solid optical materials million times greater relative fringe shifts (0.01÷5.0), revealed the horizontal projection of the aether wind velocity hundreds km/s. Since my results “weakened the experimental foundation of special relativity”, their publishing is rejected until now.

In the current report I argue reasonably, relying on my experience, that Trimmer et al. (as well as Shamir &Fox), actually obtained positive results in their measurements of aether wind which amounts to several hundreds km/s, proceeding from the declared by them resolution of their experimental units. I believe their experimental data. But I guess that they were faced with hidden artefacts in the interferometer with solid optic materials and not aware of it. The theory used by them for processing the measurements of the interference fringe shift obtained is not appropriate for interferometers with solid optical materials. I have found the possible reason why Trimmer et al. did not reveal the experimental facts undermining theories repudiating aether.

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1. Declared in [1] results of measurements

The measured in [1] shift of the interference fringe disclosed:

– the ratio of the aether wind velocity (inside the optical material made of fused quartz) to the light speed in vacuum $\sim 10^{-10}$;

– the velocity of aether wind ~3.8 cm/s.

Whereas the authors [1] do not mention the resolution power of their device, but judging by the declared results of measuring the relative fringe shift and calculated from it shift the velocity of aether wind, the resolution was no worse than $\sim 10^{-7}$ of the fringe width.

Eventually Trimmer et al. concluded, that they detected the aether wind in the glass optical material whose velocity appeared to be the million times less than the orbital velocity of the Earth. Let us consider attentively the shakiness of the basis on which the conclusions of these authors [1] rest upon.

2. The resolution of the Michelson interferometer by the observing the shift of the fringe

I present in Fig.1 as the curve 1 the "general empiric correlation " $\delta(l)$ of the resolving power δ of the Michelson-type interferometer for detecting the shift of the interference pattern depending on the length of the light paths ($2l=2\cdot l_{\|}=2\cdot l_{\perp}$), passed by the two interfering beams in the air of normal pressure (curve 1) and in laboratory vacuum with a residual pressure of ~1 mmHg (curve 4). We may see that δ (i.e. minimally noticeable shift of the fringe, divided by its width), strongly depends on the length l of the path of rays in the optical medium, before they get into the interference screen. Curve 1 was measured by me in the wavelength interval $3 \leq l \leq 1.2\cdot 10^{3}$ cm with a source, the spectral quality of which was estimated (from the half-width) by the value $\delta_s \sim 3\cdot 10^{-5}$.

Applying in Fig.1 a linear extrapolation of the measured by me curve 1 to wavelengths $l \sim 0.1$ km, we get a "general trend" (1), which fit all levels of resolution of the Michelson type interferometer with air optical materials, which were obtained in experiments published for hundred years by different experimenters. In particular, Michelson &Morley [5] – $\delta \sim {}^{1}/_{40}$, Miller [6] – $\delta \sim {}^{1}/_{20}$, Demjanov [4, 7, 8] – δ~$^1/_{120}$, Shamir&Fox [3] – δ~$^1/_{3000}$, at last, Trimmer ~10^{-6}. Note that the highlighted box 5 in Figure 1 defines the region δ×*l* of parameters at which have been implemented almost all of my measurements [4] on interferometers with different optical media (in particular, with water 2, glass and fused quartz 3).

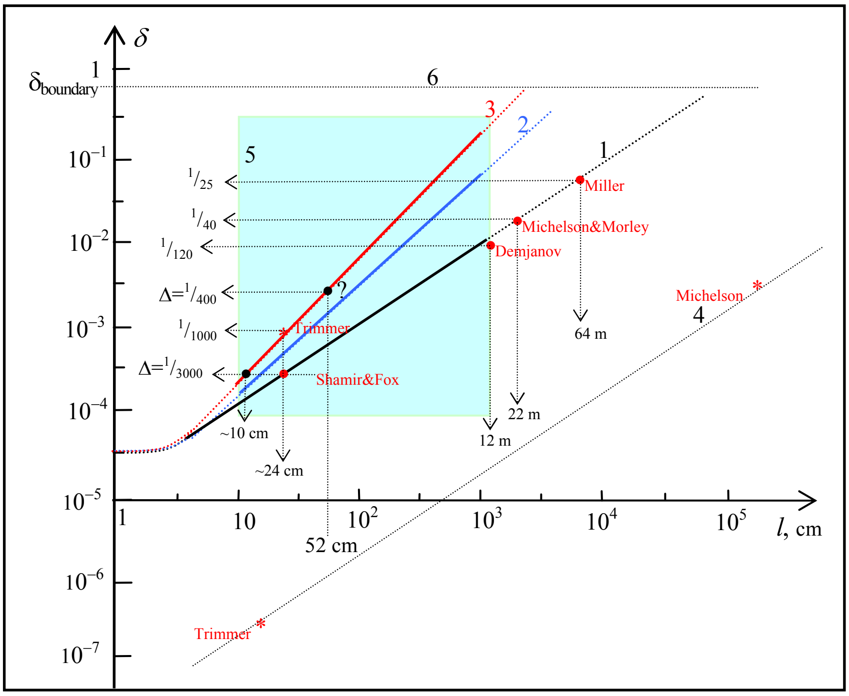

Рис.1. Dependences δ(*l*) of the resolving power *δ* on the length *l* of the path ("to" and "fro") of visible light in the interferometer with optical media: 1 – the air of normal pressure 2 – distilled water; 3 – fused quartz; 4 – laboratory vacuum with evacuation ~1 mmHg.; 5 – the region of parameters δ×*l*, where were actually implemented [4] all my experiments on listed optical materials (see bold portion of curves 1-3); 6 – border $\delta_{boundary}$ of the full diffusive blurring of the fringe. The points (• and *) define the resolving power of the interferometer declared in four experimental works: Michelson&Morley, Miller, Demjanov, Shamir&Fox (• for air of normal pressure), and two experimental works: Michelson *et al.* and Trimmer *et al.* (* for laboratory vacuum), which in all the six cases confidently registered a non-zero shift of the interference fringe.

The comparison of trends δ(*l*) of the resolution of the interferometer for least observed shift of the fringe from two beams propagating in different optically transparent media, leads to a qualitatively obvious result: a diffuse scattering of light increases in proportion to the length of their flight in the medium, being much worse in solids and liquids than in gases. For the purposes of our analysis of the results [1] are particularly important quantitative empirical data in Figure 1. As is seen from the section 1 above, the authors [1] recorded in fused quartz with a full light path 2·*l*=24 cm unprecedentedly small relative shift of the fringe (in my estimation, no more than ~ 10^{-6} of the bandwidth). This is a thousand times better than I could obtain in my measurements [4], and ten thousand times better than achieved by Michelson & Morley [3] and Miller [4]. For nearly 40 years, no one doubted that in 1973 the measuring the fringe shift at the level 10^{-6} already was possible with the technique, which is described briefly in [1]; this can be seen from the fact that the work [1] with its "negative " result is often referred to as the "golden fund" of the experiments in favor of relativity. As to me, being grasped the subtleties of many measurements on the Michelson interferometer, I do not doubt in it too.

The fact is that the phenomenal result [1] by the resolution of the fringe shift at the level ~10^{-6} of its width sheds light on what the authors measured [1]. And they measured the fringe shift in the high-contrast interference pattern obtained from the two artifact rays $S_{r\perp}$ and $S_{r\|}$, circulating in the two short vacuum arms $l_\perp+\Delta l_\perp$ and $l_\|+\Delta l_\|$ between the partially reflecting the light right-angled butts of the fused quartz rod that return artifact rays $S_{r\perp}$ and $S_{r\|}$ to the mirrors, and then to the semi-transparent plate *P* (Fig.2b). These two artifact arms form (due to the evacuation chamber), two quasiresonance zone with low light scattering (i.e. with high quality factor, secured to authors [1] a high resolution of super-contrast interference fringe obtained from artifact rays $S_{r\perp}$ and $S_{r\|}$).

Passed inside the rod portions of the rays S_n propagate toward each other in the solid optical medium with much greater losses than in laboratory vacuum. When they reached the opposite exit boundary inside the rod, each of them again reflected. After a run in the rod of the total path $2l$=2·12 cm, very weakened and diffusive rays S_n return to the plate *P*. Their intensity appears to be 5-10 times less than that of the artifact rays $S_{r\perp}$ and $S_r\|$. If the artifact rays are not specifically removed, as described, for example, in [7], then the formed by them fringe completely suppresses the useful fringe of the weak and diffusive rays S_n. As a result, the useful fringe, which carries all the information about the speed of the aether wind in the solid optical medium becomes unobservable (which is highly probable case in the authors' experiment [1]).

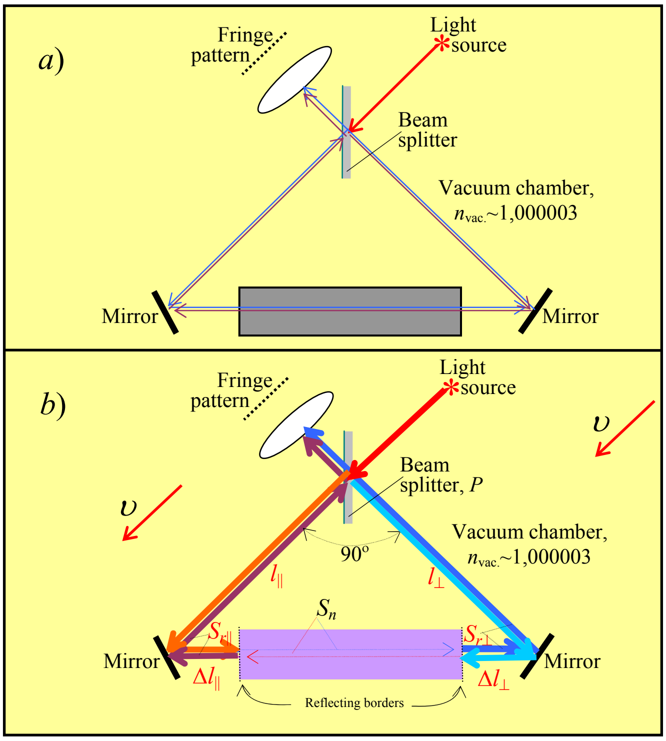

Fig 2. The optical scheme of forming beams of the interferometer, proposed by the authors [1]:
a) the expected by the authors [1] idealized scheme of the course of optical processes in the unusual one-rod interferometer-detector of "aether wind";
b) the actual unperceptibly formed scheme of optical processes with the unexpected, and therefore completely missed in the analysis [1], artifacts of parasitically-reflected rays $S_{r\|}$ and $S_{r\perp}$ from straight edges of the glass rod that turns the unusual optical interferometer with a solid optical material into the usual two-arm crosswise Michelson type interferometer with laboratory-evacuated light paths.

The correctness of my evaluation of the results obtained in [1] is confirmed by the very results of [1]. I suppose that the accomplished by me experimental investigation of the resolving power of the Michelson-type interferometer (see Fig.1) can be laid in the basis of the right understanding of the reason why the authors [1] have managed to register a uniquely high (~10^{-7}) resolution of the fringe shift. This will enable us to give the true scheme (presented in Fig.2b) by which they actually performed their experiment. It is clear from Fig.1, that the exceptionally small (~10^{-6}) fringe shift can be obtained only at short and evacuated light paths of the length not more than l=10÷15 cm (see the red point * on the curve 4, Fig.1). If we assume that the authors [1] observed an interference pattern from the rays S_n (see Fig. 2), passed in the rod of fused quartz a full run $2l$=2·12=24 cm, then they were not able to measure the relative fringe shift Δ~10^{-6} recorded by them. Indeed, the resolving power of the interferometer with a solid optical material of such length would have been a thousand times insufficient, as is well seen by the position of the point *Trimmer on the curve 3 in Fig. 1, which determines by the trend 3 the resolving power of the interferometer (~1/1000) with the optical material of fused quartz of full length 2l = 24 cm. Thus only vacuum paths of the length $2l$=15-25 cm were able to secure the resolution of the relative shift ~10^{-6} in the experiment [1]. And this clearly points to the fact that the authors [1] dealt with the scheme of the interferometer shown in Fig.2b, in which the glass rod participates as a reflector, but not a carrier of rays.

3. What speed of aether wind did the authors [1] measure?

Insofar as the authors [1] recognized their experiment as positive (there was registered the fringe shift ~10^{-6}), and nobody denies it (and I, proceeding from my experience, confirm that this is possible), then, with the account of the above said, let us calculate the velocity of the aether wind corresponding to their measurement. The distance between the semi-transparent plate *P* and rectangular butts of the fused quartz rod along the round-trip paths $l_{\parallel}+\Delta l_{\parallel}$ and $l_{\perp}+\Delta l_{\perp}$ (Fig.2b), according to [1], was each 12+2=14 cm. In the light path's part of the interferometer there was the laboratory vacuum of unknown rarefaction. Most likely, the evacuation in such a bulky chamber there was about 1÷10 mmHg. There was used the source of white light. Hence, refined the true values of parameters in the non-negative experiment [1] should be as follows: the relative fringe shift is $\Delta=10^{-6}$; wavelength $\lambda\sim5\cdot10^{-7}$ m; the length of orthogonal arms – each 14 cm; refractive index of laboratory vacuum in the chamber – $n_{vac.}$~1.000003 ($\Delta\varepsilon$~0.000006) for the residual pressure 10 mmHg or $n_{vac.}$~1.0000003 ($\Delta\varepsilon$~0.0000006) for 1 mmHg. We will make two estimation of the aether wind velocity υ for the presented two values of refractive index of laboratory vacuum in the chamber of the setup in [1], using the correct formula for υ taken from [4, 7, 8]:

$$\upsilon = c\cdot\sqrt{\frac{\Delta\cdot\lambda\cdot n}{2l\cdot\Delta\varepsilon(1-\Delta\varepsilon)}}\,. \qquad (1)$$

When $n_{vac.}$~1.000003 ($\Delta\varepsilon$~0.000006) we obtain υ~150 km/s; when $n_{vac.}$~1.0000003 ($\Delta\varepsilon$~0.0000006) – υ~450 km/s. There was shown in works [7-9] that at northern mid-latitudes (the city of Obninsk) within 24 hours of the day and night, the horizontal projection of the aether wind speed varies from 140 to 480 km/s, i.e. the estimations of the possible value of aether wind velocity made from the authors [1] observations of the affirmative shift ($\Delta=10^{-6}$) of the interference fringe at their setup it is reasonable to consider as falling within the found by me range of values 140 km/s<υ<480 km/s. Anyway, there can be no question about the ridiculous value υ~3.8 cm/s, obtained by the authors [1] from the erroneous interpretation of their results.

In the conclusion, note that by the mentioned in [1] possibility to perform this experiment on γ-rays of ^{57}Co source, having the frequency ~$3\cdot10^{18}$ Hz [10] there can be foreseen an evidently negative result. Insofar as the refractive index of all media (including the glass rod, sorting plate *P* and even "reflecting" mirrors) equals one ($\Delta\varepsilon$=0) at these frequencies, by (1) there will be no shift Δ. I do not cease to speak about the negative outcome of such experiments on γ-rays actually in all my works [4, 7-10].

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