Mende-Dubrovin interferometer: from the experimental refutation of the principle of the invariance of the speed of light to the new prospects for the development of the passive radar

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Annotation.

The new type of interferometer with splitting of ray is developed. The method of checking the justifiability of the special theory of relativity (SR) is substantiated and its experimental check with the aid of this interferometer is carried out. It is experimentally proven that the speed of light is added to the rate of radiation source, which contradicts SR. It is shown that the developed interferometer can be used in the passive radar.

The keywords: Special theory of relativity, interference, laser, Michelson interferometer, the law of Sneliusa, radar.

1. Introduction

Michelson interferometer was invented by American physicist by Albert Abrakhamom by Michaelson. A number of important scientific and applied problems was solved with the aid of this interferometer. However, in Michaelson's experiments there were significant errors. It completed these errors, here it attempted to prove that the speed of electromagnetic (EM) of wave is added to the speed of the source, which radiates this wave. It considered to the end of its life that there is an elastic medium, in which are extended EM of wave. Therefore the results of the experiments, which it conducted together with Morley [1] for the detection of this medium, were for it large unexpected contingency. Attempting to improve experiment, it attempted as the radiation source to use light of star, but still large failure here awaited it. The studies, carried out with the aid of its interferometer, showed that the measured speed of light, does not depend on the speed of star and is equal to the previously measured by it value, which corresponded to the special theory of relativity, which life it so did not recognize to the end.

In order to understand, in than consisted Michaelson's error, let us examine the principle of the work of its interferometer [2], diagram of whom it is given in Fig. 1.

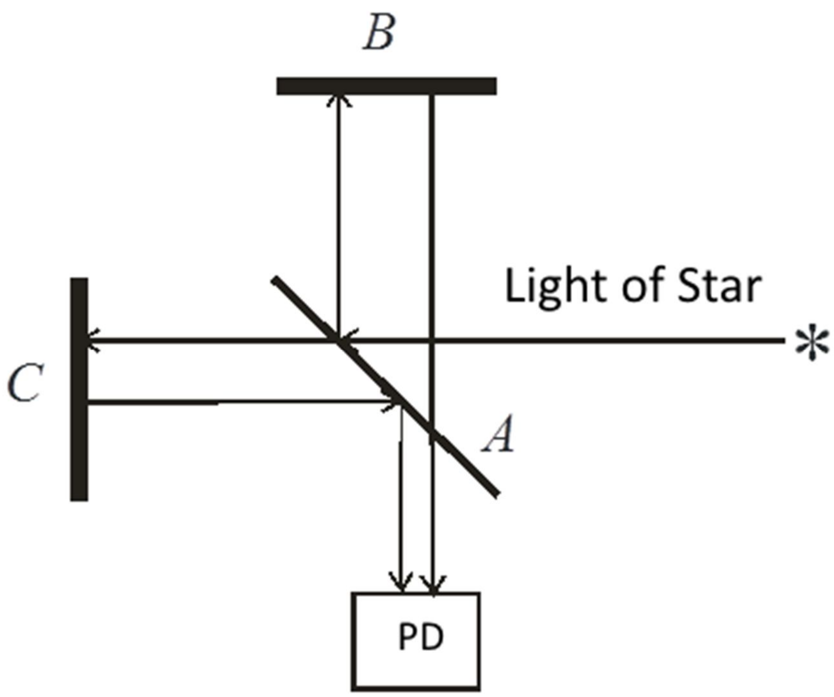

Fig. 1. Schematic of Michelson interferometer.

The light of star, reflected from the dividing mirror A falls on the reflecting mirror v and, being reflected from it, it falls on photodetector. The special feature of this process is the fact that the mirror v is located in the same inertial reference system (ISR), in which is located interferometer itself. This means that, whatever there was the speed EM of the wave, which arrived from the star, its speed, after reflection from the mirror v, will be equal to the speed of light in ISR of interferometer.

The second part EM of the wave, which arrived from the star, penetrating the dividing mirror A, also falls on reflective mirror s. After reflection from this mirror the wave will also have a speed equal to the speed of light in the system of interferometer. But a question consists in what speed will have the electromagnetic wave after the passage of dividing mirror indicated. The reflecting coating, with the aid of which occurs the division of ray, is substituted to the transparent glass plate.

Let us examine the flow chart of the ray through the dividing mirror, taking into account that the fact that the reflecting layer on it is substituted to the transparent of the glass- specific thickness. Since glass- is the dielectric, which possesses the dielectric constant, different from air, the trajectory of the motion of ray will depend on the refractive index of glass. This trajectory is shown in Fig. 2

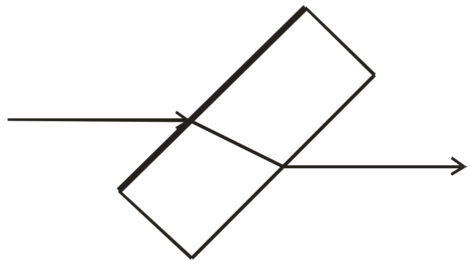

Fig. 2 Propagation of light beam through the glass plate

Light beam falls on the glass plate from the side, on which it is substituted semitransparent coating and further, refracting twice, it leaves from it in the same direction. During the reverse motion of ray its trajectory remains constant it changes only direction of its motion. In this case the ray moves in accordance with the law Of sneliusa 2, sharply changing its direction after entrance and output from the plate. But this refraction of ray is connected with the fact that the electric fields of the wave, passing through the plate, make it necessary to kolebatsya the bound charges in the dielectric, which re-emit these fields. And if prior to the entrance into the plate wave had a speed different from the speed of light in the frame of reference of interferometer, then after the passage of the wave through the plate its speed will be equal to the speed of light in the system of its counting. Therefore with the aid of the Michelson interferometer it is not possible to measure the speed EM of wave to its contact with dividing mirror. Michaelson did not consider these circumstance, of than consisted its error.

Were subsequently invented different modifications of Michelson interferometer [2], such as the interferometer of Zhamensci, Christmas, Fabry-Perot and other instruments with repeatedly divided light beams. But in all these instruments for division and separation of light rays are used the semi-transparent layers of metals, substituted to the glass plates, or interfaces between the dielectrics with different dielectric constant. Therefore all interferometers indicated suffer the same deficiencies, as Michelson interferometer.

In the article is proposed the new type of the interferometer of that deprived of such deficiencies, as basis of which is assumed the principle of splitting ray.

2. Interferometer with splitting of the ray

The schematic of interferometer with splitting of laser beam is shown in Fig. 3

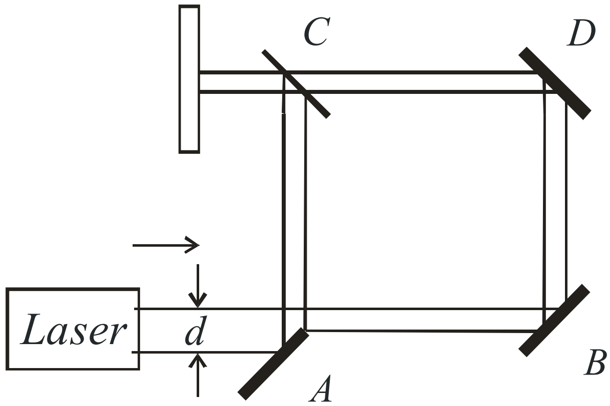

Fig. 3. Schematic of interferometer with splitting of ray

Laser beam, whose diameter is equal d, it partially overlaps the reflecting mirror a. This mirror the part of the ray it located so that reflects in the normal direction with respect to the primary direction of the motion of ray. The second part of the ray continues to move in the perezhnem direction with the previous speed and, falling on the reflecting mirror v, it is reflected in the vertical direction with respect to the initial direction of motion. Further rays, after passing ways indicated in the diagram, where D - the reflecting mirror, and mirror C - dividing, fall on the screen, where is reproduced the picture of their interference. In the diagram examined the laser can be fixed or move with the given speed. On the spot laser also can be located the mirror, which reflects the ray of fixed laser, in this case the mirror also can be fixed or move according to the assigned law. The advantage of this interferometer is the fact that in it for the separation of ray are not used the dividing mirrors, but splitting ray it is produced by the method of its overlap by the first reflecting mirror. This method allows to split ray in any proportions with the way of the mechanical displacement of the first mirror.

The schematic of the interferometer, in which is used the fixed laser, whose ray is reflected from the fixed or moving mirror, it is depicted in Fig. 4. On this diagram the laser beam has the assigned diameter, which is equal to the distance between the lines, which emerge from the laser.

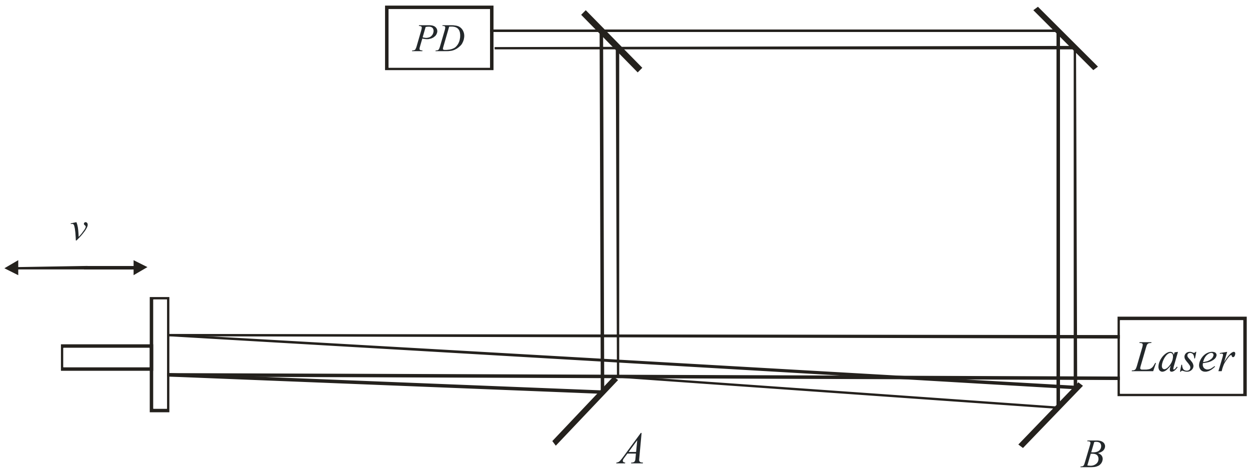

Fig. 4. Schematic of interferometer with the reflective mirror

Let us describe the parameters of the interferometer being investigated and the method of its tuning.

Interferometer is installed on the mounting plate by the size of 75x300x1200 mm and has the following parameters: the distance between the tip of laser and the mirror into – 200 mm, distance between the mirrors A also in, and also D with 250 mm, the distance between the mirrors A also D, and also in and with – 200 the mm. Distance from the tip of laser to the reflecting mirror -1400 mm.

In the interferometer as the laser the laser with the green flash with Green Laser Pointer the wavelength nm 532 and a power of 5 mW is used. The diameter of its ray is 1.1 mm. Laser beam leaves from the tip. To this tip from the outer side is dressed the sheet reflector, in which there is an opening for the passage of the ray with a diameter of about 2 mm. At first reflecting mirrors A also in are established in such a way that they would not interfere with the passage of the straight and reflected laser beam. In this case the position of laser is established so that the ray and the surface of platform they would be parallel.

In the interferometer there is a vibrator, which accomplishes a fluctuating motion of the reflecting mirror. For the exception of the influence of vibrator on the work of interferometer it is established on separate mounting plate by the size of 75x300x650 mm. This plate was established on the separate table. Besides this vibrator it is located in the duct, inside which there is a brick lining from paralona, and ray to the reflecting mirror passes through the opening in the duct. This is done so that the acoustic wave, generated by vibrator, would not influence the work of interferometer. Vibrator ensures the harmonic oscillation of the reflecting mirror with a frequency 50 Hz. The amplitude of the fluctuations of mirror can be regulated from zero to 5 mm.

Tuning interferometer is produced in the following order. Laser beam is directed at the fixed reflecting mirror, and this mirror is established in such a way that the reflected beam would fall on screen on the tip of laser. In this case the distance from the reflection of ray on the screen to the opening in it must comprise order 2-4 mm. Then mirrors A also in are established at the angle 45 of degrees with respect to the direction of the reflected beam. Further mirror v is advanced towards to ray in such a way that it would completely overlap the reflected beam, but it did not overlap straight line. After this, it is advanced mirror a. It is advanced until to ray intensity, reflected from the mirrors A D it is equal. Further, justifying mirrors D and s, they attain the information of rays on the screen, located on the course of ray. For an increase in the interference picture the objective, established on the course of ray (in the diagram it is not shown) is used. Then they include the vibration of the reflecting mirror and observe the behavior of interference picture on the screen. If it is necessary to derive the signal, given by the brought rays to the oscillograph, should be used a photodetector.

3. Substantiation and conducting experiment on checking of the justifiability of the special theory of relativity

The special theory of relativity (SR), created by Einstein, rules in physics already more than hundred years [3,4]. This theory is based on the postulates, and this causes criticism from the side of many scientists.

If inertial reference system (ISR) K moves with respect to ISR K' with speed v , that formula transformations of frequency and wave vector into SR upon transfer of one system to another are given by the relationships:

$$\omega' = \frac{\omega\left(1+\frac{v}{c}\right)}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{3.1}$$

$$k' = \frac{\frac{\omega}{c}\left(1+\frac{v}{c}\right)}{\sqrt{1-\frac{v^2}{c^2}}}. \tag{3.2}$$

In these relationships v - the speed not hatch ISR, in which is located the radiation source, and by primes are noted frequency and wave vector in hatch ISR. Consequently, upon transfer of electromagnetic wave from one ISR to another simultaneously changes its frequency, and wave vector in accordance with the given relationships. But these changes occur in such a way that the ratio of frequency to the wave vector in both systems remains to the constant and equal speed of light.

Relationships (3.1) (3.2) are the consequence of postulate SR about the invariance of the speed of light in both ISR in question. The consequence of this postulate is the fact that, if in IRS for some reasons changed the frequency of the incoming into it electromagnetic (EM) wave, then simultaneously with this change in this system to change and wave vector, and, as a result, will change wavelength incoming EM of wave. But this means that us lacks the possibility to learn, does enter into the observation system signal from the moving emitter or fixed, if we do not know the relative speed of ISR examined.

Let us examine at first classical theory of the Doppler effect

If flat transverse EM wave is propagated in selected ISR along the axis z and at the origin of coordinates its electric field it changes according to the law

$$E(t) = E_0 \sin \omega_0 t,$$

the the same value of field will be observed at any observation point z with the delay $t = \frac{z}{c}$, where c phase wave velocity. This condition is observed when radiation source it is located in the same ISR, as the selected coordinate system. In this case the dependence of electric field on the coordinate and the time will be written down

$$E(t,z) = E_0 \sin \omega_0 \left(t - \frac{z}{c} \right).$$

The instantaneous values of phase at the observation points z_1 z_2 will be respective the wound:

$$\varphi_1(t) = \omega_0 t - \frac{z_1 \omega_0}{c}, \tag{3.3}$$

$$\varphi_2(t) = \omega_0 t - \frac{z_2 \omega_0}{c}, \tag{3.4}$$

and phase difference between the points in this case indicated will comprise

$$\Delta\varphi = \frac{(z_2 - z_1)\omega_0}{c} = \frac{\Delta z \omega_0}{c} = \Delta z k,$$

where $\Delta z = z_2 - z_1$ - the distance between the observation points. In this relationship the value

$$k = \frac{\omega}{c}$$

the absolute value of the wave vector represents .

Let us examine the case, when electromagnetic wave comes into assigned ISR from without. For the case, when the generator, which radiates wave, is fixed with respect to selected ISR situation not to change. And if at the observation point z_1 the phase of wave is determined by relationship (3.3), that at the observation point z_2 the phase of wave will be determined by the relationship (3.4). But if we for what or reasons the frequency of incident wave change ourselves and will become equal ω_1 , that for the phase of wave will be carried out the same relationships (3.3) and (3.4), into which should be substituted the new value of frequency. As it was already said, into SR it does not have value, what reasons led to a change in the frequency, since fulfilling of the relationships (3. 1) and (3.2) they require precisely such correspondence.

But the reasons for a change in the frequency of wave, which is necessary in ISR can be two. The first of them can be connected with the fact that it changed the frequency of the oscillator, which radiates wave, which was fixed with respect to selected ISR. The second reason can be connected with the fact that the generator of wave it moves with respect to ISR indicated and a change in the frequency is connected with the Doppler effect.

Let us examine the case, when the generator of wave moves with the constant velocity $\pm v$ with respect to assigned ISR. In this case the phase of signal at the observation points z_1, z_2 they will change according to the law

$$\varphi_1(t) = \omega_0 t - \frac{\omega_0}{c}(z_1 \pm vt), \tag{3.5}$$

$$\varphi_2(t) = \omega_0 t - \frac{\omega_0}{c}(z_2 \pm vt). \tag{3.6}$$

In these relationships the speed can be both the constant and change in the time.

A phase difference between the observation points in this case will comprise

$$\Delta\varphi_{1-2} = \frac{\omega_0 \Delta z}{c}. \tag{3.7}$$

And this phase difference on the speed of generator does not depend.

However, the frequency of signal at the points indicated will change according to the law

$$\omega_1 = \frac{\partial \varphi_1(t)}{\partial t} = \omega_0\left(1 \mp \frac{v}{c}\right), \tag{3.8}$$

$$\omega_2 = \frac{\partial \varphi_2(t)}{\partial t} = \omega_0\left(1 \mp \frac{v}{c}\right). \tag{3.9}$$

It is evident that at both observation points the frequency obtained the identical Doppler additive

$$\Delta\omega_D = \mp\frac{\omega_0 v}{c}, \tag{3.10}$$

which it does not depend from the distance to the observation points.

Other conclusions follow of SR. Let us examine the case, when the speed of generator is considerably lower than the speed of light, in this case Doppler additive to the frequency coincides with the classical theory. If, as it was already said, simultaneously with a change in the frequency change and wave vector, then in this case will change a phase difference between the observation points, and this phase difference will depend both on frequency and on the distance between these points. Actually, wave vector is connected with the frequency with the relationship

$$k = \frac{\omega}{c}.$$

Substituting here the value of frequency from the relationship (3.8) or (3.9), we obtain

$$k = \frac{\omega_0 \left(1 \mp \frac{v}{c}\right)}{c}.$$

Consequently, a phase difference between the observation points into SR must change according to the law

$$\Delta\varphi = \frac{\Delta z \omega_0 \left(1 \mp \frac{v}{c}\right)}{c}. \tag{3.11}$$

In this relationship the speed also can be both the constant and change in the time.

From the relationship (3.11) it follows that a phase difference between the observation points will depend on the distance between this by points and on the speed of generator. However, in the classical case, as follows from the relationship (3.7), a phase difference from the frequency, but, therefore, also on the speed of generator it does not depend.

But if, as follows from the relationship (3.7), during the motion of generator a phase difference between the observation points it did not change, therefore, it did not change and wavelength between these points. In this case a change of the frequency in the observation points can be connected only with a change in the phase speed EM of wave in the observation system. This change can be determined from the relationship

$$\lambda = \frac{2\pi c}{\omega_0} = \frac{2\pi(c \pm \Delta c)}{\omega_0\left(1 \mp \frac{v}{c}\right)} \tag{3.12}$$

from where we obtain

$$\Delta c = -v.$$

This means that in this case in the observation system the addition of velocities of light and speed of generator occurs. The obtained result means that wave velocity in the observation system can be both more and it is less than the speed of light, which contradicts SR.

Therefore the measurement of a phase difference between the observation points for the case of the moving generator is the task of the proposed experiment. If it seems that a phase difference does not depend on the speed of the motion of generator, this will mean that SR it is not accurate.

Let us examine the case, when are carried out SR, for the generator, which is varied along the axis z according to the harmonic law with the frequency, Ω

$$z = z_1 + z_0 \sin\Omega t.$$

where z_1 - the initial position of generator, z_0 - the amplitude of its of fluctuations.

Then the flutter speed of generator will be determined by the relationship

$$v = \frac{\partial z}{\partial t} = z_0\Omega\cos\Omega t = v_0 \cos\Omega t,$$

where $v_0 = z\Omega$ - the amplitude of the deviation of speed.

In this case doppler additive to the frequency at both observation points will change according to the law

$$\Delta\omega_D = \frac{\omega_0 z_0 \Omega\cos\Omega t}{c}.$$

Additive to the wave vector in this case will be determined by the relationship

$$\Delta k(t) = \frac{\omega_0 z_0 \Omega \cos \Omega t}{c^2}.$$

Then the phase difference between the observation points, caused by this additive comprises

$$\Delta\varphi(t) = \frac{\Delta z \omega_0 z_0 \Omega \cos \Omega t}{c^2}. \qquad (3.13)$$

To this dependence of a phase difference on the time corresponds the frequency modulated signal, whose frequency will change according to the law

$$F(t) = \omega_0 \left(1 - \frac{\Delta z x_0 \Omega^2 \sin \Omega t}{c^2} \right), \qquad (14.3)$$

i.e. within the framework SR Buddes obtained the frequency-modulated signal, whose frequency changes according to the harmonious law and the amplitude of the deviation of frequency M is equal

$$M = \frac{\Delta z \omega_0 x_0 \Omega^2}{c^2}$$

Let us calculate the expected parameters of the signal, which enters from the photodetector, for the case examined. For this it is utilized the parameters of the interferometer, described above, on which were conducted studies. The distances between the mirrors A also in it was 250 mm, the frequency of the vibrations of vibrator - 50 Hz, the amplitude of the fluctuations of mirror was equal 5 mm. With these of the parameter in the case of justifiability SR amplitude of the deviation of the frequency of the frequency-modulated signal, which must be ISRlated on the photodetector it will be about 180 Hz. This signal easily yields to measurement.

However, with conducting of experiment according to the diagram, represented in Fig. 4, with the harmonic oscillations of mirror interference picture did not change, and interference fringes remained at their places, picture was only extended on the vertical line approximately on 50%. This was connected with the fact that the axis of oscillation of the reflecting mirror is slightly inclined with respect to the laser beam reflected. Separately clearly were distinguished the interference fringes, when they were located vertically. With the start of vibrator they only udlinnyalis. Since the interference fringes with the start of the vibration of mirror did not change their position and did not move, signal on the photodetector was absent, the carried out experiment showed that the rate of radiation source is added to the speed of light, which contradicts SR.

Experience with the vibrating laser was also carried out. For this shank of laser it was ground and on easy-push fit with the aid of the bushing was put into the reinforcing post, which was attached to the mounting plate. From the reverse side of reinforcing post was located the vibrator, the frequency of vibrations of which was 50 Hz. The amplitude of the fluctuations of laser could be regulated in the limits 0-0.3 mm. In this experiment within the assigned limits of the fluctuations of laser interference picture remained fixed.

3. Use of Mende- Dubrovin interferometer for purposes the passive radar

As it was already said, SR cannot be within the framework determined the reason for a change in the frequency EM of the wave, which is necessary into the observation system. To make this forbids postulate about the constancy of the speed of light in all ISR independently of that, these systems relative to each other do move, or they are located at rest. At the same time such reasons there can be two. Frequency incoming EM of wave can change due to a change in the frequency of the oscillator, fixed with respect to the observation system, the second reason can be connected with the fact that the generator, which radiates EM wave, it moves with respect to the observation system, and this change is connected with the Doppler effect.

Mende- Dubrovin interferometer gives the possibility to solve this problem.

In order passively to determine the speed of generator, follows one of the mirrors, which are located in the observation points, to make mobile and to measure the wavelength EM of the wave between the observation points. For this should be compared the displacement of mirror with a quantity of strips of those corresponding to this displacement. Then should be measured the frequency of incident wave and determined its wavelength, substituting in it the value of the speed of light. The relation of the speed of light and difference between calculated thus wavelength and wavelength between the observation points will be the Doppler additive in the composition of the measured frequency.

4. Conclusion

By the empirical basis of the principle of the invariance of the speed of light SR it is customary to assume the class of the physical experiments, which use a Michelson interferometer and called Michaelson's experiences. However, a question about that until recently remained open, are explained the results of these experiences by the principle indicated or by some other reason. This caused the urgency of the improvement of means and methods of the corresponding checkings in the direction of an increase in the cleanliness of experiment, i.e., the elimination of other possible reasons for explanation.

For this purpose the authors developed the new type of interferometer with splitting of laser beam and is proposed the method of checking SR with the aid of this interferometer. If following Michaelson's experiences the method proposed again confirmed SR, then it would be possible and to further improve means and methods of checkings, but in this case one should recognize the still high degree of experimental confirmation of this theory. However, the results of the experiment conducted showed that the speed of light from the moving generator is obtained by the classical addition of velocities of light relative to generator with the speed of its motion. Consequently, SR it is not accurate, of than any laboratory of peace can be convinced, after repeating our simple experiment. But indeed this indicates the beginning of the sunset of entire era in the history of physics – of era, which abolished for the high speeds of the motion of the conversion of Galileo upon transfer of one ISR to another and of that replaced with their conversions of Lorenz. The experiment conducted showed the insolvency of this replacement.

Of the new ideology of electrodynamics and entire physics, which assumes the fundamental role of the conversions of Galileo, is dedicated the monograph of the contributors [5], where within the framework of ideas about not the invariance of the theorem of Gauss for the electric field of the moving charge it is introduced the new concept of scalar- vector potential, or they are proposed are new conversions pour on, connected with the transformations of coordinates of Galileo. Still Maxwell used conversions of Galileo during the construction of electrodynamics. However, at that time still was not explained the fundamental role of the conversions of Galileo as the connecting beginning between the space and the time, and these conversions were disdainfully placed as if house with respect to "present" conversions separately of space and separately time. But indeed the precisely fundamental role of the conversions of Galileo predetermines existence of the effects, which is conventionally designated as relativistic, but which, as it seemed, have to the conversions of Lorenz of no relation.

The authors hope that the appearance of their monograph [5] in conjunction with the represented experimental results they will impel researchers to the long ago ripened revolutionary revision of fundamental physical ideas.

The important technical application of the result of this work relates to the passive radar. IN SR principally it cannot be differed the change in the frequency, created by fixed generator, from the same change in the frequency, caused by the Doppler effect. Now a change in the frequency of the incoming signal in conjunction with the invariability of a phase difference between the observation points in the interferometer must unambiguously testify about the Doppler effect, and in conjunction with a change in the phase difference between these points – about a change in the frequency of fixed oscillator.

The appreciation

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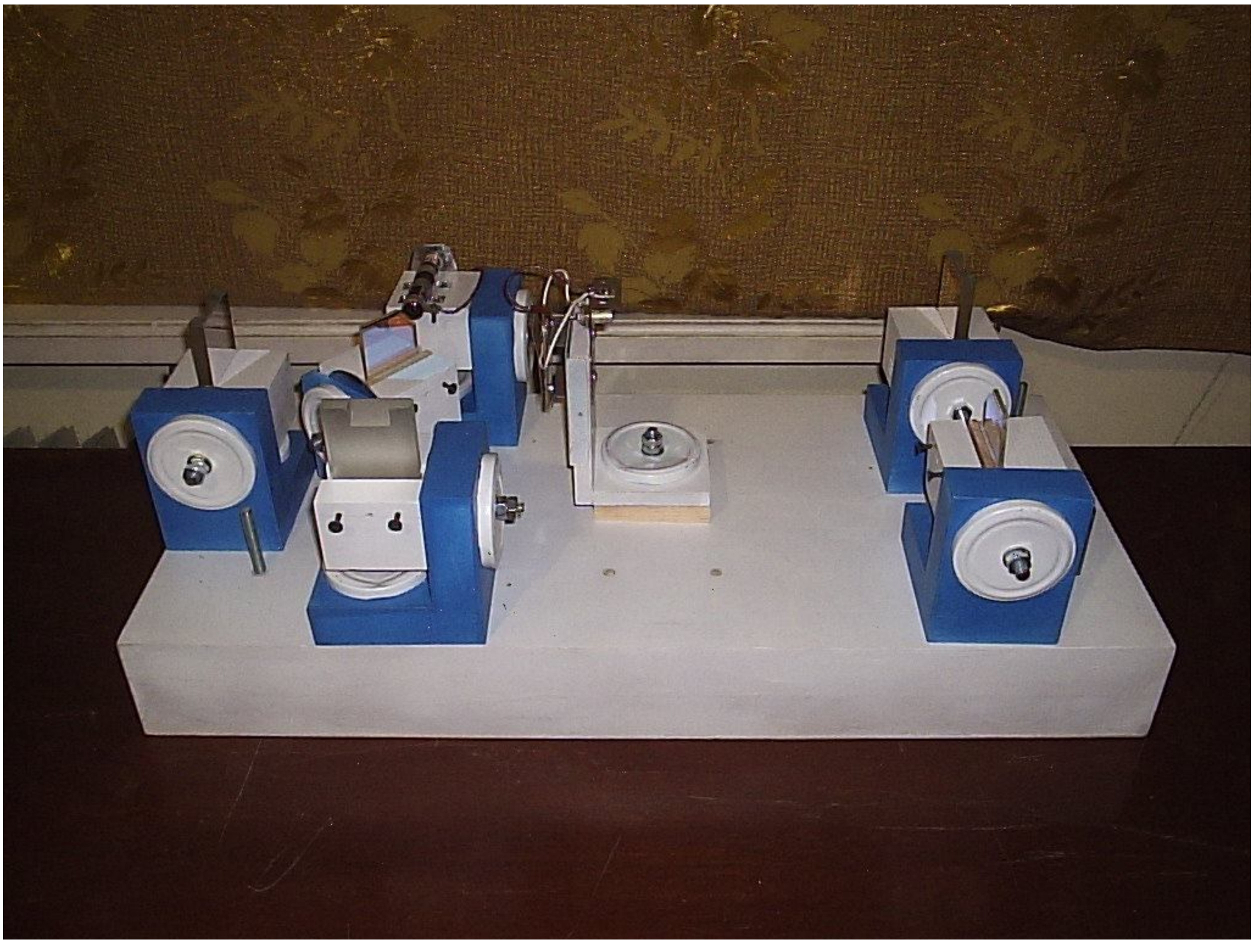
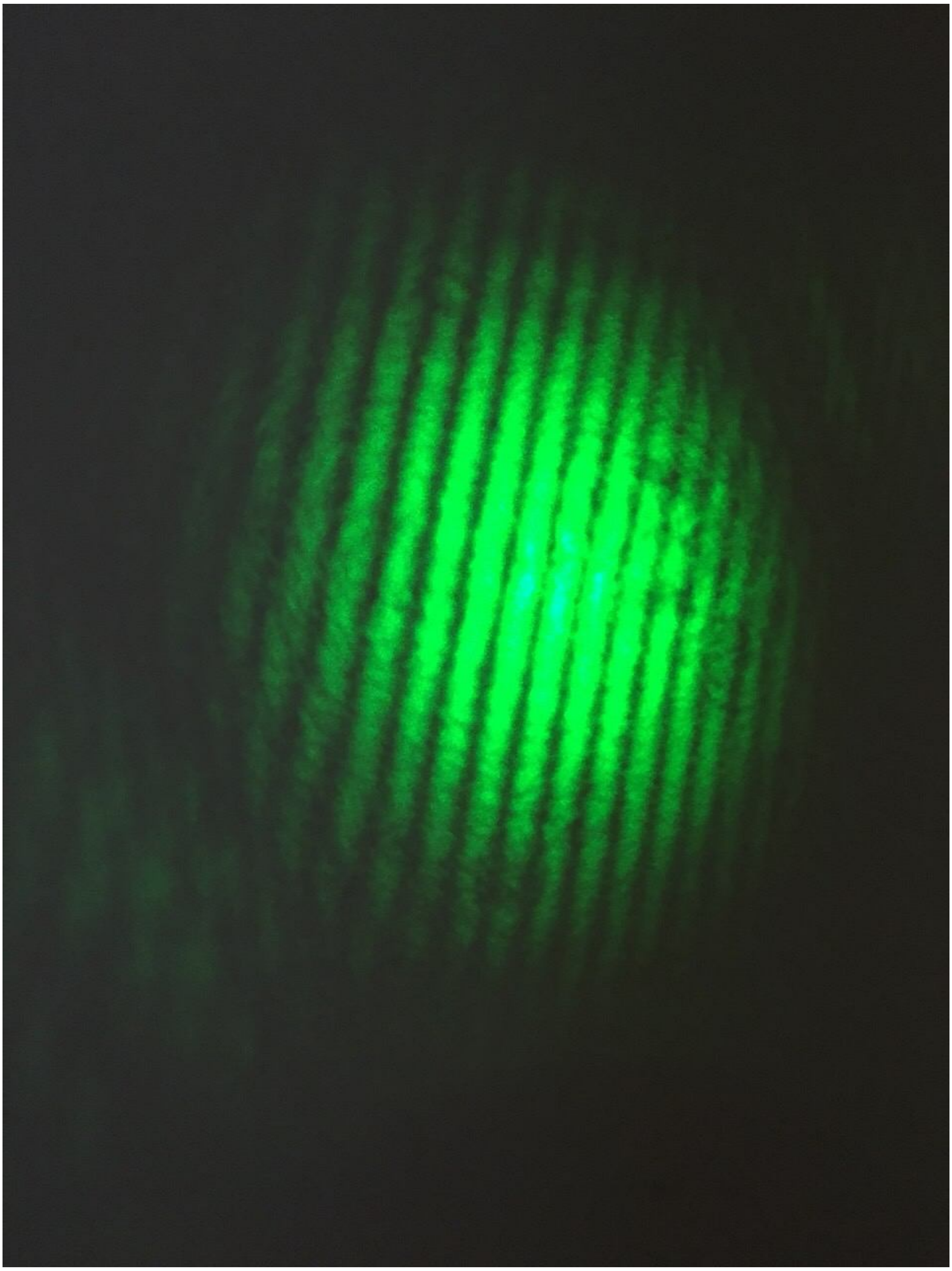
Photos of interferometers and their nodes

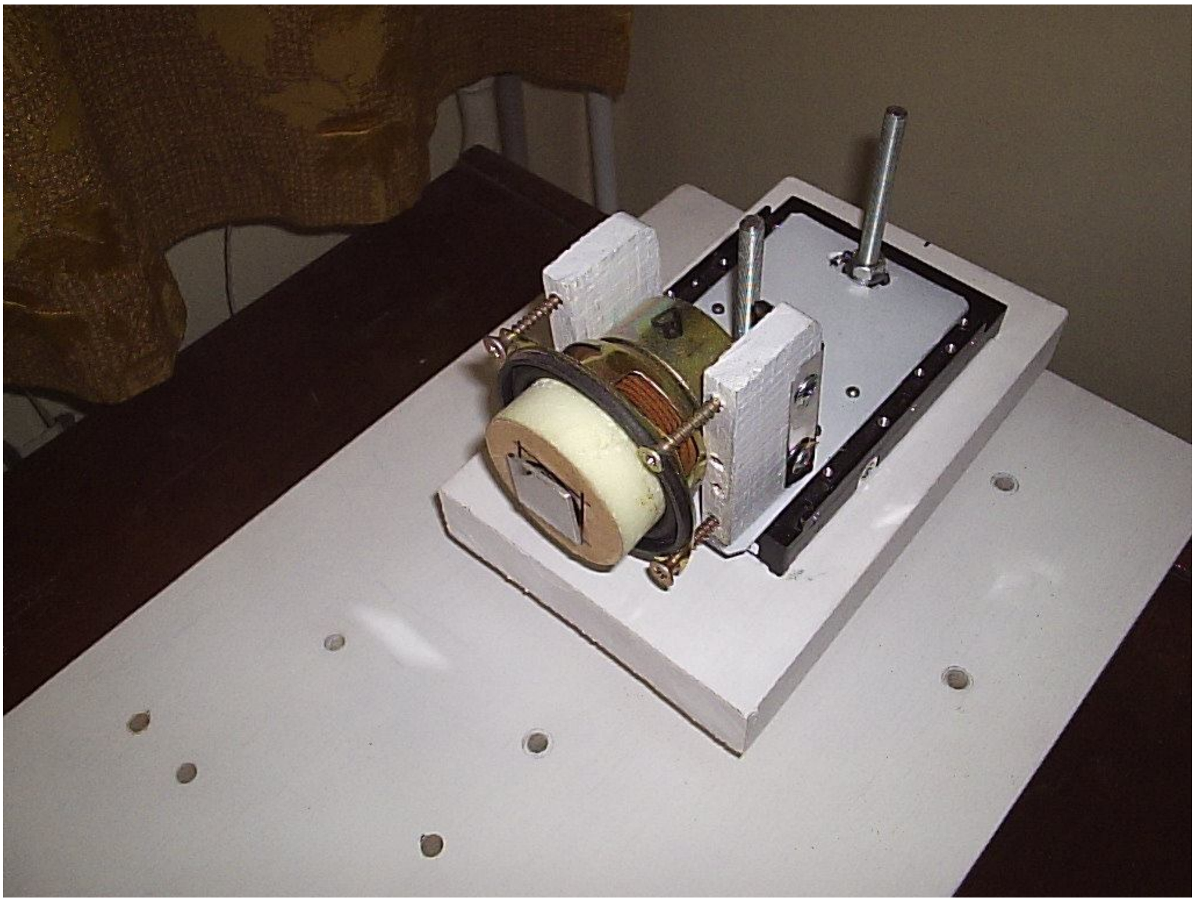


The Michelson interferometer is assembled in this photograph on the mounting plate. It is to the left in the foreground visible two reflecting mirrors, dividing mirror is located between them. The laser is visible after the dividing mirror, to the right of dividing mirror is located photodetector. On right to edge located two spare mirrors. Mirrors are located on the hinges, which make it possible to revolve mirrors in the ortoganalnykh directions. Hinges I provide the possibility to achieve angular turning of mirrors with the accuracy of the order several tens of seconds. Any desired configuration of interferometer can be assembled on the platform.

The working Michelson interferometer is depicted on this photograph. Ray from laser (to the right in the background) comes to the reflecting mirror (to shine by green color) and comes the dividing mirror (in the center in the foreground). Then, after being reflected from two mirrors, through the dividing mirror, and then the objective falls on the reflecting mirror (in the background round mirror with the opening). After being reflected from it, rays are projected naprotivopolozhno the located screen, where is formed the interference picture, which is shown in the following photograph.



On the following two photographs the vibrator with the reflecting mirror on the erecting platform and laser is depicted.



The interferometer with splitting of ray is depicted on this photograph. Is to the left visible the part of the platform, on which is located the reflecting mirror with the vibrator. On the left edge of platform is established the rotary reflecting mirror, with the aid of which the laser beam is advanced by the parallel to mounting plate. In operating conditions, when ray is reflected from the mobile mirror, rotary mirror is turned so as not to interfere with the straight and reflected beam.

In the following two photographs the unit of the vibration of laser is shown. The micrometer, which is used for determining the amplitude of the vibration of laser, is located under the laser. In the second photograph is visible the vibrator, which the usual dynamic loudspeaker is.