Natural light monochromatic beams propagation velocity in atmospheric air

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Problem state

According to existing theoretical physics the light velocity in vacuum c_0 = 2,99792458·10^8 *m/s* is the fundamental constant being the same for all types of radiation from the radio frequency rays to γ-rays. However there is no any substantiation of force and energy stipulating such high light velocity, and c_0 value was determined for the entire white light in empirical way.

§ 1. Up-to-date achievements of fundamental physics

According to new physics theory developed by D.H. Baziev and given in "Principals of physics unified theory" («Основы единой теории физики» (ОЕТФ) [М., Педагогика/Pedagogika, 1994, 640 p.]) the white light propagation velocity is not the fundamental constant as the velocity of elementary rays forming the white light is the function of wavelength $c_i = f(\lambda\nu)$ which has the following solution:

$$c_i = \sqrt{\mu \cdot \nu_i} = \mu / \lambda_i \text{ – for vacuum,} \quad (1)$$

$$c_i = \mu / \lambda_i \cdot n_i \text{ – for atmospheric air,} \quad (2)$$

where μ = 119,916 984 m^2/s = const – Milliken's constant representing the sectorial velocity of photon in electric field of the ray's axial charge; n_i – air refractive index for investigated monochromatic beam having the λ_i wavelength.

Note that the air refractive index for the rays with different wavelength values within the range from λ = 400 *nm* to λ = 1200 *nm* varies to a very little degree and lies within the interval from n = 1,0002982 (for violet rays) to n = 1,0002886 (for infrared rays) [3, p. 181].

Since Newton life time it is known that the white light consists of the elementary rays system with different wavelength values covering the spectral interval 400-750 nanometers. Analysis made within the bounds of physics unified theory shows that the light propagation velocity c_0 is the property only of white light violet part representing the light's front as on trace from start to finish with receiving equipment the ray bundle is the subject to structural changes resulting in fact that the most short-wave violet rays with wavelength of λ = 400 *nm* achieve the finish first while the red rays with wavelength of λ = 750 *nm* are the last, according to formula (2):

$$c_1 = \mu / \lambda_1 \cdot n_1 = \frac{119{,}916\,984\, m^2/s}{4 \cdot 10^{-7} m \cdot 1{,}0002982} = 2{,}997\,030885 \cdot 10^8 m/s \quad (3)$$

– the violet ray velocity in atmosphere,

$$c_2 = \mu / \lambda_2 \cdot n_2 = \frac{119{,}916\,984\, m^2/s}{7{,}5 \cdot 10^{-7} m \cdot 1{,}00029035} = 1{,}598\,429\,016 \cdot 10^8 m/s \quad (4)$$

– the red ray velocity in atmosphere.

These theoretical results derived from the physics new theory confirm that the violet rays both in vacuum and in atmospheric air propagate faster than the red ones k = c_1/c_2 = 1,874 985 times!

Since 1973 when The International committee on numerical values for science and engineering General assembly have made decision concerning the numerical value of light velocity in vacuum $c_0 = 2{,}99792458 \cdot 10^8$ *m/s* the world scientific community is in a state of calmness regarding to this question. However we all should wake up and take a serious view of new results in physics obtained in theoretical and experimental way during last 30 years because the light velocity, accepted and recognized as the constant but actually not such, became a dogma preventing the further development of fundamental science. Just that very circumstance dictates necessity to revert to this question using the new qualitative level, i.e. to measure experimentally the natural light monochromatic beams propagation velocity in atmospheric air within the spectral range of 300–1200 *nm*. While soling this problem it is necessary to take into account that the natural light structure radically differs from the laser ray structure that leads to difference to their propagation velocities up to 3.4%. The laser ray and radar radiation have the velocity $\upsilon_0 = 2{,}8992629 \cdot 10^8$ *m/s* and do not depend on neither the wavelength nor generation frequency, but the laser ray velocity can be function of an axial field charge being unknown until the "Principals of physics unified theory" book was published.

The second aspect of problem concerning the light is its structure and material composition. The existing point of view stating that the light represents electromagnetic wave does not withstand to any critics due to fact that this assertion is in non-decidable contradiction with one of the light most important properties – energy which the light has and which the light transfers. The matter in the fact that in existing theory neither magnetic nor electric field has not structure, it does not contain material particles with mass m_i and cannot be the carrier of energy in joules as dimension of this quantity cannot be expressed without participation of mass with finite mass m_i:

$$E_i = m_i\upsilon_i^2 / 2 = m_i\upsilon_i u_i = m_i\upsilon_i^2 \cdot \tau_{i.} \cdot \nu_{e\partial},\ J, \qquad (5)$$

where: υ and u - are the velocities of body with mass m_i, τ_i is duration of this body movement, $\nu_{e\partial} = 1\ s^{-1}$ – act of body interaction with force source, according to Newton's first law. From (5) it is evident that if $m = 0$ the energy equals zero as well. But the light carries energy and, subsequently, consists of photons possessing the finite mass and is not the electromagnetic wave! Just that provision was proved by me experimentally in N.S. Kurnakov General and non-organic chemistry institute in 1999-2000, and this experiment having the 100 % repeatability is described in "Photon charge and mass" («Заряд и масса фотона» [М., изд. Педагогика/Pedagogika, 2001-2002]. The role of Lewes "photon" and Newton "corpuscle" is played the truly elementary particle called by me as "electrino" (symbol ε) and derived from Planck's constant during solution of its physical content in 1982, as follows:

$$h = m_\varepsilon \cdot \mu \cdot \sqrt[3]{4\pi / 3} / 2 = 6,626\ 2681 \cdot 10^{-34}\ kg \cdot m^2 / s = \text{const} \qquad (6)$$

where: m_ε=6,855757299 63·10^{-36} *kg* = const – is electrino mass, μ – is Milliken's constant.

According to results the famous Planck's formula

$$E_i = h * f_i,\ J \qquad (7)$$

According to results the famous Planck's formula expresses the gas and liquid oscillators' energy per second, where f_i is frequency of test oscillator in continuum. Other constant called as Hertz constant, $\hbar$, was obtained from Planck's constant:

$$\hbar = h / \sqrt[3]{4\pi / 3} = 4,110\ 608\ 69204 \cdot 10^{-34}\ kg \cdot m^2 / s = const \qquad (8)$$

Exactly Hertz constant is applicable for calculation of natural light elementary ray's energy per second, E_i:

$$E_i = \hbar \cdot \nu_i = \hbar \cdot \mu / \lambda_i^2,\ J, \qquad (9)$$

where: $\nu_i = \mu / \lambda_i^2$ – frequency of photons along the ray axis, λ_i – wavelength of this ray in meters.

To demonstrate these solutions let's consider energy per second of mono-ray passing from the Sun and having the wavelength λ_1 = 4·10^{-7} *m* (violet ray).

$$\nu_1 = \mu / \lambda_1^2 = \frac{119,916\ 984\ m^2 / s}{1,6 \cdot 10^{-13}\ m^2} = 7,494\ 8115 \cdot 10^{14}\ s^{-1} \qquad (10)$$

violet ray frequency,

$$E_i = \hbar \cdot \nu_1 = 3,080\ 823\ 729\ 71 \cdot 10^{-19}\ J \text{ – in vaccum} \qquad (11)$$

According to physics new theory the photon performs two kinds of movement simultaneously as it displaces along the ray axis by half-circle steps and every its step regardless of the wavelength is forming angle γ = 4 *rad*, while the velocity c_i of ray propagation in space and the electrino's orbital velocity u_i are connected by relationship:

$$u_i = 2c_i = 2\mu/\lambda_i,\ \text{m}/s \qquad (12)$$

that allows calculating the violet ray energy not using the frequency and Hertz constant but mechanically:

$$E_1 = \frac{m_\varepsilon \cdot c_1 \cdot u_i}{\gamma} = \frac{m_\varepsilon \cdot c_1 \cdot 2c_1}{\gamma} = \frac{2m_\varepsilon \cdot c_1^2}{4} = \frac{m_\varepsilon \cdot c_1^2}{2} =$$
$$= \frac{6,855\ 737\ 29963 \cdot 10^{-36}\ kg \cdot (2,997\ 9246 \cdot 10^8\ m/s)^2}{2} = \qquad (13)$$
$$= 3,080\ 823\ 72971 \cdot 10^{-19}\ J$$

Full coincidence of violet mono-ray energy per second according to (11) and (13) finally disproves the obsolete conceptions of light's nature as electromagnetic wave and De Broyl's wave-particle and at the same time confirms validity of Newton's views at nature of light who already in 1687 has stated that the light consists of corpuscles, although ha time it was impossible to prove such statement.

Paragraphs 13 and 14 in "Principals of physics uniform theory" are devoted to light structure and generation. There is considered the light ray energy base determined by electrino's positive charge, ε = 1,68766436671·10^{-27} *C*, with ray axial field negative charge equal in its modulus to ε. Now the violet ray energy per second looks as follows:

$$E_1 = \frac{\alpha \cdot \varepsilon \cdot q}{\nu_{ed}} \cdot \nu_1 = \frac{\alpha \cdot \varepsilon \cdot q \cdot \mu}{\nu_{ed} \cdot \lambda_1^2} = -3{,}080\,823\,72871 \cdot 10^{-19}\ J, \qquad (14)$$

where: α = 1,04044721942·10^{20} J/C^2 = const – is electro-dynamical constant of physics uniform theory, q = -ε = -1,98766431671·10^{-27} C.

In (14) the sign minus (-) appears and shows that movement of electrino playing role of photon occurs around the force center along the second order trajectory which determines the photon constant sectorial velocity:

$$\mu = u_1 \cdot r_1 = 2c_1 \cdot \frac{\lambda_1}{2} = c_1 \cdot \lambda_1 = 119{,}916\,984\ m^2 / s = \text{const} \qquad (15)$$

where: $r_1 = \lambda_1|2$ – of the violet ray photon orbit radius, $c_1 = c_0$ – velocity of this ray in vacuum, λ_1 = 4·10^{-7} m – pitch of photon of the same ray, both these values were determined long ago by means of direct measurements.

Thus, the fundamental physics in the light structure is not its propagation velocity in vacuum but the photon sectorial velocity – the same for whole natural light spectrum.

And finally, it is necessary to add few words about the meaning of Planck's constant physical sense solution and deduction from it the second, truly elementary particle. Note that the first truly elementary particle is electron discovered by J. Thomson in 1897 in Cambridge and being the carrier of negative charge. This solution allows make the following conclusions:

1. The electrino discovery has led to recovery of charge symmetry in the atom's structure and physics theory as this particle is the charge antipode of electron.

2. The electrino is the carrier of magnetic field, carrier of electric current, photon in all types of radiation and plays the role of neutrino during the movement along trajectory of the first order with velocity of movement in interstellar space υ_ν = 10^{20}–10^{30} *m/s*.

3. The electrino portion in atom's structure is 50 % of charge and 99,83 % of mass beginning from the elementary atom with mass m_u =1/12·^{12}C = 1,66057·10^{-27} *kg* to uranium and all other bodies including the planets, stars and galaxies.

§ 2. Results of light propagation velocity in atmospheric air as function of wavelength

Diagram of optical system test plant is shown in figure 1: polychromatic light of ДРШ-500 mercury lamp with power *W* = 500 *W* propagates from point S as the expanding beam to convex lens located at distance of 2*f* = 13,062 *m* (*f* = 6,531 *m* – lens focal length). The ray bundle from lens passes to rotating mirror in point A and focuses at it. The mirror consists of two parts: the plane of its lower part, 4(2x2) cm^2, is parallel to rotating axis, and the upper part with the same dimensions of 4(2x2) cm^2 has the incline in direction of rotating axis by angle β = 1°22´. The mirror is secured on MA-30M DC motor shaft with power of 95 *W* (*i* = 3,6 *A*, *V* = 27 *V*).

During rotation of mirror the rat bundle under investigation starts from the lower mirror and with expansion passes at the first spherical mirror in point B, with curvature radius R_1 = 22,9 *m*; the ray reflected by this mirror is directed to the second spherical mirror in point D, with curvature radius R_2 = 26,27 *m*; from this mirror the beam returns to rotating mirror, finishes at its upper part and is directed to the screen in point A_1 located at distance *R* = 7,2 *m* from rotating mirror, where it focuses. The overall length of trace from start to finish equals *L* = 89,10 *m*. At power supply voltage *V* = 29 ± 0,25 *V* the rotation frequency was equal *n* = 12 831,05 *rpm* = 213,850833 *rps*; the maximum value (51408/4 = 12 852 *rpm)* differed from average one by $\Delta n = n_{max} - \overline{n}$ = 20,95 *rps* that is 0,001632 of average value and therefore this instability had no noticeable negative affect to experiment.

In point A instead of screen there was installed the three-support massive table where the "Zenit" camera with removed objective lens and equipped with shutter release cable was placed.

The essence of experiment was in photo fixing of monochromatic beam tracks made by the beams on photoemulsion of commercially available color film "Kodak" with sensitivity of 400 units (27 dynes according to old classification). Before the camera it was installed the thin celluloid film with vertical bars located at interval of *a* = 5 *mm* and playing the role of coordinate scale on the photo film. This scale allows easy determining the enlargement factor during photocopying, k_i:

$$k = a_1/a, \qquad (16)$$

where: a_1 - is distance between bars on photo measured by ruler in millimeters with accuracy of 0,1 mm.

If in case of mirror rotation absence, by means of manual control, to direct the light beam, reflected by the mirror upper part, through camera, the continuous beam track from camera input point (reference point) to camera output point with length l_i is detected on photo film. However, when the mirror rotation occurs the beam track changes consisting of two parts: non-visible part due to fact that during the time period τ_i when the initial beam front passes trace the rotating mirror turns by some angle φ_i and the beam front finishes at incidence angle has been changed. Therefore the beam deviates from the reference point by distance Δl presenting the non-visible segment of track. The second par of track is the result of actual effect of light onto photo emulsion, and the length of this part can be easily measured on photo and provides to us the complete information concerning the experiment's dynamics.

It is absolutely clear that the ray deviation from the reference point is the function of its propagation velocity at equality of all other conditions. The matter that if the old point of view is true and c_0 is fundamental constant being the same for all types of radiation we'll obtain for all monochromatic beams under investigation the same deviation Δl and the same length of explicit track for all beams. On the contrary, if in experiment we'll obtain tracks of several monochromatic beams which are not equal to each other but correlating with the wavelength, we come to conclusion about failure of c_0 as fundamental constant and about necessity to reverse all physics theory created during twentieths of XX century, as well as metrology.

§ 3. Air refractive index as function from light ray trace length

Initial data for analysis:

$n_в$ = 1,0002918 – surface air refractive index at temperature of t = 20°C and P_0 = 101325 Pa [3, p. 138].

n_1 =1,0002827 – air refractive index under the same conditions for violet monochromatic beam with wavelength $\lambda_1 = 4 \cdot 10^{-7}$ m (front boundary of sunlight visible spectrum),

n_2 =1,0002802 – – refractive index for blue monochromatic beam with wavelength $\lambda_2 = 4{,}6 \cdot 10^{-7}$ m,

n_3=1,000 277 8786 – air refractive index under the same conditions for green monochromatic beam with wavelength $\lambda_3 = 5{,}4607 \cdot 10^{-7}$ m (middle of visible spectrum),

n_4 = 1,00027524 – air refractive index for red monochromatic beam with wavelength $\lambda_4 = 7{,}6 \cdot 10^{-7}$ $м$ (rear boundary of visible spectrum) [n_1 – n_4, 4, p.791],

$\Delta n = n_1 - n_4$ =0.000 0074 = 0,00073979 % n_1 – difference of air refractive indices for rays of the front and rear boundaries of light visible spectrum.

Analysis results

It is accepted that refractive index of any medium transparent for light is determined by ratio of the light velocity in vacuum, c_0, to its velocity in investigated medium, c_i:

$$n_i = c_0/c_i \tag{17}$$

However, from position of physics unified theory this formula is erroneous as the light velocity in vacuum, c_0, is not the universal constant and characterizes only the violet rays with wavelength $\lambda_1 = 4 \cdot 10^{-7}$ m in vacuum, according to formula (1):

$$c_0 = \mu / \lambda_1 = \frac{119{,}916\,984\ m^2/s}{4 \cdot 10^{-7}\ m} = 2{,}9979246 \cdot 10^8\ m/s = \text{const} \tag{18}$$

Why is c_0 constant value? First, distance between the photons along the ray axis, i.e. λ_1 = const; second, λ_1 remains constant due to fact that dispersion and absorption of photons in vacuum is absent. If taking into account these provisions to consider the light velocity in real medium, from interstellar space to crystalline structures, we'll get other expression where c_i always less than c_{0i} as n_i in all real mediums is always greater than 1:

$$c_i = \frac{\mu}{\lambda_i \cdot n_i} = \frac{c_{0i}}{n_i}, \qquad (19)$$

where c_{oi} is the velocity of *i*-ray in vacuum.

However, (19) does not contain very important factor – the ray trace length in investigated medium, L_i. This factor has the great importance as the n_i represents the continuous function of the ray front co-ordinates.

Refractive index of the air and other gases is measured by means of Jamin interferometer equipped with two cells. The first cell contains the reference gas and the second one – the investigated gas. Without particular information about these cells length I accept it equal to $l_{eд} = 1\ m$. Here it is necessary to take into account the ray wavelength change at its interaction with the air's molecules at cell trace $l_{eд}$ as in cell input point the ray wavelength equals λ_{0i} while in output point – λ_i at constant ray frequency v_{0i} along the entire path of ray:

$$v_{0\mathrm{i}} = \mu/\lambda_{0i} = \text{const}, \qquad (20)$$

that allows transferring from propagation velocity to wavelength during determination of n_i:

$$n_i = \frac{\lambda_i}{\lambda_{0i}}, \qquad (21)$$

and further – to determination of spatial factor of refractive index k_n:

$$k_n = \frac{\lambda_i - \lambda_{0i}}{\lambda_{0i} \cdot l_{eд}},\ m^{-1} \qquad (22)$$

The light ray, contrary to existing conceptions, never represented electromagnetic wave and is not such today. Ray represents the extended in a space electrodynamic system with the base in form of axial negative field around which the positively charged electrinos move by circular pitchs. The electrino movement pitch equals λ_i being simultaneously the average distance between them along the ray axis. If even one electrino-photon comes out the ray composition the immediate reformation of ray occurs that leads to uniform distribution of released space equal to one pitch λ_{0i} after which the pitch length in the ray takes the new value λ_i::

$$c_i = \frac{\mu}{\left(\lambda_{0i} + \dfrac{n_i \cdot \lambda_{0i}}{k_i}\right)} = \frac{\mu}{\lambda_{0i} \cdot \left(1 + \dfrac{n_i}{k_i}\right)}, \qquad (24)$$

where: n_i - number of photons leaving the ray during passing the cell.

Now taking into account (17) – (24) let's carry out the quantitative analysis of dynamics of violet, blue, green and red rays during their passing the cell in Jamin interferometer.

3.1. Violet ray

λ_{01} = 4·10^{-7} m – pitch length in the cell input point,

λ_1 = λ_{01} ·n_1 = 4·10^{-7} m·1,000 2827 = 4,001 1308·10^{-7} m (25)

– pitch length in the cell output point,

$$c_1 = \mu / \lambda_1 = \frac{119,916\,984\, m^2 / s}{4,0011308 \cdot 10^{-7}\; m} = 2,997\,077\,326\,23 \cdot 10^8 \; m/s \tag{26}$$

– ray velocity in the cell input point,

$$k_0 = \frac{1}{\lambda_{0t}} = 2,5 \cdot 10^6 \; m^{-1} \tag{27}$$

– number of photons per running meter in the cell input point,

$$k_1 = \frac{1}{\lambda_t} = 2,499\,293\,449\,74 \cdot 10^6 \; m^{-1} \tag{28}$$

– number of photons at ray segment $l_{e\partial}$ = 1 *m* in the cell output point,

$$\Delta k_1 = k_0 - k_1 = 706,55026 \tag{29}$$

– number of photons dispersed from ray by air molecules during passing the cell,

$$k_{n1} = \frac{\lambda_1 - \lambda_{01}}{\lambda_{01} \cdot l_{e\partial}} = \frac{\lambda_{01}(n_1 - 1)}{\lambda_{01} \cdot l_{e\partial}} = \frac{(n_1 - 1)}{l_{e\partial}} = \frac{0,0011308 \cdot 10^{-7}\; m}{4 \cdot 10^{-7}\; m^2} = 2,827 \cdot 10^{-4}\; m^{-1} \tag{30}$$

– spatial refractive factor,

n_1 (L) = (n_1 + k_{n1}·L) = 1,000 2827 + 0,025 18857 = 1,025 471 127 (31)

– spatial refractive factor of air on trace L = 89,1 *m* being the base in our experiment,

$$c_1' = \mu / \lambda_{01} \cdot n_1(L) = \frac{\mu}{4,101\,88508 \cdot 10^{-7}\; m} = 2,923\,460\,35203 \cdot 10^8 \; m/s \tag{32}$$

– violet rays velocity at the end of passing the trace L,

$$\overline{c}_1 = \frac{c_{01} + c_1'}{2} = 2,960\,692\,47601 \cdot 10^8 \; m/s \tag{33}$$

– average velocity of ray on trace L,

$$\tau_1 = L / \overline{c}_1 = \frac{89,1\, m}{\overline{c}_1} = 3,009\,431\,095 \cdot 10^{-7} \; s \tag{34}$$

– violet ray delay time on trace L = 89,1 *m*

$$\overline{\lambda}_1 = \mu / \overline{c}_1 = 4,050\,3019132 \cdot 10^{-7} \; m \tag{35}$$

– average pitch of photon on trace L,

$$\overline{k}_1 = \frac{1}{\overline{\lambda}_1} = 2,468\,951\,75083 \cdot 10^6 \; m^{-1} \tag{36}$$

– average linear density of photons on trace L,

$$\Delta k_1(L) = k_0 - \overline{k}_1 = 31\,048,24917 \; m^{-1} \tag{37}$$

– number of photons dispersed from violet ray by air molecules on trace L.

From (35) it follows that during passing the distance of 89.1 *m* only the photon pitch has increased by 5,03 % that characterizes very essential red shift. And what can be the result when this ray passes from the Sun to the Earth at sunrise and sunset the distance $L_1 = 1\cdot10^4$ *m* along the Earth surface through the most dense and contaminated air layer? Let's calculate:

$$n_1(L_1) = n_1 + k_n \cdot 1\cdot10^4\ m = 3,827\,2827 \quad (38)$$

– the air refractive index for violet rays at sunrise and sunset,

$$\lambda_1' = \lambda_{01}\cdot n_1(L_1) = 15,309\,1308\cdot10^{-7}\ m = 1,53091308\ \mu m \quad (39)$$

– the violet rays come out the spectrum visible part and transfer to near infrared part of spectrum,

$$c_1' = \mu/\lambda_1' = 7,833\,036\,739\cdot10^{7}\ m/s \quad (40)$$

– the violet ray propagation velocity in the surface air layer output point post passing the trace L_1,

$$\overline{c}_1(L) = \frac{c_{01}+c_1''}{2} = 1,890\,614\,137\cdot10^{8}\ m/s = 0,63\cdot c_0 \quad (41)$$

– average velocity of ray on trace L_1,

$$k(L_1) = \frac{1}{\lambda_1'} = 6,532\,049\,487\,74\cdot10^{5}\ m^{-1} \quad (42)$$

– average linear density of ray photons on trace L_1,

$$\Delta k(L_1) = k_0 - k(L_1) = 1,846\,795\,05123\cdot10^{6}\ m^{-1} \quad (43)$$

$$k_1(L_1) = \Delta k(L_1)\cdot L_1 = 1,846\,795\,05123\cdot10^{10}$$

– total number of photons lost by the ray on trace L_1.

Now it becomes clear why the sunrises and sunsets on our planet always have red-yellow colors – high the red shift factor within the entire range of solar spectrum, greater for short-wave and smaller for long-wave part of spectrum.

3.2 Blue ray

$\lambda_{02} = 4,6\cdot10^{-7}$ m – photon pitch length in the cell input point,

n_2 = 1,000 2802 – refractive index [4, p. 791],

$$\lambda_2 = \lambda_{02}\cdot n_2 = 4,601\,288\,92\cdot10^{-7}\ \text{m} \quad (44)$$

– photon pitch length in the cell output point,

$$c_{02} = \mu/\lambda_{02} = 2,606\,890\,95652\cdot10^{8}\ m/s \quad (45)$$

– ray velocity in the cell input point,

$$c_2 = \mu/\lambda_2 = 2,606\,160\,71029\cdot10^{8}\ m/s \quad (46)$$

– ray velocity in the cell output point

$$k_0 = \frac{1}{\lambda_{02}} = 2,173\,913\,043\,47\cdot10^{6}\ m^{-1} \quad (47)$$

– linear density of photons in the cell input point,

$$k_2 = \frac{1}{\lambda_2} = 2{,}173\,304\,0839\,67 \cdot 10^6 \ m^{-1} \quad (48)$$

– linear density of photons in the cell output point,

$$\Delta k_2 = k_0 - k_2 = 608{,}9598 \text{ m}^{-1} \quad (49)$$

– number of photons dispersed by air molecules in cell,

$$k_{n2} = \frac{\lambda_2 - \lambda_{02}}{\lambda_{02} \cdot l_{ed}} = \frac{12{,}8892 \cdot 10^{-11} \ m}{4{,}6 \cdot 10^{-7} \ m^2} = 2{,}802 \cdot 10^{-4} \ m^{-1} \quad (50)$$

– spatial refractive factor,

$$n_2\,(L) = (n_2 + k_{n2} \cdot L) = 1{,}025\ 24602 \quad (51)$$

– the air refractive index on trace $L = 89{,}1\ m$,

$$\lambda_2(L) = \lambda_{02} \cdot n_2(L) = 4{,}716\ 131\ 692 \cdot 10^{-7} \text{ m} \quad (52)$$

– photon pitch at the end of trace L,

$$\bar{\lambda}_2(L) = \frac{\lambda_2 + \lambda_2(L)}{2} = 4{,}658\,710\,306 \cdot 10^{-7} \ m \quad (53)$$

– average photon pitch on trace L,

$$\bar{c}_2 = \mu / \bar{\lambda}(L) = 2{,}574038\ 22353 \cdot 10^8 \ m/s \quad (54)$$

– ray average velocity on trace L,

$$\tau_2 = L / \bar{c}_2 = \frac{89{,}1\,m}{\bar{c}_2} = 3{,}461\,487\ 05895 \cdot 10^{-7} \ s \quad (55)$$

– ray delay time on trace L,

$$\bar{k}_2 = \frac{1}{\bar{\lambda}_2(L)} = 2{,}146\,516\,813\,27 \cdot 10^6 \ m^{-1} \quad (56)$$

– average linear density of photons in ray on trace L,

$$\Delta k_2(L) = k_0 - \bar{k}_2 = 27\,396{,}2302 \ m^{-1} \quad (57)$$

– average number of photons lost per every meter of the ray path,

$$k_2(L) = \Delta k_2(L) \cdot L = 2{,}441\,004\,110\,82 \cdot 10^6 \quad (58)$$

– number of photons dispersed from ray by air molecules on trace L.

3.3. Green ray

$\lambda_{03} = 5{,}4607 \cdot 10^{-7}$ m – – photon pitch length in the cell input point,

$$\lambda_3 = \lambda_{03} \cdot n_3 = 5{,}462\ 217\ 411\ 67 \cdot 10^{-7} \text{ m} \quad (59)$$

– photon pitch length in the cell output point,

$$c_{03} = \mu / \lambda_{03} = 2{,}196\,000\,219\,75 \cdot 10^8 \ m/s \quad (60)$$

– ray velocity in the cell input point,

$$c_3 = \mu / \lambda_3 = 2{,}195\,390\,1678 \cdot 10^8 \ m/s \quad (61)$$

– ray velocity in the cell output point,

$$k_0 = \frac{1}{\lambda_{03}} = 1{,}831\,267\,053\,67 \cdot 10^6\ m^{-1} \quad (62)$$

– linear density of photons in the cell input point,

$$k_3 = \frac{1}{\lambda_3} = 1{,}830\,758\,325\,11 \cdot 10^6\ m^{-1} \quad (63)$$

– linear density of photons in the cell output point,

$$\Delta k_3 = k_0 - k_3 = 508{,}728\ 56\ \text{m}^{-1} \quad (64)$$

– number of photons cut off by air molecules in the cell,

$$k_{n3} = \frac{\lambda_3 - \lambda_{03}}{\lambda_{03} \cdot l_{ed}} = \frac{15{,}174\,1167 \cdot 10^{-11}\ m}{5{,}4607 \cdot 10^{-7}\ m^2} = 2{,}778\,785\,99823 \cdot 10^{-4}\ m^{-1} \quad (65)$$

– spatial refractive factor of air for given ray,

$$n_3\,(L) = n_3 + k_{n3} \cdot L = 1{,}025\ 036\ 861\ 84 \quad (66)$$

– refractive index of air on trace L,

$$\lambda_3(L) = \lambda_{03} \cdot n_3(L) = 5{,}597\ 418\ 791\ 44 \cdot 10^{-7}\ \text{m} \quad (67)$$

– photon pitch at the end of trace L,

$$\bar{\lambda}_3(L) = \frac{\lambda_3 + \lambda_3(L)}{2} = 5{,}529\,818\,101\,55 \cdot 10^{-7}\ m \quad (68)$$

– average photon pitch on trace L,

$$\bar{c}_3 = \mu / \bar{\lambda}_3(L) = 2{,}168\,552\,05357 \cdot 10^8\ m/s \quad (69)$$

– average velocity of photon on trace L,

$$\tau_3 = L / \bar{c}_3 = 4{,}108\,732\,36145 \cdot 10^{-7}\ s \quad (70)$$

– ray delay time on trace L,

$$\bar{k}_3 = \frac{1}{\bar{\lambda}_3(L)} = 1{,}808\,377\,74703 \cdot 10^6\ m^{-1} \quad (71)$$

– average linear density of photons on trace L,

$$\Delta k_3(L) = k_0 - \bar{k}_3 = 22\,889{,}30664\ m^{-1} \quad (72)$$

– average number of photons lost by the ray per every meter of trace,

$$k_3(L) = \Delta k_3(L) \cdot L = 2{,}039\,437\,22162 \cdot 10^6 \quad (73)$$

– total number of photons lost by the ray on trace L = 89,1 m.

3.4. Red ray

$\lambda_{04} = 7{,}6 \cdot 10^{-7}$ m – photon pitch length in the cell input point,

$n_4 = 1{,}000\ 27524$ – refractive index [4, p. 791],

$$\lambda_4 = \lambda_{04} \cdot n_4 = 7{,}602\ 091\ 824 \cdot 10^{-7}\ \text{m} \quad (74)$$

– photon pitch length in the cell output point,

$$c_{04} = \mu / \lambda_{04} = 1{,}577\,855\,05263 \cdot 10^8\ m/s \qquad (75)$$

– ray velocity in the cell input point,

$$c_4 = \mu / \lambda_4 = 1{,}577\ 420\ 8833 \cdot 10^8\ m/s \qquad (76)$$

– ray velocity in the cell output point,

$$k_0 = \frac{1}{\lambda_{04}} = 1{,}315\ 789\ 47368 \cdot 10^6\ m^{-1} \qquad (77)$$

– linear density of photons in the cell input point,

$$k_4 = \frac{1}{\lambda_4} = 1{,}315\ 427\ 415\ 44 \cdot 10^6\ m^{-1} \qquad (78)$$

– linear density of photons in the cell output point,

$$\Delta k_4 = k_0 - k_4 = 362{,}058\ 24\ \mathrm{m}^{-1} \qquad (79)$$

– number of photons dispersed from ray at passing the cell,

$$k_{n4} = \frac{\lambda_4 - \lambda_{04}}{\lambda_{04} \cdot l_{ed}} = \frac{20{,}918\ 24 \cdot 10^{-11}\ m}{7{,}6 \cdot 10^{-7}\ m^2} = 2{,}7524 \cdot 10^{-4}\ m^{-1} \qquad (80)$$

– spatial refractive factor,

$$n_4\,(L) = n_4 + k_{n4} \cdot L = 1{,}024799\ 124 \qquad (81)$$

– refractive index of air on trace L,

$$\lambda_4(L) = \lambda_{04} \cdot n_4(L) = 7{,}7884733424 \cdot 10^{-7}\ \mathrm{m} \qquad (82)$$

– photon pitch at the end of trace L = 89,1 *m*,

$$\overline{\lambda}_4(L) = \frac{\lambda_4 + \lambda_4(L)}{2} = 7{,}695\ 282\ 5832 \cdot 10^{-7}\ m \qquad (83)$$

$$\overline{c}_4 = \mu / \overline{\lambda}_4(L) = 1{,}558\ 318\,134\ 56 \cdot 10^8\ m/s \qquad (84)$$

– average velocity of ray on trace L,

$$\tau_4 = L / \overline{c}_4 = 5{,}717\ 702\ 82485 \cdot 10^{-7}\ s \qquad (85)$$

– ray delay time on trace,

$$\overline{k}_4 = \frac{1}{\overline{\lambda}_4(L)} = 1{,}299\ 497\ 437\ 79 \cdot 10^6\ m^{-1} \qquad (86)$$

– average linear density of photons on trace L,

$$\Delta k_4(L) = k_0 - \overline{k}_4 = 16292{,}03589\ m^{-1} \qquad (87)$$

– average number of photons lost by the ray per every meter of trace,

$$k_4(L) = \Delta k_4(L) \cdot L = 1{,}451\,620\,397\ 79 \cdot 10^6 \qquad (88)$$

– total number of photons dispersed by air molecules on trace L = 89,1 *m*.

Thus, all above-stated information represents the theoretical base within the bounds of new physics applied to considered experiment. In conclusion of this section of paper let's compare some coefficients sequent from considered theoretical material.

$$\alpha_1 = \frac{c_1}{c_2} = \frac{2{,}997\,077\,326\,23 \cdot 10^8}{2{,}606\,160\,710\,29 \cdot 10^8} = 1{,}149\,997\,125\,81, \qquad (89)$$

$$\alpha_2 = \frac{c_1}{c_3} = \frac{c_1}{2{,}195\,390\,1678 \cdot 10^8} = 1{,}365\,168\,4198, \qquad (90)$$

$$\alpha_3 = \frac{c_1}{c_4} = \frac{c_1}{1{,}557\,420\,8833 \cdot 10^8} = 1{,}899\,985\,83, \qquad (91)$$

$$\beta_1 = \frac{\lambda_4}{\lambda_1} = \frac{7{,}602\,091\,824 \cdot 10^{-7}}{4{,}0011308 \cdot 10^{-7}} = 1{,}899\,985\,83 = \alpha_3, \qquad (92)$$

$$\beta_2 = \frac{\lambda_3}{\lambda_1} = \frac{5{,}462217\,411\,67 \cdot 10^{-7}}{\lambda_1} = 1{,}365\,168\,4198 = \alpha_2, \qquad (93)$$

$$\beta_3 = \frac{\lambda_2}{\lambda_1} = \frac{4{,}601\,288\,92 \cdot 10^{-7}}{\lambda_1} = 1{,}149\,997\,125\,81 = \alpha_1, \qquad (94)$$

These coefficients confirm that transfer from considering the ray propagation velocity in medium to considering of the photon pitch dynamics allows deeper understanding the light refraction physical essence.

§ 4. Influence of chromatic aberration on the experiment results

As in carried out experiment there is used the long-focal-length lens with f = 6531 *mm* and 2f = 13062 *mm* according to manufacture's certificate (State optical institute, St. Petersburg), the chromatic aberration is unavoidable and significant. In other words the own focal length exists for every monochromatic beam. But as it was difficult to ensure displacement of rotating mirror along the lens optical axis while investigating different monochromatic beams the rotating mirror was installed in stationary manner in the point where the mercury lamp luminous plasma image (diameter d_1 = 5 *mm)* on rotating mirror was equal to d_2 = 5 *mm* (at distance of 2f from lens) white light ray bundle.

Analysis of optical system has shown that at such arrangement of lens and rotating mirror the violet rays focus in front of the mirror at distance of l_1 = 106 *mm*, and the red rays - behind the mirror at distance of l_2 = 201 *mm*. As the result the trace length was permanent and the same for all investigated beams but with some error $\Delta L = \pm\left(\frac{l_1 + l_2}{2}\right) = \pm 153{,}5\ mm,$ equal to 0,172 % of the trace length L = 89,1 *m* and not introducing the considerable error to final result, especially taking into account that the expected differences in beams velocities constitute (17–85)%.

§ 5. Analysis of experimental data

5.1. Technical characteristics of optical system

The experiment was carried out in underground part of Moscow State University Mechanics Institute wind tunnel where day light was absent. It is necessary to inform the readers that during the work I've made the mistake which leaded to failure of interference filters manufactured by the famous firm “Balzers” Due to experience absent I located the filters close to light source with heat action destructive to filters. Only one series of photos of 21.05.2005 has the scientific importance.
The attempt to place the vertical reference line to each exposure appeared difficult task. With great difficulty it was achieved for the beam of white light on photo No. 1 where the reference line virtually coincides with right-hand edge of frame and with the seventh vertical line (from left to right) of coordinate scale. The attempt to place the vertical reference line at red monochromatic beam shooting failed (photo No. 4), and this photo is not considered in our analysis. The essence of reference line in fixing the spatial point of entering the front of investigated beam into camera; this line is the same for all light beams under investigation since during exposure series all assemblies of optical system remain immobile while the filters are changed and the camera is reloaded.

L = 89,1 m – – trace length,

n_0 = 213,85 obr/s – mirror rotation frequency = const,

$\omega_0 = 2\pi \cdot n_0$ = 1343,659 178 rad/s = 76 986 stopni/s – mirror angular velocity,

R = 7,20 m – distance between the rotating mirror and the screen,

$\upsilon = 2\pi \cdot R \cdot n_0$ = 9 674,346 0812 m/s

– velocity of ray sliding along film, the same for all beams,

$\gamma = a_1/a$ = 40 mm/5 mm = 8 – photos enlargement,

$\varphi_\mathrm{i} = \tau_\mathrm{i} \cdot \omega_0$ – mirror turn angle during waiting time τ_i,

$\tau_i = L/c_i$ – beam front delay time,

$\Delta l_i = \tau_i \cdot \upsilon$ – deviation of beam from the reference point on film during the mirror rotation,

$\Delta l_i = \varphi_i \cdot R$ – as previous, calculation according to mirror rotation,

l_0 = 252 mm – total length of track on photos, the same for all photos,

$l_0 = l_i + \Delta l_{if}$,

where l_i is the track length value measured on photos from the right-hand extreme point of track to exit from frame near the photo left-hand edge,

$\Delta l_{if} = \Delta l_i \cdot \pi \cdot \gamma$, mm, where π - is the beam sweeping angle by the rotating mirror,

γ is photo enlargement.

The measurement error on photos does not exceed ± 2 *mm*.

5.2. White light, photo No. 1

$c_1 = \overline{c}_1(\text{см. }33) = 2{,}960\,692\,476 \cdot 10^8\ m/s$ – average velocity on trace,

τ_1 = 3,009 431 095·10^{-7} s (см. 34) – front delay time,

$$\varphi_1 = \tau_1 \cdot \omega_0 = 4{,}043\,649\,71135 \cdot 10^{-4}\ \text{rad} \qquad (95)$$

– mirror rotation angle,

$$\Delta l_1 = \varphi_1 \cdot R = 2{,}911\,427\,79217 \cdot 10^{-3}\ м = 2{,}911\ \text{mm} \qquad (96)$$

– deviation of rays on film,

$$\Delta l'_{1f} = \Delta l_1 \cdot \pi \cdot \gamma = 73{,}172\ mm \qquad (97)$$

– deviation of rays on photo, theoretical value,

$$\Delta l_{1f} = 60\ \text{mm} \qquad (98)$$

– value measured on photo,

$$l'_1 = l_0 - \Delta l'_{1f} = 178{,}827\ mm \qquad (99)$$

– length of white light beam track, theoretical value,

l_1 = 192 *mm* - track value measured on photo,

$$\left.\begin{aligned} \Delta &= l - l'_1 = 13{,}172 mm \\ \Delta &= \Delta l'_{2f} - \Delta l_{1f} = 13{,}172\ mm \end{aligned}\right\} \qquad (100)$$

– divergence of experimental and theoretical values of the white rays front.

The following question is arising: What is the cause such significant divergence of theoretical and experimental values? The answer from position of physics new theory is such simple as unexpected or even impossible from position of existing theory – the initial point of track is formed not by the violet rays with wavelength λ_{01} = 4·10^{-7} *m* but the ultraviolet ones passing the trace faster than the violet rays. Note that the high pressure mercury lamp ultraviolet spectrum part is rich, and in zone of near ultraviolet radiation it has the intensity sufficiently high to spoil the film.

This statement can be easily checked by means of calculation, and its validity can be proved:

$$\Delta l_u = \frac{\Delta l_{1f}}{\pi \cdot \gamma} = \frac{60\ mm}{25{,}132\,741\,229} = 2{,}387\,324\,146\ mm \qquad (101)$$

– deviation of expected ultraviolet ray on film,

$$\tau_u = \Delta l_u / \upsilon = \frac{23{,}873\,24146 \cdot 10^{-4}\ m}{9{,}674\,346\,0812 \cdot 10^3\ m/s} = 2{,}467\,685\,28469 \cdot 10^{-7}\ s \qquad (102)$$

– delay time of expected ultraviolet rays front,

$$\overline{c}_u = L / \tau_u = \frac{89{,}1\, m}{2{,}467\,685\,284\,69 \cdot 10^{-7}\ s} = 3{,}610\,67112377 \cdot 10^{8}\ m/s \qquad (103)$$

– average velocity of expected ultraviolet rays on trace *L*,

$$\overline{\lambda}_u = \mu / \overline{c}_u = \frac{119{,}916\,984\, m^2 / s}{\overline{c}_u} = 3{,}321182\,680\,15 \cdot 10^{-7}\ m \qquad (104)$$

– average pitch of photons in expected rays which truly represent the near ultraviolet radiation!

$$n_c = \overline{c}_u / \overline{c}_1 = \frac{3{,}610\,671123\,77 \cdot 10^{8}\ m/s}{2{,}960\,692\,476 \cdot 10^{8}\ m/s} = 1{,}219\,536$$

– the ultraviolet rays propagation velocity exceeding with respect to light velocity on trace *L*,

$$n(c_0) = \overline{c}_u / c_0 = 1{,}204\,390\,23842$$

– the ultraviolet rays propagation velocity in air exceeding with respect to light velocity in vacuum, c_0!

$$k_{nu} = \frac{(n_u - 1)}{l_{ed}} = 2{,}876 \cdot 10^{-4}\ m^{-1} \qquad (105)$$

– spatial factor, where n_u = 1,000 2876 for λ_u = 3,321·10^{-7} m [4, p. 791],

$$n_u(L) = n_u + k_{nu} \cdot L = 1{,}025\,912\,76\ m^{-1}$$

– refractive index of trace *L* air for ultraviolet rays,

$$\lambda_{0u} = \frac{2\overline{\lambda}_u}{(2 + k_{nu} \cdot L)} = \frac{6{,}642\,365\,3603 \cdot 10^{-7}\ m}{2{,}025\,625\,16} = 3{,}279\,168\,077 \cdot 10^{-7}\ m \qquad (106)$$

– pitch of photon of ultraviolet rays forming beginning of the white light beam in the cell input point (initial pitch of photon).

To avoid the paper text overloading I consciously miss consideration of lens absorption and reflection factors and the factors of reflection by all mirrors used in this experiment, because the final result depends on them slightly.

The results (101) – (106) prove that the near ultraviolet radiation propagates even in the air with velocity exceeding the light velocity in vacuum by 20,4%. This result excellently confirms discovery of electrino playing the role of photon and at the same time refutes Einstein's theory of relativity that makes the further works on accelerators including the collider in CERN to be meaningless.

5.3. Blue light, photo No. 2

$$c_2 = \overline{c}_2 (\text{см. } 54) = 2{,}574\,038\,22353 \cdot 10^{8}\ m/s$$

τ_2 = 3,461 487 05895·10^{-7} s (см. 55)

$\varphi_2 = \tau_2 \cdot \omega_0$ = 4,651 658 85628·10^{-4} *rad* (107)

– mirror rotation angle

$\Delta l_2 = \varphi_2 \cdot R$ = 3,348 762 376 52·10^{-3} *м* = 3,348 mm (108)

$$\Delta l'_{2f} = \pi \cdot \gamma \cdot \Delta l_2 = 84{,}163\, mm \quad (109)$$

– theoretical value of ray deviation from the reference point,

$$l'_2 = l_0 - \Delta l'_{2f} = 167{,}836\, mm \quad (110)$$

– theoretical length of track

Δl_{2f}= 86 mm (111)

– experimental value of front deviation,

l_2= 166 mm (112)

– the track length value measured on photo; exposure during the blue rays shooting occurred to be insufficient although its duration was 120 min.

Divergence of experimental and theoretical values in this case does not exceed the experiment error limits.

5.4. Green light, photo No. 3

$$c_3 = \overline{c}_3 = 2{,}168\,552\,05357 \cdot 10^8 \; m/s \quad (69)$$

τ_3 = 4,108 732 361 45·10^{-7} s (70)

$\varphi_3 = \tau_3 \cdot \omega_0$ = 5,520 735 5474·10^{-4} rad (113)

– mirror rotation angle during time τ_3

$\Delta l_3 = \varphi_3 \cdot R$ = 3,974 929 882 12·10^{-3} m = 3,975mm (114)

– deviation of beam front on film,

$$\Delta l'_{3f} = \pi \cdot \gamma \cdot \Delta l_3 = 99{,}90088\, mm \quad (115)$$

– deviation of front on photo, theoretical value,

$$l'_3 = l_0 - \Delta l'_{3f} = 152{,}1\, mm \quad (116)$$

– theoretical length of track,

$$\left.\begin{array}{l} l_3 = 154\, mm \\ \Delta l_{3f} = 98\, mm \end{array}\right\} - \text{ experimental values.} \quad (117)$$

Experimental value of green rays characteristics does not differ from value predicted by means of new theory.

5.5. Red light, photo No. 4

$$c_4 = \overline{c}_4 = 1{,}558\,318\,13456 \cdot 10^8 \; m/s \quad (84)$$

τ_4 = 5,717 702 824 85·10^{-7} s (85)

$\varphi_4 = \tau_4 \cdot \omega_0$ = 7,682 643 877 68·10^{-4} rad (118)

$\Delta l_4 = \varphi_4 \cdot R$ = 5,531150359192·10^{-3} m = 5,531 mm (119)

– deviation of red beam front on film,

$$\Delta l'_{4f} = \pi \cdot \gamma \cdot \Delta l_4 = 139,022\ mm \quad (120)$$

– deviation of front on photo, theoretical value,

$$l'_4 = l_0 - \Delta l'_{4f} = 112,978\ mm \quad (121)$$

– track length on photo,

$$\left.\begin{aligned} \Delta l_{4f} &= 137\ mm \\ l_4 &= 115\ mm \end{aligned}\right\} - \text{ experimental values.} \quad (122)$$

As it is seen for the red ray beam the divergence of experimental and theoretical values does not exceed the experiment error limits too.

Considering the ratio of track length to deviation length we'll obtain:

$$\delta_1 = \frac{l_u}{\Delta l_{uf}} = \frac{192 mm}{60\ mm} = 3,2\,, \quad (123)$$

$$\delta_2 = \frac{l_1}{\Delta l_{1f}} = \frac{178,828 mm}{73,172\ mm} = 2,44\,, \quad (124)$$

$$\delta_3 = \frac{l_2}{\Delta l_{2f}} = \frac{166,0 mm}{86\ mm} = 1,93\,, \quad (125)$$

$$\delta_4 = \frac{l_3}{\Delta l_{3f}} = \frac{154 mm}{98\ mm} = 1,57\,, \quad (126)$$

$$\delta_5 = \frac{l_4}{\Delta l_{4f}} = \frac{137 mm}{115\ mm} = 1,19\,, \quad (127)$$

The coefficients are the result of experimentally received and fixed on the color film results repeatable in any optical laboratory. They confirm that the every monochromatic beam of natural light has its own velocity depending on the photon pitch (or wavelength according to old terminology) both in vacuum and in air.

Conclusions from described experiment

1. Velocity of light propagation in vacuum, c_0 = 2,9979246·10^8 m/s, is not the fundamental constant which is the same for all radiation types as it was considered heretofore.
2. This value c_0 characterizes the velocity of propagation in vacuum only for violet rays with the photon pitch nanometers according to Baziev's formula and has the following corrected value:

   $c_0 = \mu/4 \cdot 10^{-7}$ m = 2,9979246·10^8 m/s = const
3. Light is not electromagnetic wave but represents the electrodynamic system formed by the ray axial negative field and electrino's continuum having the finite mass and finite positive charge which do not depend on movement velocity in space.

4. Term "photon" introduced into scientific vocabulary by G Lewes in 1929 is equivalent of Newton's "corpuscle" of 1687, and functionally they are represented by the real truly elementary particle - "electrino" discovered in 1982 and published in 1994 in PPUT.
5. Forecast of physics new theory created by D.H. Baziev after discovery of electrino have been confirmed by this experiment results.

Referencies

1. Базиев Д.Х. Основы единой теории физики. М., изд. Педагогика, 1994 г., 640 стр.
2. Базиев Д.Х. Заряд и масса фотона. М., изд. Педагогика, 2001 и 2002 годы, 75 стр.
3. Аллен К.У. Астрофизические величины. М., Мир, 1977 г. 2-ое изд.
4. Физические величины. Энергоиздат, М., 1991 г.

Москва, 24.09.08.

All photos and table with the experiment results see below.

Website: http://eee.electrino.pl/

Forum: http://www.electrino.pl/Forum/viewtopic.php?t=51