HOW ESTIMATE SPEED OF LIGHT

The foreword

With full confidence it is possible to say, that the heading of this article will seem to a reader as frivolous.

But do not hurry up with conclusions!

The speed of light meanwhile remains for us the greatest riddle though intuitively we understand, that behind it there are all other secrets of the nature – electric charge, structure of photon and electron, black holes, a dark matter, magnetars, dark energy, etc., etc. Therefore any research connected with a speed of light, let even outside of a pragmatism, it is not necessary to reject from first lines.

The speed of light we indissolubly associate with the electromagnetic wave, one of which characteristics is length of a wave. Let's compare three formulas for very short electromagnetic waves which and are successfully used for a long time both in the theory, and in practice.

Length of a wave of Compton for electron (Compton, 1923)

$$\lambda_C = \frac{h}{M_e \cdot c} \qquad (1)$$

Length of a wave of de Broglie in application to electron (de Broglie, 1924)

$$\lambda_B = \frac{h}{\sqrt{2 \cdot q_e \cdot M_e \cdot U}} \qquad (2)$$

Length of a wave of electromagnetic radiation in Josephson's effect (Josephson, 1962)

$$\lambda_D = \frac{h \cdot c}{2 \cdot q_e \cdot U} \qquad (3)$$

Between three these lengths of waves there is a simple mathematical link

$$\lambda_C \cdot \lambda_D = \lambda_B^2 \qquad (4)$$

It is necessary to notice, there is also essential difference of wave of Josephson from two others. Josephson's effect concerns to macroscopical effects though it is described by the equations of quantum physics. Experimentally Josephson's effect is found out at cryogenic temperatures in the field of superconductivity of substances.

To macroscopical effects of the same sort, as Josephson's effect, concerns the phenomenon of quantization of the magnetic stream, found out in 1961. The magnetic stream through a thin superconducting ring with a current has values, multiple to the elementary magnetic stream or to the quantum of magnetic stream Φ_o

$$\Phi_o = \frac{h}{2 \cdot q_e} = 2.067833636 \times 10^{-15} \quad |\mathrm{Wb}| \qquad (5)$$

In the afore-cited formulas following designations are used:

$h = 6.62606876 \times 10^{-34}$ |J|×|s| –Planck's constant;

$c = 299792458$ |m/s| – speed of light in vacuum;

$M_e = 9.10938188 \times 10^{-31}$ |kg| – mass of rest of electron;

$q_e = 1.602176462 \times 10^{-19}$ |C| – elementary charge;

U – electric voltage accelerating a charge in volts |V|.

Pay attention, that in the formula (1) electricity is absent in general. There is no either voltage, or a charge. Though, interaction in effect of the Compton, also as in two other cases, electromagnetic. The reason of why classical electrodynamics could not offer more exact calculation, than under the mechanistic formula (1), we will try to find out.

Radiation of an absolute black body

For own decision of task on radiation of absolutely black body by methods of classical physics we will enter some simplifying conditions:

1. Absolutely black body has the form of sphere of radius ***r*** which internal surface has reflexion factor equal to unit.

2. The photon represents absolutely elastic material point of mass $\boldsymbol{M}_{\lambda}$.

3. All photons hit simultaneously in one half of sphere, then fly by through the centre of sphere and hit simultaneously in an opposite half of sphere.

4. Blows are in regular intervals distributed on a surface of hemispheres.

5. The sphere volume is equal V = 1м^3.

$$V = \frac{4}{3} \cdot \pi \cdot r^3 = 1 \ \ |\mathrm{m}^3|$$

$$r = \sqrt[3]{\frac{3 \cdot V}{4 \cdot \pi}} = \sqrt[3]{\frac{3}{4 \cdot \pi}} = 0.62 \ \ |\mathrm{m}|$$

$$S = 4 \cdot \pi \cdot r^2 = \sqrt[3]{36 \cdot \pi} = 4.836 \ \ |\mathrm{m}^2|$$

According to the law by Stephan-Boltsman, the volume density of energy of radiation of absolutely black body is equal

$$w(T) = \frac{4 \cdot \sigma \cdot T^4}{c} \quad |\mathrm{J}|\times|\mathrm{m}^{-3}| \qquad (6)$$

where: $\sigma = 5.670400\times10^{-8}$ $|\mathrm{W}|\times|\mathrm{m}^{-2}|\times|\mathrm{K}^{-4}|$ – constant by Stephan-Boltsman.
T – absolute temperature of internal walls of sphere.

Generally speaking, the unit of measure in the formula (6) already corresponds to pressure of radiation upon internal walls of sphere:

$$|\mathrm{J}|\times|\mathrm{m}^{-3}| = |\mathrm{N{\cdot}m}|\times|\mathrm{m}^{-3}| = |\mathrm{N}|\times|\mathrm{m}^{-2}| = |\mathrm{Pa}| \qquad (7)$$

To define scaling factor we will make own calculation, strictly observing sequence of events. According to Planck's formula energy of one photon is equal

$$w_{\lambda} = h \cdot \nu = \frac{h \cdot c}{\lambda} \qquad |\mathrm{J}| \qquad (8)$$

Hence, amount of photons inwardly of sphere of radius ***r***, with volume 1m^3, equally

$$\beta_{\lambda} = \frac{w(T)}{w_{\lambda}} = \frac{4 \cdot \sigma \cdot T^4 \cdot \lambda}{h \cdot c^2} \qquad (9)$$

The site of a hemisphere or the stain, falling to blows of one photon is equal

$$S_0 = \frac{S}{2 \cdot \beta_{\lambda}} = \frac{h \cdot c^2 \cdot \sqrt[3]{36 \cdot \pi}}{8 \cdot \sigma \cdot T^4 \cdot \lambda} \quad |\mathrm{m}^2| \qquad (10)$$

Time of affecting of a photon for a stain is defined by length of wave of a photon. On conditions of our mental experiment the photon "presses" on a stain with some average force $\boldsymbol{F}_{\lambda}$ during time when the wave enters into a wall of sphere and leaves it.

During first half of this time interval kinetic energy of a photon is transferred to a sphere wall, turning to potential energy, and then again comes back to a photon. Hence, the sphere wall experiences pair of impulses, that in a reality is photon reradiation.

Thus, time of action of force $\boldsymbol{F}_{\lambda}$ on a stain will be defined as

$$\tau_{\lambda} = \frac{2 \cdot \lambda}{c} \quad |\mathrm{s}| \qquad (11)$$

Periodicity of blows of the given photon in the given stain is equal

$$\tau_r = \frac{2 \cdot \lambda + 4 \cdot r}{c} \quad |s| \qquad (12)$$

Newton's second law says – change of quantity of movement of a body to equally impulse of the force operating on a body. In our case it looks so:

$$2 \cdot M_\lambda \cdot c = F_\lambda \cdot \tau_\lambda = F_\lambda \cdot \frac{2 \cdot \lambda}{c} \quad \text{или} \quad M_\lambda \cdot c^2 = F_\lambda \cdot \lambda \quad (13)$$

where: $\boldsymbol{M_\lambda}$ |kg| – the formal mass of photon necessary for us for use of laws of classical mechanics in the subsequent calculations.

Using the formula (8) for expression of energy of a photon through Planck's constant, we will receive following expression for force $\boldsymbol{F_\lambda}$

$$F_\lambda = \frac{h \cdot c}{\lambda^2} \quad |N| \qquad (14)$$

Further we should "smear" force $\boldsymbol{F_\lambda}$ on all interval between two blows of a photon and thus to calculate averaged, for the given time interval, force $\boldsymbol{F_0}$ operating on the given stain, area $\boldsymbol{S_0}$.

$$F_0 = \frac{F_\lambda \cdot \tau_\lambda}{\tau_r} = \frac{h \cdot c}{\lambda \cdot (\lambda + 2 \cdot r)} \quad |N| \qquad (15)$$

After a number of transformations, the definitive formula for calculation of pressure of monochromatic light on internal walls of sphere will look like

$$p(\lambda, T_\lambda) = \frac{F_0}{S_0} = \frac{8 \cdot \sigma \cdot T_\lambda^4}{c \cdot (\lambda + 1.24) \cdot 4.836} \quad |Pa| \qquad (16)$$

In the given formula the temperature of walls of sphere T_λ is function of length of a wave of photons being in sphere.

The form of this dependence to us should be found.

If inside our sphere there will be photons with length of a wave of visible light the formula (16) will become well familiar to us from formula textbooks:

$$p = \frac{8 \cdot \sigma \cdot T^4}{5.99664 \cdot c} \approx \frac{4 \cdot \sigma \cdot T^4}{3 \cdot c} \quad |Pa| \qquad (17)$$

If in sphere to start radio-waves with length of the wave equal to radius of sphere pressure upon internal walls of sphere should decrease to size

$$p = \frac{8 \cdot \sigma \cdot T^4}{8.99496 \cdot c} \quad |Pa| \qquad (18)$$

From this follows, that it is necessary to search for an exact and unique explanation of physical sense of temperature in the atom.

Besides, there is a question, whether it is possible to use a principle of definition of pressure under formula by Stephan-Boltsman at calculation of pressure of an electromagnetic wave under formula by Pointing. Or whether, in other words, it is possible to use change of temperature of various parts of radio transferring aerials for calculation and optimisation of a design of aerials and modes of transfer and reception of electromagnetic waves.

Polytronic radiation of atom

In our previous work "The elementary charging impulse" we have resulted the simplified formula for calculation of energy of the photon radiated by radial polytron of atom (under this formula the hydrogen spectrum calculate off).

http://vlamir43.narod.ru/ELEMENTARY_CHARGE_IMPULSE_r.zip

Here we use the same formula, but after several numerical transformations:

$$w_t(n_e, m_{ij}) = \frac{4 \cdot \pi \cdot M_e \cdot c^2}{\alpha} \cdot \left(\frac{n_e}{K}\right)^4 \cdot \left(\frac{1}{m_i^2} - \frac{1}{m_j^2}\right) \quad |J| \qquad (19)$$

where: n_e = 0.0528466 – amplitude order of a radial polytron for atom of hydrogen;

m_i and m_j – frequency orders of a polytron at ***i*** -th and ***j*** -th power levels, equal amount of half waves (or amount of knots) on a ring.

The inverse constant of thin structure 1/α = 137.036 has appeared in the formula as a result of multiplication of numbers (3/2)×0,72408×K^4, (where K=3.3515 which in turn is the transformed number 0.089=0.298^2 from formulas in the aforementioned reference).

The formula (19) gives value of energy of the photon radiated by one atom, and, hence, one stain $\boldsymbol{S_o}$ on an internal surface of sphere. To define a stream of photon energy from one hemisphere it is necessary to multiply energy from one stain by amount of all photons in sphere, i.e., conditionally speaking, on density of photon gas in sphere. But at present, the qualitative picture of process is more interests.

Comparing formulas (19) and (6), we see, that the temperature of walls of sphere depends on amplitude and frequency of own fluctuations of polytrons. Presence of constant thin structure testifies that it is really electromagnetic process and, therefore, the formula can be applied to calculation of the Compton's effect.

In the modern physics following power equivalents are applied to recalculation of dimensions of various physical parametres:

$$h \cdot \nu_e = \frac{h \cdot c}{\lambda_e} = M_e \cdot c^2 = k \cdot T_e = 8.1871 \times 10^{-14} \qquad |J| \qquad (20)$$

where: ν_e = 1.23559×10^{20} |Hz| – frequency of wave of the Compton for electron;

$\lambda_e = \lambda_C$ = 2.42631×10^{-12} |m| – length of wave of the Compton for electron;

k = 1.3806503×10^{-23} |J|×|K^{-1}| – constant by Boltsman for ideal gas;

T_e = 5.92989×10^9 |K| – temperature of electronic gas, that in physical sense it is necessary to understand, how temperature in electron.

Having used of a parity of equivalents (20) we will copy the equation (19) in the thermodynamic form

$$w_t(n_e, m_{ij}) = \frac{4 \cdot \pi \cdot k \cdot T_e}{\alpha} \cdot \left(\frac{n_e}{K}\right)^4 \cdot \left(\frac{1}{m_i^2} - \frac{1}{m_j^2}\right) \quad |J| \qquad (21)$$

Let's make calculation of energy of radiation of a radial polytron in atom of hydrogen at energy transition from a frequency order m_i = 2 on a frequency order m_j = ∞.

$$w_t(n_e, 2, \infty) = \frac{4 \cdot \pi \cdot k \cdot T_e}{\alpha} \cdot \left(\frac{n_e}{K}\right)^4 \cdot \left(\frac{1}{2^2} - \frac{1}{\infty^2}\right) = 2.179 \times 10^{-18} \quad |J| \qquad (22)$$

In electron-volts this energy will make 2.179×10^{-18} |J| = 13.599 |eV|, i.e. it is energy of ionization of atom of hydrogen. Actually, it is process of generation of electron by atom of hydrogen as the radial polytron of atom, having absorbed energy of ionization 13.599 |eV|, should pass to higher power level with frequency order m_i = 1. But it means that the radial polytron would lose one more of the remained two knots by means of which it is kept in atom structure. Therefore the radial polytron is compelled to throw out surplus of energy, but not in the form of a photon, and in the form of the girdled wave with frequency order m_i = 2 and with full energy 510999 |eV|.

The formula (21) gives value of energy for one radiator, i.e. it is energy of one photon. To calculate density of photon energy in sphere, it is necessary to multiply value of energy under the formula (21) by amount of photons β_λ in sphere from the formula (9). After transformations we receive the formula

$$W_t(n_e, m_{ij}, \lambda, T) = \frac{\sigma \cdot k \cdot T_e}{h \cdot \alpha \cdot c} \cdot \left(\frac{2 \cdot n_e \cdot T}{K}\right)^4 \cdot \left(\frac{\pi \cdot \lambda}{c \cdot m_i^2} - \frac{\pi \cdot \lambda}{c \cdot m_j^2}\right) \quad |J| \qquad (23)$$

In the formula (23) before brackets are grouped six world constants, that are procured by physicists of many generations. We will designate this group one symbol **γ** and we will calculate its value.

$$\gamma = \frac{\sigma \cdot k \cdot T_e}{h \cdot \alpha \cdot c} = 3.2025951517271 \times 10^6 \quad |J| \times |m^{-3}| \times |K^{-4}| \times |s^{-1}| \qquad (24)$$

Dimension of the constant **γ** says that it is the stream of beam energy entering into unit of volume (or leaving of it) in unit of time at change of temperature of walls of sphere on Calvin's one degree.

The second multiplier in the formula (23), bracketed and raised in the fourth degree, represents amplitude parameter of temperature. At it even there is that temperature which appears in law by Stephan-Boltsman.

$$T_a(n_e, T) = \frac{2 \cdot n_e \cdot T}{K} \quad |K| \qquad (25)$$

However it is necessary to say, that some contribution to this temperature should give and last factor in the formula (23). The third multiplicand has dimension of time and represents frequency parameter of temperature.

$$T_f(m_{ij}, \lambda) = \frac{\pi \cdot \lambda}{c \cdot m_i^2} - \frac{\pi \cdot \lambda}{c \cdot m_j^2} \quad |s| \qquad (26)$$

In the formula (23) speed of light is present at two factors. And, if in the formula (24) speed of light enters, as necessary parameter, that in the formula (26) it is possible to apply the period of fluctuations in a wave $\lambda/c = \theta$, then:

$$W_t(n_e, m_{ij}, \theta, T) = \frac{\sigma \cdot k \cdot T_e}{h \cdot \alpha \cdot c} \cdot \left(\frac{2 \cdot n_e \cdot T}{K} \right)^4 \cdot \left(\frac{\pi \cdot \theta}{m_i^2} - \frac{\pi \cdot \theta}{m_j^2} \right) \quad |J| \qquad (27)$$

It is experimentally established, that the temperature in interplanetary space keeps at level 2.7K, and it is considered to be, that this level is provided with relic photons with length of a wave ~ 0.074 |m|, though actually level of microwave radiation in the Universe is rather non-uniform.

In our early researches it has been established, that relic radiation of the Universe on length of a wave ~ 0.074 |m| corresponds to energy transition of radial polytrons from a frequency order $m_i = 234$ on a frequency order $m_j = 236$.

Let's make some numerical comparisons:
Density of energy of relic radiation under formula by Stephan-Boltsman (6)

$$w(T) = \frac{4 \cdot \sigma \cdot 2.7^4}{c} = 4.021 \times 10^{-14} \quad |J| \times |m^{-3}| \qquad (6a)$$

Density of energy of relic radiation under the formula (23)

$$W_t(n_e, m_{ij}, \lambda, T) = \gamma \cdot \left(\frac{2 \cdot n_e \cdot 2.7}{K} \right)^4 \cdot \left(\frac{\pi \cdot 0.074}{c \cdot 234^2} - \frac{\pi \cdot 0.074}{c \cdot 236^2} \right) = 4.024 \times 10^{-14} \quad |J| \qquad (23a)$$

At those simplifications, which we have entered in the research beginning, this comprehensible enough coincidence.

And, at last, to find out area of applicability of purely mechanistic approach to calculation of energy of photons, we will consider a photon, as a material point which makes harmonious fluctuations with the period τ_r and аплитудой r rather the sphere centre.

In the classical mechanics energy of harmonious fluctuations of a material point is calculated as half of product of mass of a point by a square of cyclic frequency and by a square of amplitude of fluctuations of a point.

Angular frequency for our sphere in volume of one cubic meter is equal

$$\omega_r = \frac{2\cdot\pi}{\tau_r} = \frac{\pi\cdot c}{\lambda + 2\cdot r} \quad |\text{rad}|\times|\text{s}^{-1}| \qquad (28)$$

Having taken of the parity of equivalents (22) we will write down mass of a photon

$$M_\lambda = \frac{h}{\lambda\cdot c} \quad |\text{kg}| \qquad (29)$$

Kinetic energy of harmonious fluctuations of one photon is equal

$$w_r = \frac{h\cdot c\cdot\pi^2\cdot r^2}{2\cdot\lambda\cdot(\lambda+2\cdot r)^2} \quad |\text{J}| \qquad (30)$$

For calculation of density of kinetic energy of photons in sphere, it is necessary to multiply value of energy under the formula (30) by amount of photons β_λ in sphere from the formula (9). After transformations we receive the formula

$$W_r = \frac{2\cdot\pi^2\cdot r^2\cdot\sigma\cdot T^4}{c\cdot(\lambda+2\cdot r)^2} \quad |\text{J}| \qquad (31)$$

Calculation under the formula (31) for λ = 0.074 |m| and T = 2.7 |K| gives value 4.418×10^{-14} |J|. It is 10% more than at calculation under the formula (23a). But the Compton's effect has been theoretically proved under formulas of classical mechanics.

При T = 2.673 |K| значение плотности кинетической энергии по формуле (31) совпадает со значением фотонной энергии по формулам (6а) и (23а).

Поскольку наши реликтовые фотоны по длине волны относятся к макроскопическим объектам, то мы вправе воспользоваться формулой Джозефсона и, поскольку эти фотоны в действительности находятся в условиях космического холода, то к ним можно применить и формулу (5)

$$U = \frac{h\cdot c}{2\cdot q_e\cdot\lambda} = \Phi_0\cdot\nu \quad |\text{Wb}|\times|\text{Hz}| \qquad (32)$$

Let's decipher units of measure in the formula (32): |Wb|×|Hz | = $|\text{N}^{1/2}|\times|\text{m}|\times|\text{s}^{-1}|$, i.e. it is product of a root square from force by speed. And, at this electromagnetic process there can be only a speed of light. Besides, the combination of quantum of magnetic stream with frequency of radiation, which can accept only integer values, suggests, that thus should be quantized and other participants of process, including space, time and, probably, a speed of light.

Having executed calculation for three next quantum conditions of relic radiation we will see the following picture:

for ν = 3999999999 |Hz| length of a wave λ = 0.074948114518737 |m|
for ν = 4000000000 |Hz| length of a wave λ = 0.074948114500000 |m|
for ν = 4000000001 |Hz| length of a wave λ = 0.074948114481263 |m|

The energy difference between two next frequencies is equal Planck's to constant, both in the above-stated case, and for any next frequencies. Therefore, including the speed of light in fundamental parameter of Universe, and, considering that polytrons in atoms cannot change any way the sizes, we come to conclusion, that all frequencies of electromagnetic radiation in the Universe are built in strict quantized row, and Planck's constant characterizes a present status of the Universe.