ФИЗИКА ЭЛЕМЕНТАРНЫХ ЧАСТИЦ И АТОМНОГО ЯДРА. ТЕОРИЯ

NEW INTERPRETATION OF THE HUBBLE LAW[1]

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New interpretation of the Hubble law is considered. It is supposed that the emptiness does not exist, but there is real physical medium — Ψ-ether, which uniformly fills all the world space as was supposed by Maxwell, Lorentz, Poincare at the end of the 19th – beginning of the 20th centuries. The modern (not mechanical!) Ψ-ether is defined as the Bose–Einstein condensate of neutrino–antineutrino pairs of Cooper type and it is a carrier of electromagnetic field.

The two different forms are predicted for the red shift in the Hubble diagrams in the region of $r \gtrsim 6500$ Mpc.

Рассматривается новая интерпретация закона Хаббла. Предполагается, что пустоты не существует, а есть физическая среда — Ψ-эфир, заполняющая все мировое пространство и являющаяся носителем электромагнитных колебаний, как это признавалось Максвеллом, Лоренцем, Пуанкаре в конце XIX – начале XX вв. Современный (а не механический!) Ψ-эфир определяется как бозе-эйнштейновский конденсат нейтрино-антинейтринных пар куперовского типа. Красное смещение вызывается затуханием распространяющейся в Ψ-эфире световой волны.

Предсказываются две различные формы зависимости красного смещения на хаббловской диаграмме в области расстояний $r \gtrsim 6500$ Мпс.

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There are two assertions in the modern cosmological science which are beyond question. The Universe expands, the expansion accelerates, the expansion obeys the Hubble law

$$cz = Hr.$$

Here c is the light velocity; $z = \Delta\lambda/\lambda$ is the quantity of the redshift of observed spectral lines; H is the Hubble constant equal to 55–65 km/(Mpc · s); r is the distance from the Earth to an observed object of the Universe. The redshift is connected with the Doppler effect. Though it is well known that the Doppler effect functionally depends on the velocity of objects $z = \Delta\lambda/\lambda \sim v/c$ (this relation valid for nonrelativistic velocities v), where v is the radial velocity of the observed object, and for the Hubble law $\Delta\lambda/\lambda \sim r$, (but not v), nevertheless it is stated that if we use the right value of the coefficient of the proportionality H, the Hubble formulae «may be used for definition of the distance r if we measure the redshift of galaxy or if we calculate (from this redshift) the velocity of the galaxy remove $v = cz$» [1]. The same statement was made in review paper by A. D. Chernin: «At each moment of the world history the recession velocity of an object, the distance of which from us is r, is proportional

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to r: $v = Hr$, where H is the constant coefficient. This dependence is only a consequence of the similarity and the isotropy of the Universe...» [2]. An analogous statement was made by I. D. Karachentsev and D. I. Makarov: «...Distribution of these galaxies relative to distances and radial velocities is given in Fig. 1... The line of regression $v = HD$, given in Fig. 1, through the origin of the coordinate system corresponds to the local value of the Hubble «constant» $H = (64 \pm 2)$ km/(Mpc·s)...» [3]. Karachentsev and Makarov found out nonisotropic field of velocities of the local Group of galaxies. «...Peculiar velocity
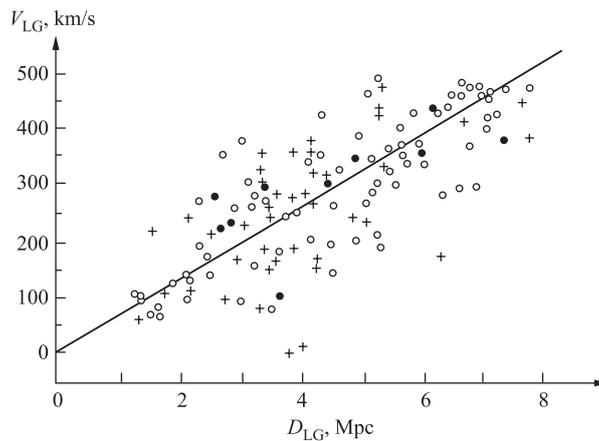

Fig. 1. The redschift in the Hubble diagram from the work by Karachentsev and Makarov

is found to be described with a tensor of local Hubble parameter having the principal axis 81:62:48 km/(Mpc·s) with a standard error ~ 4 km/(Mpc·s) each» [4].

Apparently, due to the anisotropy of the Hubble stream, in the phrase «Hubble constant» the word «constant» was taken by Karachentsev and Makarov in the quotation mark.

The presence of anisotropy of the local Hubble stream requires a correction of the definition of similarity and isotropy of the Universe and a correction of using the Hubble law to definition of distances to distant galaxies.

The main conclusion from the above-mentioned passages consists in that exchanging the dependence of redshift on the velocity of an observed object by the dependence on the distance of observed objects the authors not only distort the physical contents of the Doppler effect, but also make from this distortion unfaithful conclusion about the expanding of the Universe and this conclusion leads to a pill of hypotheses about possible properties of cosmological vacuum.

The remark about of the pile of hypotheses does not refer to the papers of Chernin, and Karachentsev and Makarov — it mostly refers to the established views on modern science which have roots stretching back into the 20th century when the special theory of relativity, quantum mechanics and relativistic field theory arose.

The second statement accepted in the modern cosmology can be formulated as follows: vacuum is not an emptiness. The hypothesis of the Big Bang in the emptiness would lead to the delay of the expansion of the Universe, but the delay is not observed as it follows from

the unfaithful interpretation of the Hubble law. And then it was supposed that vacuum is not emptiness, and a number of unusual properties was assigned to it to solve the problem of expanding of the Universe. One appeals to using the idea of virtual processes which was used in the Lamb shift calculations of the levels of hydrogen atom or the anomalous magnetic moment of the electron. Of course, the agreement of the theory with the experiments in these calculations is fantastic, but it was obtained because some mathematical artifices like the renormalization of mass, charge and others were used. Very prominent scientists did not trust the renormalization procedure and, for instance, Dirac wrote: «I am inclined to suspect that renormalization theory is something that will not survive in the future, and that the remarkable agreement between it and the experiments should be looked on as a fluke» [5].

In the modern field theory the vacuum is defined by the expression $a^-|0\rangle = 0$, where a^- — an operator of annihilation of quantum of any field. The operator a^-, acting on the vacuum state $|0\rangle$ gives zero and, therefore, there are no any particles in the vacuum, the vacuum is emptiness. The quantum numbers of the vacuum such as momentum, energy, electrical charge and others — all equal zero [6].

If somebody obtains nonzero energy, momentum, charge and mass from «nothing» using virtual physical processes and mathematical artifices, then this somebody deceives us.

The fundamental scientific philosophical statement that it is impossible to introduce the unity of the metric system in the emptiness is forgotten now. Here it is appropriate to remember the quotation of Feynman: «...When you follow of our physics too far, you find that it always gets in some kind of trouble...» [7] and farther: «...There are so many things about elementary particles we still don't understand...» [8].

Today the so-called international community of science «turn a blind eye» to all the above-mentioned «some kind of trouble», because we do not have another theory.

In this work, I advocate that the emptiness does not exist but there is real physical medium which uniformly fills all the world space — the Ψ-ether [9]. Thus, postulate homogeneity and isotropy of the space. The Ψ-ether being a homogeneous medium ensures the unity of measure and number in the Universe, the Maxwell spoke about at the end of the 19th century.

The Ψ-ether is defined as the Bose–Einstein condensate of neutrino–antineutrino pairs of Cooper type and it is a carrier of the electromagnetic field. This definition of the Ψ-ether can be easily seen from a simple chain of the well-known formulae.

The vector $\mathbf{A}$ and scalar φ potentials are related with the strengths of the electric $\mathbf{E}$ and magnetic $\mathbf{H}$ fields by [10]

$$\mathbf{H} = \operatorname{rot}\mathbf{A},$$

$$\mathbf{E} = -\frac{1}{c}\frac{\partial \mathbf{A}}{\partial t} - \operatorname{grad}\varphi.$$

No attention is paid in textbooks or monographs to the fact that thus introduced auxiliary electromagnetic potentials $\mathbf{A}$ and φ are equated to the physical observables $\mathbf{H}$ and $\mathbf{E}$. This is impermissible in physics. If we make use of the Lorentz condition

$$\operatorname{div}\mathbf{A} + \frac{1}{c}\frac{\partial \varphi}{\partial t} = 0$$

and combine the vector **A** and scalar φ potentials into one four-dimensional vector Ψ_i, the Maxwell equation can be written in the form

$$\Box \Psi_i(x,t) = 0.$$

I define these equations as equations for the real Ψ-ether.

The Klein–Gordon operator $\Box$ can be represented as a product of two commuting matrix operators of the first order, each acting on spinor function of neutrino. Thus, we establish the connection of the electromagnetic field with the spinor particles-neutrinos. Neutrinos and antineutrinos can form a combination with the spin 1 (electromagnetic field) and spin 0 (it is natural to suppose that there may exist combinations with higher values of the spin).

We conclude that the electromagnetic potentials **A** and φ are not auxiliary functions, as it is written in all textbooks for University students, but they are connected by some definite relations with physical reality — the Ψ-ether.

It can be assumed that the scalar component of the Ψ-ether takes the properties of a carrier of gravitational forces.

So, I state that the light is not a substance but a process going on in a substance, as was affirmed by Maxwell, Lorenz, Poincare at the end of the XIX — beginning of the XX centuries.

The whole visible known Universe is immersed in the all-penetrating Ψ-ether, and it lives and develops according to its laws. The Ψ-ether is an abyss in which the known physical world, negligible as compared to the ether, is immersed. The world of the Ψ-ether has neither top, nor bottom, nor left, nor right.

The relict radiation can now be interpreted as age-long luminescence of the weakly excited world Ψ-ether, or in other words, as eternal oscillations of $\nu\bar{\nu}$-pairs forming the either. Naturally, the relict radiation has to be isotropic, it goes to the Earth with equal intensity and its spectrum influences the radiation of the spectrum of the black body. In the world Ψ-ether gigantic magnetic fields and axes can naturally arise, and the light which comes to the Earth from Universe may have a definite kind of polarization.

The Ψ-ether is a single candidate for its definition as an inertial coordinate system. «... It is self-evident (and this was always supposed even before the creation of the theory of relativity) that there exists at least one reference frame, which is inertial as concerns mechanics and in which at the same time the Maxwell equation is valid...» [11].

Sometimes the relict radiation is connected with the inertial system of coordinates. However, as has been mentioned above, the relict radiation is considered here as eternal oscillation of the weakly excited world Ψ-ether. The inertial system is defined by the distribution of matter in the Universe [12] and the Ψ-ether is thus the only candidate for the definition of the inertial system of coordinates, or the privileges system of coordinates in the Universe, as it is defined by V. A. Fock [13].

It was justified above that the electromagnetic field has the discrete structure — it consists of neutrino–antineutrino pairs. Therefore, as philosophers say, «bad infinity» is interrupted when constant properties of any physical object, including the electromagnetic field, are preserved, even under unlimited division of its size up to zero.

Let us call the cooper neutrino–antineutrino pairs, of which the electromagnetic field consists, psions (a derivative of the word Ψ-ether). There is a limit for the existence of electromagnetic waves of a small size when the length of a free path of psions becomes

smaller than the distance between them. The smallest length may be defined from maximal energy of γ-quanta coming from cosmos to the Earth. This energy approximately equals $\leqslant 10^{+23}$ eV. The frequency ν of these quanta approximately equals $\sim 10^{38}\,\mathrm{s}^{-1}$, and the wavelength $\lambda \sim 10^{-28}$ cm.

The density of psions in $1\,\mathrm{cm}^3$ determines the reliability of information accepted and transferred by the Ψ-ether. If two or more impulses come to a psion, gained information will by distorted in further transmission.

As concerns large wave lengths, the limit for the existence of electromagnetic waves sets in when large wavelengths of the Ψ-ether lose their wave configuration becoming a chaotic motion of huge masses of the Ψ-ether («noises»). The largest lengths of radiowaves amounts to $\sim 10^{10}$ m and may be even larger, and the frequency of such waves (the lowest frequency) is $\nu \sim 3 \cdot 10^{-2}\,\mathrm{s}^{-1}$.

So, when the wave properties of the Ψ-ether come to an end, our cognition of secrets of the Universe by means of optical instruments and radiotelescopes ends too. The man does not «hear» the full voice of the Universe, the man becomes «blind» and «deaf» in the Universe.

Evidently, there exist phenomena whose description requires studies of the microscopic properties of constituents of the Ψ-ether, psions.

So, the light considered by us as the vibration of the Ψ-ether in the process of propagation in the Universe will lose the energy. The propagation of light can be considered as propagation of waves in an elastic medium. Therefore, the loss of the energy in process of propagation of the light in the Universe will be extremely small.

Two models of the loss of the energy of the light wave are considered here. Let an energy of light quanta equal $h\nu$.

The first model. Suppose that the relative loss of γ-quantum energy is proportional to the distance r passed by γ-quantum in the Ψ-ether. The initial frequency of γ-quantum equals ν_0 and the final one equals ν ($\nu < \nu_0$). Therefore, $\delta\nu = \nu - \nu_0 < 0$

$$-\frac{\delta\nu}{\nu_0} = \alpha r; \quad -\frac{\delta\nu}{\nu_0} = \frac{\delta\lambda}{\lambda} = z.$$

So:

$$z = \alpha r.$$

The coefficient α is determined from experiment. It is natural to propose that $\alpha = H/c$, where H — is the Hubble constant in $\mathrm{km}/(\mathrm{Mpc} \cdot \mathrm{s})$, and r is the distance in Mpc. Hence, we get the known expression for the Hubble law

$$cz = Hr.$$

Thus, the redshift is related to the distance r only.

The second model is the model of exponential loss energy of γ-quanta:

$$d\nu = \alpha\nu dr.$$

After integration we get

$$\nu = \nu_0\,\mathrm{e}^{-\alpha r}.$$

Under the condition $\alpha r \ll 1$ we have $\lambda \approx \lambda_0(1 + \alpha r)$ and

$$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{\Delta\lambda}{\lambda_0} = z = \alpha r,$$

and in this case we put $\alpha = H/c$ and get the same expression for the energy loss of the light wave

$$cz = Hr.$$

The law of energy loss of light quanta in both the model is the same as in the region $\alpha r < 1$, $r < 1/\alpha$. This value r is defined from the inequality

$$r < \frac{c}{H} \approx \frac{300000\,\text{km/s}}{60\,\text{km/(Mpc} \cdot \text{s)}}.$$

Up to 5000 Mpc we cannot distinguish between the linear law of energy loss and the exponential one. But if $r \sim 6500$ Mpc, exponential loss is approximately twice larger than the linear one.

The critical value of r, at which the linear law of energetic loss begins to differ from the exponential one, is defined by the Hubble constant.

Now the law of redshiff has to be written in the form

$$z_{\text{full}} = z_{\text{Doppler}} + z_\Psi = \left(\frac{v}{c}\right)_{\text{Doppler}} + \left(\frac{H}{c}r\right)_{\text{Psi}}.$$

The correct Doppler redshift has the usual form

$$z_{\text{full}} - z_\Psi = \left(\frac{v}{c}\right)_{\text{Doppler}}.$$

The redshift in the Hubble diagram from the work by Karachentsev and Makarov (see Fig. 1) will now have the form (see Fig. 2).
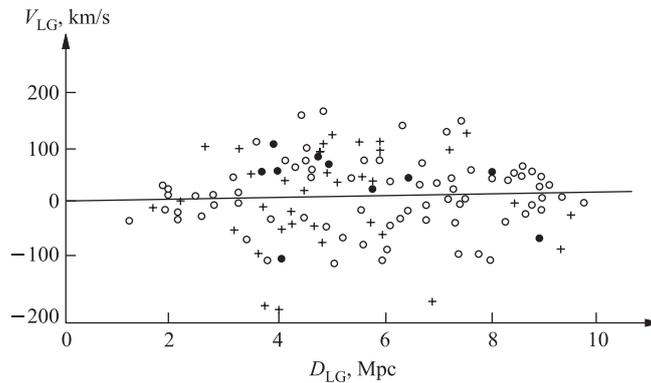

Fig. 2. The redschift in the Hubble diagram in the framework of Ψ-ether model

From Fig. 2 we can see that of 145 galaxies of the local Group approximately one half has a redshiff ($\Delta\lambda/\lambda > 0$), and the other half has a blueshift ($\Delta\lambda/\lambda < 0$). One half of Galaxies moves away from the Centre of the Local Group of Galaxies and other half of Galaxies comes to the Centre of the Local Group of Galaxies. So, we observe streams of Galaxies in some directions with respect to the Centre of the Local Group approximately with the velocity ~ 100 km/s.

We have no grounds to think that the law of motion of Galaxies in the Universe at distances far from the Centre of the Local Group of Galaxies differs from the law of motion of Galaxies of the Local Group and, therefore, a general picture of the motion of Galaxies in the Universe does not look like the expansion of the Universe.

So, we have a different point of view on the problem of the evolution of the Universe. But it is clear that an unfaithful interpretation of the redshift in the Hubble law led to many false problems which are now very actively discussed in many scientific papers.

And if we admit the fault in the interpretation of the Hubble law, then the problem of the monotonous expanding of the Universe changes to the problem of studying vivid dynamics of the nonrelativistic motion of Galaxies in the Universe, and modern cosmological science turns to real problems of the evolution of the Universe.

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