Galilean Electrodynamics, Spring 2012, Vol. 23, Special Issues No. 1, P. 3 – 13.

Cosmic Red Shift, Microwave Background, and New Particles

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Abstract

The explanation of the red shift in spectra of remote galaxies and cosmic microwave background radiation from the concept of an expanding Universe seems inadequate, and invites other explanations. The present paper studies the idea of cosmic red shift and microwave background radiation as a consequence of interaction between photons and previously unknown particles. It shows that the overall mass of the new particles in the Universe has the same order of magnitude as the mass of all the nucleons. Thus the problem of invisible dark matter may be solved. The question must be raised about the need for the existence of dark energy. In particular, the effect of attenuation of radiation from the distant supernovas is considered to be the consequence of scattering of photons on the new particles, but not the result of the dark energy activity.

Key Words: Red shift; Cosmic Microwave Background Radiation (CMBR); Particles; Dark matter; PACS: 14.80.-j ; 95.30 C ; 95.35 ; 98.70.Vc

1. Introduction

The cosmological red shift of wavelengths observable in spectra of remote galaxies, and the almost isotropic CMBR with a spectrum close to the radiation of a black body, were the major discoveries of the last century. The usual interpretation of the red shift is reduced to the appearance of the Doppler effect as a consequence of the expansion of space throughout the Universe, together with all the contents. In this case the further from us the galaxy is, the more its speed V_g should be. So it is supposed that the red shift confirms the theory of the Big Bang, which could generate our Universe.

Accordingly, the CMBR that existed in the early hot and dense Universe is considered to have cooled by the present time. Thus the radiation temperature should fall in inverse proportion to the distance scale factor, and the energy density must fall in inverse proportion to the fourth power of the scale factor. However, the given explanations collide with many difficulties that exist in the model of the expanding Universe.

First of all, we would like to note the insufficiency from a philosophical point of view of the explanation of the red shift effects and the CMBR as the consequence of space expansion. Really, according to the theory some initial and extremely dense substance is supposed to exist, and in the result of its transformation, substance, radiation and space start to expand. The idea of space expansion is necessary for the stationarity of the Universe, which has finite substance density, and for the explanation of the fact that the more remote galaxies have greater red shift.

The unsatisfactory aspect of this theory is the assumption of the existence of the primary matter with surprising properties, arising from nowhere, and not less surprising scale factor of a geometrical-mathematical nature which leads to the space expansion in a set way [1].

The high degree of the temperature isotropy of the CMBR coming from different parts of the sky means that there is a certain connection between the properties of remote galaxies. But these galaxies could not cooperate with each other during the presumable age of the Universe because of the large distance between them. Therefore, into the theory the idea of an inflationary phase is introduced, assuming extremely high rates of expansion of the early Universe.

In connection with these and many other problems, the questions of any actual substantiation of cosmological theories were repeatedly considered. So, in [2] are analyzed the consequences arising from the idea of the red shift, not as the result of the Doppler effect, but rather of the interaction in space with particles of the type of axions, or φ-particles. It is possible to consider our work as continuation of movement in this direction. We also offer a description of the connection between the red shift and the CMBR.

2. Red Shift

If we consider the red shift of this or that galaxy as the result of its movement, then according to the relativistic Doppler effect there is a change of wavelength λ_0 of the electromagnetic signal coming from the given galaxy to the Earth:

$$\lambda = \lambda_0\left[1 - V_g\cos(\beta)/c\right]\Big/\sqrt{1 - V_g^2\big/c^2}\ , \qquad (1)$$

where β is the angle between the velocity vector of the galaxy and the direction to the Earth, c is the speed of light, and λ is the wavelength observable on the Earth.

At large distances, the angle β is close to π for galaxies scattering from each other; therefore, it is possible to put $\cos\beta = -1$. It then follows from (1) that the red shift z, understood as a relative change of the wavelength, looks like:

$$z = \frac{\lambda - \lambda_0}{\lambda_0} = \sqrt{1 + V_g/c}\Big/\sqrt{1 - V_g/c} - 1\ ,$$
$$V_g = c\left[(z+1)^2 - 1\right]\Big/\left[(z+1)^2 + 1\right]\ . \qquad (2)$$

At small z, the dependence of the galaxy speed in (2) becomes a very a simple formula:

$$V_g \approx cz\ . \qquad (3)$$

At the same time, Hubble's empirical law connects the distance to the galaxy, determined by independent methods, with the red shift of its spectrum:

$$r = cz/H\ , \qquad (4)$$

where $H = (50\ \text{to}\ 100)$ km/(s·Mpc) is Hubble's parameter.

The expression for the probable speed of galaxies depending on the distance to them follows from equations (3) and (4): $V_g \approx Hr$.

We consider, that the red shift of galaxies' spectra is not connected with any moving apart of the galaxies, but rather with the effect of reduction of photon energy in their propagation through space. From the common viewpoint, the photon can be considered as an oscillator that should reduce its energy with time. If the angular wave frequency of a photon is $w = d\varphi / dt = 2\pi\nu$, and the energy of the photon is E, then the Q-factor of the photon as an oscillator is determined in this way:

$$Q = \frac{E}{dE/d\varphi} = \frac{wE}{dE/dt} \quad . \qquad (5)$$

Supposing the Q-factor is time-independent, by integration of (5) we come to the following dependence of the photon energy on time:

$$E = E_0 \exp(-wt/Q) \quad . \qquad (6)$$

Let us assume further, that the Q-factor is directly proportional to the angular frequency of the photon, and the time is proportional to the distance r passed by the photon. As $E = hc/\lambda = h\nu$, where h is Planck's constant, and ν is the frequency of the wave, it is possible to rewrite (6) as:

$$\lambda = \lambda_0 e^{\alpha r} \quad , \quad \nu = \nu_0 e^{-\alpha r} \quad , \qquad (7)$$

where α is a constant, λ_0 and ν_0 are the wavelength and frequency of the photon wave at its radiation.

From (7) it turns out that as the photon propagates and the distance passed increases, the length of the photon wave grows. Taking into account (7) and the definition of the red shift z, we shall obtain:

$$z = \frac{\lambda - \lambda_0}{\lambda_0} = \frac{\lambda}{\lambda_0} - 1 = e^{\alpha r} - 1 \quad . \qquad (8)$$

The combination of equations (4) and (8) allows us to find parameter α. At small value of the red shift, it is possible to simplify (8), expanding the exponent, further using z in (4), we find α and also s:

$$z \approx \alpha r = Hr/c \ , \ \alpha = H/c \ , \ s = \frac{1}{\alpha} = \frac{c}{H} = 3 \text{ to } 6 \,\text{Gpc} \quad . \qquad (9)$$

The parameter s is the distance on which the photon energy decreases in $e = 2.718$ times (e is the basis of the natural logarithm), range of s is determined by the discrepancy of measurements of Hubble parameter.

3. Model of a Photon

In order to speak in more detail about energy losses in electromagnetic quanta during their propagation in cosmological space, we shall consider an elementary model of a photon [3]. The given model has been constructed by the analysis of movement of the test charged particles in the field of an electromagnetic wave. Then by means of inverse transformation, the similar selfcoordinated movement of particles forms a wave. In this case we consider that this wave is circularly polarized, and the wave's particles support the form of the photon.

If the wave in the photon is directed along the X axis, then the centripetal force acting in the plane ZOY is necessary for particles to move on a helical line. The equation of the movement of the wave particle is determined by Lorentz's force through which the acceleration $\ddot{\mathbf{r}}$ can be found:

$$m\ddot{\mathbf{r}} = q\mathbf{E} + q\left[\mathbf{V}\times\mathbf{B}\right] \quad , \qquad (10)$$

here m is the mass of the particle, q is the charge of the particle, $\mathbf{E}$ is the vector of the wave's electric field intensity, $\mathbf{B}$ is the vector of magnetic field induction, $\mathbf{V}$ is the particle velocity vector.

As the plane of polarization of the wave rotates along the X axis, for the component of fields, in view of perpendicularity $\mathbf{E}$ and $\mathbf{B}$, it is possible to write:

$$E_x = 0 \ , \ E_y = E_0 \sin(wt - kx) \ , \ E_z = E_0 \cos(wt - kx) \quad ,$$

$$(11)$$

$$B_y = -\frac{1}{c}E_0 \cos(wt - kx) \ , \ B_z = \frac{1}{c}E_0 \sin(wt - kx) \quad .$$

Using conditions (11) in (10) and considering, that $\ddot{\mathbf{r}} = \dot{\mathbf{V}} = d\mathbf{V}/dt$, we shall obtain the equations for speeds:

$$mdV_x / dt = q(V_y B_z - V_z B_y) = \frac{q}{c}(V_y E_y + V_z E_z) \quad , \qquad (12)$$

$$\begin{aligned} m dV_y / dt &= qE_y + q(V_z B_x - V_x B_z) \\ &= qE_y(1 - V_x / c) + qV_z B_x \ , \end{aligned} \qquad (13)$$

$$\begin{aligned} m dV_z / dt &= qE_z + q(V_x B_y - V_y B_x) \\ &= qE_z(1 - V_x / c) - qV_y B_x \ . \end{aligned} \qquad (14)$$

Expressing E_y from (13) and E_z from (14), and using them in (12), we come to an equation that can be integrated:

$$\begin{aligned} (c - V_x)dV_x &= V_y dV_y + V_z dV_z \ , \\ V_x^2 - 2cV_x &+ V_y^2 + V_z^2 + A = 0 \ . \end{aligned} \qquad (15)$$

where A is a constant of integration.

The speeds of particles of the following kind are the solutions of the equations (13) and (14), in view of conditions (11) for intensities of electric field:

$$V_y = -V_0 \cos(wt - kx) \quad , \quad V_z = V_0 \sin(wt - kx) \quad , \qquad (16)$$

and the following equations are carried out:

$$w = kc + (q/m)B_x \quad , \quad k = qE_0 / mV_0 c \quad . \qquad (17)$$

Using speeds (16) in (15), we find the speed of particles along the X axis:

$$V_x = c \pm \sqrt{c^2 - V_0^2 - A} \quad . \qquad (18)$$

For each speed amplitude V_0 , the speed of photon particles V_x along the direction of its propagation can be equal to speed of light by the choice of a constant A in (18).

Thus, the photon can be presented in the form of helical structure in which the charged particles rotate along the direction of photon's movement. To keep particles from scattering, it is necessary to add centripetal force. It can be the gravitational force operating from the bunch of particles, which make a photon in aggregate. Besides, it is possible to consider the Lorentz force from the longitudinal magnetic field B_x also created by particles. For example, fast movement of charged particles is equivalent to current, attracted to each other under action of magnetic forces.

Because of the fact that the equations of the gravitational field are very similar to Maxwell's equations for an electromagnetic field [4,5], both fields have been incorporated in a unified electro-gravitational field. Therefore, the carriers of both fields, a photon and a graviton, can make a single whole. In particular, the photon can be imagined as gravitons transferring also electromagnetic energy.

4. Mechanism of Energy Loss by Photons

It is possible to approach dependence (7) in a different way, by specification of the way of energy loss by photons. It is easy to notice, that expression (7) is very similar to the law of absorption of energy of radiation in the substance, known as the law of Bouguer-Lambert-Beer. For the case when radiation passes through the rarefied medium, for example in gas clouds in space, reduction of light intensity in a gas layer with thickness r occurs by exponent and is described by the formula:

$$I = I_0 \exp(-\sigma n r) \quad , \qquad (19)$$

where I_0 is the initial light intensity, σ is the effective cross-section of light dispersion, and n is the concentration of disseminating particles.

With the help of (19), knowing the thickness of the gas cloud and effective cross-section of light dispersion (which usually corresponds to the size of gas atoms), it is possible to estimate the concentration of atoms in the cloud.

Our idea about cosmological red shift is that (19) is true not only for the total light intensity from many photons, but also for each separate photon. Really, in the space such small particles can exist, meeting with which the energy of a photon will slightly decrease. The model of a photon described above, includes the coordinated movement of a set of particles so meeting with extraneous particles the photon will lose energy. At the same time the change of photon's energy will be accompanied also by the change of length of photon's wave – that is effect of red shift.

From (7), (9) and (19) it follows, that it should be in the following way:

$$\alpha = 1/s = H/c = \sigma n \quad , \qquad (20)$$

where s is the length of mean free path of photons among the particles disseminating them.

To estimate from (20) sizes of disseminating particles through their section σ, in the beginning it is necessary to determine the concentration of these particles n in the space. It is preliminarily possible to assume, that the given particles have the sizes much less than atomic so they do not reveal themselves directly.

5. Similarity of Nuclear and Star Systems

In the given part we shall try to estimate the average concentration of particles in the space, on the basis of the theory of similarity and the principle of embedding of matter levels in each other [19]. The theory of similarity already has some conclusions that are exact enough. For example, the value of the minimal mass of stars $0.056 M_c$ has been predicted in [3]. Stars of such masses have been really discovered, and are known as brown L-dwarfs and T- dwarfs.

It is easy to assume that at each level of matter there are such objects that possess the largest densities of mass and energy. We consider that at the level of stars the densest objects are neutron stars, instead of the hypothetical black holes. This follows from the fact that when the set of particles is combined in one body there is always emptiness between the particles leading to reduction of the body's density in relation to the density of one particle.

A black hole has properties such that in density of energy it corresponds to nucleons. If we assume the existence of black holes, that means it is necessary to assume the presence of gravitational forces, significant in power, that are able to pull the substance together in a black hole. However, the particles of gravitational field, gravitons, do not exist separately and are not given from the outside; they are a product generated by the matter. Stars, for example, generate radiation, substance streams and cosmic rays. Due to the law of conservation of energy, any radiation from a body cannot be more energetic than the full energy of this body.

Therefore with transition to a higher-scale level of matter, the effective density of energy of field particles and the largest possible density of object's substance decrease simultaneously.

If it were not so, at each level of matter there would be black holes. As it is known from the theory, black holes should possess ability completely to absorb matter and even radiation, giving back only small part of energy. As evolution proceeds more quickly at the lowest scale levels of matter, it is necessary to expect there the fuller transformation of substance into black holes, up to the full exhaustion of free substance. But then the opportunity for formation of the energetic particles making a field at higher levels of matter disappears as the activity of black holes for this purpose becomes insufficient. From this contradiction only one conclusion can be drawn: there are not objects of the black holes type at each level of matter. This is the same as the existence of completely absolute objects also being not admitted in philosophy.

Supposing, that at the level of elementary particles, the densest objects are nucleons, and at the level of stars – neutron stars, so based on the recent data [20] we shall make Table 1 to determine the coefficients of their similarity.

Table 1. Parameters and Coefficients of Similarity for Neutron Stars and Nucleons

Mass, kg	Radius, m	Characteristic speed, m/s
Neutron star		
$M_s = 2.7 \times 10^{30}$	$R_s = 1.2 \times 10^{4}$	$C_s = 6.8 \times 10^{7}$
Proton		
$M_p = 1.67 \times 10^{-27}$	$R_p = 8.7 \times 10^{-16}$	$c = 2.99 \times 10^{8}$
Coefficients of similarity		
$\Phi = 1.614 \times 10^{57}$	$P = 1.379 \times 10^{19}$	$S = 2.3 \times 10^{-1}$

From Table 1 it follows, that a neutron star contains the quantity of nucleons equal to $\Phi = M_s / M_p$ on the average. The typical speed of particles C_s for a neutron star has been calculated from equality of the value $M_s C_s^2$ and the full energy of the star including gravitational and internal thermal energy. A similar equality is available for a proton – for that, $M_p c^2$ in Einstein's equation also is equal to the full energy. The coefficient of similarity by the sizes is determined by the formula: $P = R_s / R_p$.

Let us assume now, that the nucleon also contains $\Phi = 1.614 \times 10^{57}$ the particles called 'praons'. Such a conclusion follows from the fact proved in [6] based on huge actual material: the existence of a ladder of space objects from praons up to meta-galaxies for which relations of similarity are carried out.

We have a question now: what is the density of substance of praons, average for all space? To determine this it is necessary to find the coefficient of similarity K_ρ by the density between levels of matter of nucleons and praons. The density of substance is measured in kg/m^3. Therefore according to the theory of similarity it is necessary to divide coefficient of similarity in mass by a cube of coefficient of similarity in the sizes:

$$K_\rho = \Phi / P^3 \quad .$$

Now it is possible to estimate the average density of substance of praons ρ_{pr} in the Universe through the average density of mass of nucleons ρ_n from here:

$$K_\rho = \rho_n / \rho_{pr} = \Phi / P^3 = 0.61 \quad , \qquad (21)$$

where Φ and P are from Table 1.

The result (21) can be understood from following reasoning. At the level of stars part of nucleons is concentrated in neutron stars with density of substance ρ_s, other nucleons are concentrated in substance of common stars, in the dust and in space gas. The relation of density ρ_s to the average density of nucleons in the Universe is equal ρ_s / ρ_n. The same proportion can be written down for the level of elementary particles: ρ_p / ρ_{pr}, where ρ_p – density of substance of a proton. From $\rho_s / \rho_n = \rho_p / \rho_{pr}$ in view of $\rho_s / \rho_p = K_\rho = 0.61$ the equality (21) just follows.

The part of praons obviously is contained in nucleons, but from (21) it is evident, that the density of praons' mass as a whole exceeds density of nucleons' mass that we observe in the Universe. As $\rho_{pr} = 1.64\rho_n$, the difference of densities is equal $\rho_{pr} - \rho_n = 0.64\rho_n$. It turns out, that there is also substance of praons, distributed in space with average density $0.64\rho_n$. The share of nucleon substance is 100/1.64 = 61 % of all mass, and 39 % of mass exists in some other form.

Long ago indications have already been made that there is the invisible substance in space called dark matter. Observable curve rotations of clusters of stars and galaxies near each other in many cases differ from what can be expected in case of presence of only nucleon substance. Such difference is attributed to gravitational influence of the dark matter.

Based on the star evolution theory the following distribution of stars according to the condition of their substance is predicted. In the present time in our Galaxy there are about $10^{11} - 10^{12}$ stars, most of which are on the main sequence. In the interior of these stars nuclear reactions actively proceed similar to the Sun. The white dwarfs, dense and cooling down kernels of stars of the main sequence, make up to 10% of all stars of the Galaxy. Such kernels remain after burning out of kernel fuel in stars and the subsequent dropping of the external envelope by the stars. Neutron stars in the Galaxy can be up to 10^9 if we consider their increased frequency of occurrence in the past and consider them as the basic source of observed quantity of heavy metals. In future transformation of all stars of the main sequence either in white dwarfs or in neutron stars is expected.

Masses of white dwarfs do not exceed masses of neutron stars, as white dwarfs drop actively superfluous substance in flashes of novae stars. The cases of formation of neutron stars from white dwarfs are not excluded; as it is very well possible if their critical mass is exceeded. For white dwarfs, the mass and the radius are inversely related, as the most massive of them have the smallest radii. The substance density of even the most massive white dwarfs is a million times less than the density of neutron stars. Therefore, in the course of evolution of the set of stars and white dwarfs, after their accumulation in the center of the Galaxy, they will be broken off because of gravitational forces from the nearest neutron stars. Nevertheless, it is possible to assume that a significant part of white dwarfs will remain on the periphery and outside the galaxies.

If we now go to the level of elementary particles of matter, it is necessary to expect that, besides nucleons in the rarefied space, there should also be so-called 'newons' (new particles), with properties similar to those of white dwarfs. Then the set of these particles forms the dark matter. The given particles should be millions of times less dense than nucleons. As the sizes of white dwarfs are hundreds and thousands of times greater than the sizes of neutron stars, the same is to be expected for the new particles in relation to the sizes of nucleons.

The average density of baryonic substance in the Meta-galaxy estimated up to 4.3×10^{-28} kg/m^3 according to [22], with the concentration of baryons of about 0.26 per m^3.

As we consider that the share of nucleon matter accounts for 61% of the total mass, and 39% of the mass consists of new particles with masses somewhat smaller than the nucleon mass, then the estimated concentration of new particles gives the value up to $n = 0.17$ /m^3. Using now the concentration given in (20) with Hubble's parameter $H = 71$ km/(s·Mpc), it is possible to estimate the cross section σ of the scattering particles and their characteristic size R_b:

$$\sigma = H / cn = 4.5 \times 10^{-26} \mathrm{m}^2 \ , \qquad (22)$$
$$\sigma \approx \pi R_b^{\ 2} \ , \ \ R_b \approx 1.2 \times 10^{-13} \mathrm{m} \ .$$

Multiplying the size R_b of new particles by the coefficient of similarity for the sizes $P = 1.379 \times 10^{19}$ from Table 1, we receive the value of about 2×10^6 m that is close to the range of radii of white dwarfs.

Thus, the new particles, which are similar to white dwarfs in their properties, can really be scattering particles, and effectively reduce the energy of photons in their distribution in the space.

It is easy to estimate that the scattering of the new particles against each other or on nucleons should occur very rarely. At the temperature of about 10 K, the speed of particles with the mass of a nucleon is $v \approx 10^2$ m/s. Then the average time between collisions will be about $s / v \approx 10^{16}$ years, where $s \approx 4$ Gpc according to (20).

If the effect of red shift is caused by interaction of photons with new particles, then as the consequence of different average concentration of new particles in the way of photons, the red shift can be different in different directions in the sky. Such an effect is really observed, leading to a different Hubble parameter (by almost twice) received by the researchers who study different parts of the sky. Even the adjacent parts of the sky, on one of which there is a significant emptiness in distribution of close galaxies, can give a difference in measured values of Hubble's parameter.

6. Red Shift and Meta-Galaxy

Nowadays, quasars with the value z more than 6 are discovered. For example, the object HCM 6A has red shift $z = 6.56$ [7]. Using (7) and parameter α from (9), and Hubble's parameter of $H = 75$ km/(s·Mpc), we receive the distance to HCM 6A equal to 7.76 Gpc. It is known that according to observations, the majority of quasars are at the distances corresponding to red shifts from $z = 0.3$ up to $z = 2$; at $z \geq 2.5$ their quantity sharply decreases [8]. Our estimation for $z = 0.3$ gives distance 1.05 Gpc = 3.24×10^6 light years, and for $z = 2$ – distance 4.39 Gpc, or 13.5×10^9 light years.

If we suppose that in their development all large galaxies in the Meta-Galaxy have somehow come through 'the quasars phase', which is characterized by strengthened generation of energy, then it is possible to assume that the given phase began in the Meta-galaxy approximately 13.5×10^9 years ago (at $z = 2$). Considering that quasars on the whole finish their active phase at the time of their observation -3.24×10^9 years ($z = 0.3$), we can estimate the time of quasars' existence and the active phase of the Meta-galaxy at 10^{10} years. The given condition concerns not only quasars, but also galaxies with the large luminosity of other types, for example to ultra-luminescent infra-red galaxies ULIRG, the largest of which do not almost meet at $z > 2$ [9]. Gamma-ray bursts also basically are found out up to $z = 2$ [18].

According to the data described in [10], periodicity of red shifts in radiation from galaxies in clusters is observed. After translating these Δz in speed by means of (3), we find characteristic differences in speed $\Delta V_g \approx c \Delta z$ with values from 2.67 km/s up to 72 km/s. For relative red shifts Δz for components in pair galaxies, the values ΔV_g up to 20 km/s, and up to 220 km/s in clusters of galaxies, has been found.

In [11] were found repeating speeds ΔV_g with values of 24.2 km/s, 36.3 km/s and 72.5 km/s for the group of 89 nearest spiral galaxies, especially at 37.2 km/s for one subgroup from 40 galaxies.

From Eq. (2) connecting red shift of a galaxy and its speed, it follows that galaxies should have inexplicable quantization in speeds if we treat the observable quantization of red shift as the consequence of Doppler effect. If we consider that cosmological red shift depends on the length of the path that is passed by light, from (8) and (9) it follows, that the periodicity of red shift is connected with the periodicity of distance under the formula:

$$\Delta z = (\Delta r / s) \exp(r / s) = \Delta r (z + 1) / s \quad . \qquad (23)$$

It is evident that at small distances r to galaxies and small z the exponent makes small contribution and the periodicity of differences in distances in considered galaxies follows from the periodicity of differences in red shifts in groups of galaxies. At large distances and red shifts the periodicity is not clear, as in (23) the exponent makes the significant contribution, and different Δz will correspond to similar Δr. This last fact also results from research of red shifts of quasars and galaxies most of which are far from us. However, the periodicity should be restored, if in each separate measurement r and z red shift will be used in (23). In the result such basic periodicity Δz must appear which would correspond to the characteristic distance between separate quasars or galaxies.

Based on (23), Table 2 gives us an interpretation of periodicity of the red shifts that were described in [10] and [11], and were expressed there in the form of periodicity of speed ΔV_g.

Table 2. Periodicity of red shifts

ΔV_g, km/c	Δr, Mpc	Interpretation
2.67	0.03	The size of large galaxies, the minimal radius of the circulation of satellites around them – dwarfish galaxies
20 – 24.2	0.22 – 0.27	The radius of gravitational influence of a large galaxy, measured by the maximal orbits of its satellites – dwarfish galaxies (an example – our Galaxy)
36.3 – 37.2	0.40 – 0.415	The distance between the adjacent large galaxies
72 – 72.5	0.8	The separation of galaxies in the clusters, the double distance between the adjacent large galaxies
220	2.45	The size of clusters of galaxies
12000	140	The average size of galaxies' super-cluster in the Meta-galaxy in view of the emptiness between super-clusters

We can notice that in Table 2 the values of Δr (and accordingly of ΔV_g) differ from each other approximately by an integer multiplier, which gives a cause for additional connection to take place between separate observable periodicities of the red shift Δz. In the last line of Table 2, we have added the periodicity connected with super-clusters of galaxies (450×10^6 light years), discovered, including, on the basis of statistical researches of dependence of luminosity of luminescent red galaxies on the distance.

The accuracy of measurement of red shift now reaches the value of 3×10^{-9}, which is equivalent according to (3) to the accuracy of measurement of speed up to 1 km/s. Therefore the red shift is well observed already in radius 1.5 – 2 Mpc of the dwarfish galaxies that surround the connected pair, consisting of our Galaxy and the next galaxy, Andromeda. At these distances, so-called 'Hubble flow' appears where it is required to consider red shift [12]. But it seems absolutely unreal that all these nearest dwarfish galaxies could simultaneously move away from us because of the Universe's expansion. And how does one explain that within a very non-uniform distribution of matter in the Local volume with the radius of 20 Mpc, it caused regular flow of cosmological expansion with linear velocity dependence on the distance? Why do local and global flows of expansion have the same dependence? And since the talk is about expanding the entire Universe with all its contents, then we need to recognize expansion of galaxies and stars and the Earth itself?

At the same time, if the red shift is not the result of Doppler effect, but of interaction of photons with new particles, the dwarfish galaxies remain turning peacefully around the large galaxies.

In [13], the regular rotation of the polarization plane of the electromagnetic radiation propagating on cosmological distances has been found. The result is proportional to the distance to the source of radiation, and does not depend on usual Faraday effect, which is subtracted from the obtained data. The characteristic spatial scale for the discovered effect makes the value of about 10^{25} m, that is less than s from (9). It is not excluded that this rotation of the polarization plane, as well as red shift, that, also is due to interaction of radiation with new particles. Really, new particles like white dwarfs can have the magnetic moments and be guided by intergalactic magnetic fields. This allows regular influence of particles on the plane of polarization.

7. Dark Matter

As was shown above, up to 39 % of all mass in the Universe can be in the form of new particles, and the share of nucleons is 61% of the mass. Such situation allows one to explain the observable discrepancy between the distribution of visible mass in star and galactic clusters and the rotation of these masses near each other. The majority of nucleons in galaxies are inside of stars. The new particles are unlikely to be inside of stars, as at large substance density they will break up in collisions with much denser nucleons. Therefore, new particles are extensively accumulated in the space surrounding galaxies, and considerably exceed the visible borders of galaxies.

Speeds of rotation of small bodies outside a massive body can be derived from the condition of equality of gravitational and centripetal accelerations:

$$\gamma M / R^2 = V^2 / R, \quad \text{from which} \quad V = \sqrt{\gamma M / R} \quad , \quad (24)$$

where γ is the gravitational constant, M is the mass of substance inside of the radius R.

It is evident that the speed should decrease with increase in distance from the center of a galaxy. However, it is very frequent even at large distances from galaxies that almost constant speed of rotation can be observed. For example, in our Galaxy the average speed of stars' rotation is about 250 km/s; it begins with the distance of about 8 kpc, and proceeds at least up to 20 kpc. That is possible, if we consider that the mass in (24) in the range from 8 up to 20 kpc accrues linearly with radius, and the average substance density falls down in inverse proportion to a square of radius. Therefore the mass of the Galaxy within the limits of radius 20 kpc should be about $2.9 \times 10^{11} M_c$, where M_c is the mass of the Sun. Our Sun is not further than 10 kpc from the center of the Galaxy. Estimations of substance density show that, already in the solar neighborhood, up to half of the mass of all galactic substance should fall to the dark matter.

The question of existence of dark matter is especially acute in clusters of galaxies, for some of which the full energy of visible substance is close to zero, or seems even to be positive. Then according to the movement dynamics of masses in a gravitational field, dissociation of such clusters should be expected. In order to prevent that, it is necessary to introduce the dark matter for an increase of the module of potential gravitation energy having on the whole a negative sign. At the scales of clusters and super-clusters, the relative quantity of dark matter is required to be even more than in galaxies. It is considered that on the scales of clusters of galaxies, the invisible substance should not be less than five times more than the visible.

For example, in the cluster of galaxies Coma, the number of galaxies in volume 1 Mpc^3 makes about 40, which means that the average distance between the galaxies equals 29 kpc. And the relation of mass of the cluster to the general luminosity, in terms of mass and luminosity of the Sun, reaches 250, whereas for a separate galaxy, such a relation does not exceed 50. If the nucleons are mostly within cluster of galaxies and dark matter in the whole volume of the cluster, then the total mass of new particles may be sufficient for the observed lack of substance.

All space objects known to us from asteroids to galaxies have a round form. It is rather mysterious, that the clusters of galaxies basically bi-dimensional, and the super-clusters of galaxies are more close to fibers, than to round objects. The length of super-clusters can be in range 10 – 100 Mpc, the cross-section up to 75 Mpc, the relation of length to width can reach 5. Super-clusters are usually directed to each other by the ends of their large axes, and in knots and branches of fibers of super-clusters, the largest clusters of galaxies are located.

It is obvious that such a form of matter on large scales is the consequence of a reduction of average substance density in large objects. Really, a cell of uniformity of substance in the Meta-galaxy presumably is about 140 Mpc. It is possible to consider that in view of emptiness, this is the size of one super-cluster on average in the Meta-galaxy. The average substance densities of the close cells almost do not differ from each other, and the basic gravitational forces not only the result of the ordinary matter, but also distributed in the space of dark matter. This is the reason why super-clusters do not interact actively, not with their neighbors, and not even with their own internal parts. Instead of round-form objects, the super-clusters form fibers – they are extended in length due to interaction with the close and massive neighbors in those places, where the attraction is strong enough.

Let us add some more remarks concerning the characteristics of the Meta-galaxy, the Universe on the whole. The standard approach is connected with consideration of the Universe on the basis of the general relativity theory. Within the limits of accepted idealizations, it is considered that the parameter of gravitation is constant. According to this fact, the substance of the infinite Universe cannot be static only in the presence of gravitational forces, and therefore in view of the red shift effect it can extend. And it happens so, that the further from us the observed objects are, the more the expansion speed is. Evolution of the Universe in this case is determined by the average density of the substance mass and the mass-energy of all available fields.

However we consider that the red shift is not the consequence of the Universe's expansion. It becomes appropriate to raise the question about applicability of that idealization due to which the invariability of gravitational forces and of the gravitational constant in all spatial scales is supposed, including even the Universe. Since gravitation cannot be a force given to the whole Universe from the outside, it should be created within the Universe, as the consequence of the microscopic levels of the matter. But we know that, for example, the nuclear forces binding the substance of nucleons, cease to work on large distances. It will be more natural to consider, therefore, that gravitational forces have a finite range of action. Let us add to it that probably there is more or less an empty space outside the Meta-galaxy up to other meta-galaxies. Continuing further, such distribution of substance, we come to the fact that the average density of the Universe tends to zero at infinity. That can be an additional reason that it is necessary to explain the organization of the Universe not just with the help of general relativity theory; other physical constructions should also be involved.

Instead of trying to apply gravitation theory to the whole Universe at once, we shall try to specify the possible parameters of our Meta-galaxy. The evolution of the Meta-galaxy can proceed not by means of explosion, but in a quieter manner, by gradual gravitational aggregation of substance from an originally more homogeneous condition. For such a case, the estimation of the maximal age of the Meta-galaxy can be calculated from the time of gravitational falling of substance:

$$t = \sqrt{3/2\pi\gamma\rho} \approx 10^{11} \text{ years.}$$

Then the estimation obtained above of 'the quasar stage' in development of the Meta-galaxy, which begun 13.5×10^9 years ago and ended 3.24×10^9 years ago, means, that only after the long process of aggregation of substance right up to the size of large galaxies, the most active phase of the Meta-galaxy begins and it continues on the whole 10^{10} years. Besides, according to estimates of energy release, this or that quasar or a galaxy can themselves be hyper-active only in the range of not more than 10^8 years; then they pass in the category of less active galaxies.

Let us accept, as an extreme case, that the gravitational potential of the Meta-galaxy reaches 10% from the maximum value, equal to the square of the light speed. Then from the relation: $0.1\,c^2 = \gamma M / R = \frac{4}{3}\pi\gamma\rho R^2$ it is possible to estimate the radius R of the Meta-galaxy from the known average substance density $\rho \approx 7 \times 10^{-28}$ kg/m^3. For R we find the value 6.9 Gpc. With such a size, the Meta-galaxy remains Euclidean to within 10%, and it can be described in the classical way. It can possibly be true that the farthest of observable objects (the distance to them according to (8) can be up to 9.6 Gpc at $z = 10$) are now already outside the Meta-galaxy, or the gravitation ceases to work at such large distances. Then the necessity for obligatory use of the general relativity theory for the whole Universe can disappear by itself.

Here we can add that the Euclidean nature of space up to very large distances can possibly be proved by means of angular measurements of the sizes of extragalactic objects depending on the distance to them.

8. Apparent Stellar Magnitudes

By definition, the apparent stellar magnitude is:

$$m = -2.5 \lg(L / 4\pi r^2) + C \quad , \qquad (25)$$

where ‘ $\lg$ ’ is logarithm to the base 10, L is the flow of radiation of the object, r is the distance in parsecs from the object to the observer, and C is a constant.

In order to consider the dependence of the observed star magnitude on the red shift, it is necessary to express r from (8) and to use the result in (25). Besides, the emitted light reduces its energy according to (6) and (7). One more effect is connected with scattering of photons on new particles, owing to which photons may change their direction in space. This leads to effective reduction of quantity of the photons received on the Earth during observation.

As a first approximation, this effect can be considered by means of multiplication L in (25) by $(1+k\alpha r)^{-1} \approx e^{-k\alpha r}$, where k is some coefficient. Having made the necessary replacements, we shall obtain:

$$m = -2.5 \lg \frac{L e^{-\alpha r}}{4\pi(1+k\alpha r)} + 5 \lg r + C =$$
$$= -2.5 \lg \frac{L}{4\pi} - 5 \lg\alpha + 5 \lg\left[\ln(z+1)\right]$$
$$+ 2.5 \lg(z+1) + 2.5 \lg\left[1 + k\ln(z+1)\right] + C \quad .$$

where ‘ $\ln$ ’ is logarithm to the base e.

If we arrange the radiating object on distance of 10 pc, then instead of m there will be the absolute magnitude M of the object:

$$M =$$
$$-2.5 \lg \frac{L}{4\pi} + 5 + 2.5 \lg(z_{10}+1) + 2.5 \lg\left[1 + k\ln(z_{10}+1)\right] + C \quad .$$

As the red shift z_{10} at a distance of 10 pc is very small, it can be ignored. Further by means of subtraction of expression M from m it is possible to get rid of some parameters:

$$m = M - 5 \lg\alpha - 5 + 5 \lg\left[\ln(z+1)\right]$$
$$+ 2.5 \lg(z+1) + 2.5 \lg\left[1 + k \ln(z+1)\right] \quad , \qquad (26)$$

where $\alpha = H / c$ – parameter from (9).

Because of the red shift from remote supernovae of type Ia, which were invoked in a number of works as standard sources of powerful radiation with known luminosity and duration of bright luminescence of tens days, there were difficulties in interpretation of the obtained results. In [14] supernovae were compared with red shifts from 0.3 up to 0.62 to the similar supernovae near us. By the amplitude of the light curve and its change in the course of time, it is possible to estimate absolute star magnitude and other parameters, including the distance to supernovae. It is accepted that, owing to the specific character of its formation from white dwarfs, the energy of supernovae of type Ia depends little on the place and the time of the flash. As a result, it appears that at the moment of the flash, all the given supernovae should seem to be further than what follows from Hubble's law with $H = 65$ km/(s·Mpc), approximately, by 10 to 15%.

The authors of [14] find the explanation that the expansion of the Universe occurs under action of some additional factor, except for gravitation. Such factor is considered to be the vacuum (or dark) energy connected with the cosmological constant, included in Einstein-Hilbert's equation for the metrics as a parameter. Unlike the density of the matter energy, the density of the vacuum energy is supposed to be a constant, irrespective of the Universe's expansion. The given assumption (about creation of vacuum energy), is obviously, not less fantastic, than geometrical expansion of the Universe. Under action of dark energy the scale factor of expansion in the past becomes relatively more, which can increase the distance to supernovae at the moment of radiation up to the necessary value because of what the radiation flow from them becomes weaker.

Our approach does not demand relativity theory, the concept of space expansion, and invocation of dark energy for the explanation of discrepancy in distances of supernovae, as is done in [14]. We consider that the given effect can be explained as the consequence of scattering of photons on the way to the Earth and corresponding reduction of their quantity. According to [14] and [15], the average magnitudes $\Delta m = m - M$ for different red shifts of supernovae are these: $\Delta m = 35$ for $z = 0.02$, $\Delta m = 40.2$ for $z = 0.2$, $\Delta m = 44.7$ for $z = 1$. This means that, as the red shift increases and remoteness of supernovae grows, the apparent magnitude becomes more positive, showing reduction of radiation flow.

Using the data Δm and z in (26), we receive the estimate of $k \approx 1.5\,\text{to}\,4$. The discrepancy in k arises from the approximate nature of our assumption that the stream of energy from a supernova decreases in inverse proportion to the distance in the form of $(1 + k\alpha r)^{-1} \approx \exp(-k\alpha r)$. It is obvious that the law of scattering of photons should be replaced with another, more exact expression. However it is clear that the reduction of the quantity of photons due to their scattering by new particles can fully explain the lack of energy that is found out in remote supernovae. As the factor k of the order of unity, it is evident that the effect of scattering of photons is additional to the red shift effect. Both these effects are the consequence of interaction of photons with new particles.

9. Cosmic Microwave Background Radiation (CMBR)

The effective temperature of an isotropic CMBR corresponds to the temperature of a black body about 2.725 ± 0.001 K. The average energy density is 4.18×10^{-14} J/m^3, the wavelength of the maximum in the spectrum of radiation energy is about 1 mm. The accuracy of measurement of temperature in the adjacent spatial areas now reaches $\Delta T / T \approx 10^{-5}$. It is possible to discover the existing temperature heterogeneity up to 10^{-4} from the average.

In order to connect the CMBR with the new particles, we shall consider distribution of light in the environment. Let I_0 be the initial intensity of light, I_R – the intensity of reflected light, I_D – the intensity of delivered light, I_A – the intensity of absorbed light in a layer with thickness r. These intensities are connected among themselves:

$$I_0 = I_R + I_D + I_A \quad .$$

In the case of infinite cosmological space, the light is repeatedly reflected and absorbed. Similarly to (7), the for intensity of light after passing the distance r in the environment we have:

$I_D = I_0 \exp(-\alpha r)$, and also $I_R + I_A = \left[1 - \exp(-\alpha r)\right] I_0$. (27)

In (27) it is possible to consider that $I_R + I_A = 0$ at $r = 0$ (reflection and absorption in a layer of zero thickness do not exist). With very large r, all reflected and absorbed radiation finally will be thermalized by new particles, and will acquire the spectrum of a black body, so according to (27) it should be true that $I_R + I_A \approx B(T)$ where $B(T)$ is the radiating ability of absolutely black body at temperature T.

Thus, radiation received on the Earth from remote sources of electromagnetic radiation should contain a component that has the spectrum of a black body. What can the temperature of this black body be?

From what is stated, it is evident that it should be $B(T) \approx I_0$. Hence, the energy density of CMBR should have the same value as the energy density of other electromagnetic radiation. This is really observed, so a spherical particle placed far from stars gets on the average the temperature of about several Kelvin units due to radiation from stars. Hence, the temperature 2.7 K of the black body consisting of disseminating particles is the average temperature of new particles. As it has been shown above, the concentration of new particles in space is almost equal to the concentration of nucleons, and the radii of new particles are in hundreds times more the radii of nucleons.

Another possible source of CMBR is connected with the interaction of new particles with surrounding substance. It is more convenient to consider in the beginning the interaction of white dwarfs, as direct analogues of new particles, with the substance surrounding these stars. It is known, that most of the stars are connected in star pairs. Close double pairs with white dwarfs very often give strong flashes, which are the consequence of substance flow to the white dwarf from the star-partner and the subsequent explosion. The energy of flashes get to the range 10^{32} – 10^{34} J for nova-like stars NL, $10^{35} - 10^{37}$ J for repeated novae Nr, $10^{38} - 10^{39}$ J for novae stars N. We shall translate now these energies into corresponding energies of new particles, for this we should divide the energy in view of data of Table 1 by the coefficient of similarity in energy $Y = \Phi S^2 = 8.5 \times 10^{55}$. As a result we receive energies in a range $10^{-24} - 10^{-16}$ J, with a maximum close to the lowest magnitude just corresponding to the energy of photons of the CMBR. Thus new particles, collecting the smallest substance around themselves, owing to their properties could also generate CMBR themselves.

Exact measurements of temperature of CMBR in different directions in the sky show that the CMBR comes from very large distances. The CMBR likely comes from outside of the Meta-galaxy, from distances, which are much large than 1 Gpc. If we take into account that the energy of photons drops with distance, then the whole curve of the CMBR can be shifted entirely to the direction of the increase of the wavelength.

Between the arrangement of galaxies' clusters and temperature points of the CMBR, there are weak correlations connected with interaction of photons and the substance of galaxies. On the other hand, the sizes of space objects have some spectrum that should be reflected in measurements of temperature difference ΔT of the CMBR between neighboring points, made with change of the angle of the sky overview. The less the angle of the overview is, the less the sky area at each measurement of temperature is. If the angular sizes of the effective sources (or scatterers) of the CMBR coincide with the angle of the overview of the tools for measurement of temperature difference, small peaks of ΔT should be expected. Similar peaks are observed in the decomposition of the power spectrum of CMBR into angular harmonics $l = 2\pi / \theta$, where θ is the effective angle of the sky overview [16]. In the concept of an expanding Universe, such peaks are interpreted as the consequence of the oscillatory heterogeneities, which could have been in the dense substance of the small Universe in the distant past.

From our point of view, the peaks are the evidence of the different degree of heterogeneity of substance distribution existing in the Universe up to the present time. Let us assume that in the parts of space visible to us, there exist objects with the maximal size, such as super-clusters of galaxies. Further, as the size reduces, clusters of galaxies and galaxies themselves will follow. With homogeneous distribution of these objects, we should expect that the nearest super-clusters will on the average be located at the certain distance R_{sg} from us, and will be visible under the average angle of the overview θ_{sg}. At distances less than R_{sg}, we shall see only clusters of galaxies with average distance from us R_{cg}, and the average angle of overview θ_{cg}. The increase of the angle of the overview to more than θ_{sg} will not give resonance, because we assume, for example, that super-clusters of galaxies are the largest objects. If $\theta \approx 1^{\circ}$, $l \approx 360$ for the angular harmonics, and the size of the Meta-galaxy is of order $R_m = 8$ Gpc, then the average size of galaxies' super-cluster will be equal to $R_m \sin\theta = 140$ Mpc. This value is close to the size of cell uniformity in Meta-galaxy substances in Table 2. All subsequent peaks with $l > 360$ in the decomposition of the spectrum ΔT have declining angular scales θ, which correspond to all the smaller objects, from clusters of galaxies, just before galaxies. Besides, the CMBR at very large distances simply cannot reach us because of lessening of the photons' energy. Thus, we consider that the reason for occurrence of peaks in the energy spectrum of CMBR is the presence of substance heterogeneities in the Meta-galaxy and in its nearest environment, irrespective of the concept of the expanding Universe.

10. Luminosity of Matter in a Meta-Galaxy

By means of (7) it is possible to estimate the average rate of generation of electromagnetic energy in a unit volume in space. We shall designate this function as L; its units are W/m^3. We shall place the all-wave energy receiver at the origin of our coordinate system, putting it in the plane *ZOX* for measuring the arriving energy. If the radiating volume is at distance r from the origin of the coordinate system, the effective quantity of energy which falls in the unit of time to the unit area of the receiver, dI, will be

$$dI = \frac{L\exp(-r/s)\sin\theta\ \sin\varphi\ dV}{4\pi r^2(1+k\alpha r)}, \qquad (28)$$

where θ,φ,r are the spherical coordinates of the radiating volume dV.

The exponent in (28) reduces the energy of all electromagnetic quanta upon their passing the distance r according to (7) and (9). The multiplier $(1+k\alpha r)^{-1} \approx \exp(-k\alpha r)$ in (28) reflects the reduction of the quantity of arriving photons due to their dispersion at different angles on new particles, $k \approx 1.5 \text{ to } 4$ [see text near Eq. (26)].

Integrating (28), we obtain the energy flow I coming from a spatial hemisphere of infinite radius to the unit area of the receiver:

$$I \approx \frac{L}{4\pi}\int_0^\infty \exp(-r/s)\exp(-k\alpha r)dr \int_0^\pi \sin^2 Q\ dQ \int_0^\pi \sin\varphi\ d\varphi, \qquad (29)$$
$$= Ls/4(1+k)$$

where according to (9) $\alpha = 1/s$.

Measuring the power of the energy falling on the receiver, it is possible with the known value $s = c/H \approx 4\,\text{Gpc}$ and $k \approx 1.5 \text{ to } 4$, to estimate from (29) the characteristic power of electromagnetic energy developed in the unit volume of the Universe, L. This L can vary in different directions, reflecting the variability of Hubble parameter and substance distribution in space.

11. Evolution of Elementary Particles

In the above part about the similarity of nuclear and star systems, it was said that new particles, as well as nucleons, are the product of development of the Universe, similar to white dwarfs and neutron stars. In this picture, it turns out that both stars and elementary particles have appeared from the substance that was getting more condensed during evolution. The processes of aggregation and accumulation of the substance can occur synchronously in very large volumes of space, as is observed in our Meta-galaxy, providing their relative homogeneity and isotropy.

There is a question: can we find new particles on the Earth if we assume their considerable amount in space and even their prevalence over nucleons? What place is occupied by new particles among known elementary particles?

The analysis of similarity relations between particles in [3] gives the following information. It is known that hadrons include baryons and mesons. The lightest baryon is the nucleon, and the lightest meson – the pion. All hadrons, except for nucleons, are unstable and disintegrate in the course of time. From the point of view of similarity, a neutron star with mass $0.2\,M_c$ (this mass in 6.8 times less than the mass of a neutron star in Table 1) corresponds to a pion, as it is lighter than a nucleon by 6.8 times. However, the substance of neutron stars with such small mass is unstable [17], and therefore such stars should disintegrate. We shall assume that, in the course of time, a neutron star with mass $0.2\,M_c$ will disintegrate to form a hydrogen cloud with mass of the order of mass of the star. This process would be equivalent to the reaction of decay of a pion to a muon and muonic neutrino (antineutrino):

$$\pi^{\pm} \to \mu^{\pm} + \nu_{\mu}\,(\tilde{\nu}_{\mu})\,.$$

Further, as a muon is 8.89 times lighter than a nucleon, a hydrogen star corresponding a muon has the mass $0.16\,M_c$. Decay of a muon to an electron (or positron) and electronic and muonic neutrino take place according to reaction:

$$\mu^{\pm} \to e^{\pm} + \nu_e\,(\tilde{\nu}_e) + \tilde{\nu}_{\mu}\,(\nu_{\mu}) \quad .$$

By means of the data in Table 1 it is possible to estimate the lifetime of neutron stars with small mass – the analogs of pions. Multiplying the lifetime of the charged pions $\tau_{\pi} = 2.6 \times 10^{-8}$ s by the coefficient of time similarity $\Pi = P / S$, we obtain:

$$\tau_{s\pi} = \tau_{\pi}\Pi = 5 \cdot 10^4 \text{ years.}$$

For this time in a neutron star of small mass, we should expect a transformation of substance that would entail its transformation to a star object of large size. The lifetime of muons is 100 times more than pion's lifetime; therefore, for the corresponding stars, the lifetime will be about 10^7 years. As a first approximation, it is possible to assume that for the given time there occurs a compression of the hydrogen cloud. As a result of the compression in the star, thermonuclear reactions begin, and it becomes a star of the main sequence. Thus to the process of radiation of electron and neutrino at disintegration of muon there corresponds emission of the envelop of such star and corresponding radiation. Subsequently the star turns in a helium white dwarf.

In the described picture, hadrons are similar to neutron stars in unstable, stable, or excited conditions. The latter basically concerns the particles-resonances, which by their very short lifetimes correspond to the massive, very hot and unstable neutron stars.

We classify new particles as leptons of muons' type, which at the level of stars correspond to white dwarfs. However we find difference between the leptons obtained on the Earth in experiments on collision of particles, and the new particles that have appeared in the space during natural evolution. This difference results from different ways of formation of muons and new particles – if muons are formed because of disintegration of pions, new particles are formed in the inverse process of aggregation and condensation of substance. Similarly, white dwarfs, being the remains of disintegration of low mass neutron stars, should have strong magnetic fields and should differ from those white dwarfs which appeared from the stars of the main sequence in the course of standard star evolution. If we assume that new particles are not only stable, but also neutral, it will be extremely difficult to discover them with the existing methods.

12. Conclusions

So, we explain the red shift by loss of energy in light quanta in their propagation in space, and the periodicity of the red shift – by approximately identical distances between the adjacent measured objects, repeating again and again in different clusters of galaxies. It is obvious that the explanation of the periodicity of red shifts within the limits of the concept of the expanding Universe is complicated. Really, for two galaxies moving close to each other, the red shift cannot be significantly different as they do not scatter from each other, but they are the components of a pair. At the same time, it is observed on a large scale, with characteristic periodicity of the relative red shift in pairs of galaxies. Precisely the same periodicity is shown, not only in interacting close pairs, but also in an arrangement of galaxies in clusters along the line of sight, as the consequence of their approximately identical space separation.

The occurrence of the two cosmological effects – the red shift and the CMBR – in our opinion occurs due to the action of the uniform space substratum consisting of new particles. The existence of new particles follows from the unified scenario of formation of space objects, from micro-particles up to galaxies, which is based on aggregation of substance and the subsequent scattering of high-energy particles. The electromagnetic energy of the Universe dissipates on new particles, which leads to red shift of the wavelength of photons, and at the same time it is transformed into background blackbody radiation. The other source of CMBR is supposed to be the radiation from the new particles themselves, which is connected with their interaction with the substance of the environment.

The new particles allow us to approach the questions of existence of the dark matter and to the dark energy itself in a different way. Owing to their weak observability, the new particles can make the basis for dark matter. At the same time, it is possible to deny the necessity of introduction of dark energy, explaining the effects attributed to it with the action of new particles.

We find the reason for homogeneity of CMBR in homogeneity of distribution of new particles in the Universe. At the same time, homogeneity of all the remaining substance, and of the electromagnetic radiation connected with it, is also observed on a large scale in the Universe. The specified homogeneities are the consequence of formation and evolution of both the new particles, and all the other elementary particles that exist on the low scale level of the matter.

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