On the Cosmological Redshift

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Abstract. The observed cosmic microwave background radiation is regarded in astrophysics as the evidence in support of the Big Bang model of the development of the Universe, *i.e.*, as the main element of a standard cosmological model. According to the latter the Universe is continuously expanding in a near homogeneous way from a denser hotter state and achieved currently the thermalized state with the 2.728 *K* cosmic background radiation. However, a recent discovery of microwave background radiation of hydrogen atoms compels us to cast doubt on the standard cosmological model that is analysed in this paper.

The following three main causes of astronomical redshirt are distinguished at present: (1) the Doppler effect (Doppler redshirt, classical and relativistic), (2) energy loses in gravitational fields (gravitational redshift), and (3) the expansion of the Universe (cosmological redshift). The latter is the stretching of space (and time) as postulated by general relativity. Emitted waves, moving in that space, are stretched, their wavelengths increase. In the case of visible light, it becomes redder.

The dominant (higher) redshirt, as believed, is due to the cosmological space expansion effect arisen at once after explosion (called the Big Bang) of a “singularity” initiated coming into being our Universe. The Big Bang hypothesis has currently become the basis for standard cosmological model in astrophysics. Thus, following the latter, cosmological redshift is explained as a result of running away galaxies, mainly, due to the supposed expansion of the Universe. Accordingly, sufficiently distant light sources must show redshift corresponding to the rate of increase of their distance *D* from Earth. This is expressed by the Hubble’s law,

$$\upsilon = H_0 D\,, \tag{1}$$

where H_0 is the constant of proportionality (the Hubble constant), and *v* is the recessional velocity (“Hubble velocity”) of a galaxy at a particular distance *D*.

It is assumed that the largest redshift, corresponding to the greatest distance and furthest back in time, is that of the observed cosmic microwave background (CMB) radiation. In this case the redshirt *z* of the source for the observer is defined as the ratio of the difference of a hypothetical “old” temperature (*T*) of the CMB at some reference time (the “look-back time”) and the CMB temperature at present (T_0) to the latter,

$$z = \frac{T - T_0}{T_0}\,. \tag{2}$$

The magnitude

$$1+z=\frac{T}{T_0} \tag{3}$$

is called the cosmological redshirt factor.

All redshifts are usually seen in the spectroscopic observations of astronomical objects. The wavelength λ of a typical background radiation with a blackbody spectrum is inversely proportional to *T*; therefore, cosmological redshirt is equally expressed in wavelengths of the observed (at present) and emitted ("old") CMB radiations, λ_0 and λ_e, respectively.

The CMB was discovered in 1964-65 by Arno A. Penzias and Robert W. Wilson. It is postulated now as radiation supposedly left over from an early stage in the creation of the Universe; and, that is amazing, this supposition is used, in turn, as a landmark confirmation of a validity of the hypothetical Big Bang model of the development of the Universe.

A precise measurement of the CMB was realized by the COBE satellites [1]. The most accurate measurement was achieved by the WMAP experiment [2]. The final estimated CMB temperature is about $T_0 = 2.728\ K$.

We will not consider here all details related to the relevant calculations, but only present the estimated value of cosmological redshirt (the CMB's redshirt) taken from [2], it is about

$$z=1089\,. \tag{4}$$

It implies, as stated in the above reference, the state of the Universe about 13.7 billion years ago, and 379,000 years after the initial moments of the Big Bang. By that time the Universe expanded and cooled down to a temperature of approximately *T*=3000 *K* (strictly in accord with (3)). At such temperature, protons and electrons can combine to form neutral hydrogen, and ordinary matter can coalesce into the dark matter clumps. The waves emitted right after the recombination can now travel undisturbed and are those that we see in the CMB radiation. The Universe becomes transparent. The CMB travels freely from this time until now.

Adherents of the above described model believe that the CMB anisotropy gives a picture of the Universe at that time. It is evident, their reasoning is based on an assumption that the mystic Big Bang has really happened, although they understand that the latter never seen by the observer and, moreover, never can be proved experimentally. If we will follow this model then cosmological redshift must be dominated for objects far outside our Local Group of galaxies; therewith, the farther away, the bigger the apparent velocity.

At the hypothesized redshirt of z = 1089, the CMB's velocity *v* (the radial velocity of the source) estimated with use of the Doppler effect formula (taking into account relativistic effects) [2], $1+z=\sqrt{\frac{(1+\beta)}{(1-\beta)}}$, where $\beta=\frac{\upsilon}{c}$, is practically equal to the phase wave speed of the emitted waves, *i.e.*, the speed of light *c*:

$$\upsilon = \frac{(z+1)^2 - 1}{(z+1)^2 + 1} c = 0.9999983c \tag{5}$$

However, our analysis conducted in [3, 4] convincingly shows that the Big Bang conception, which is in the foundation of modern standard cosmological model, is controversial. Actually, as follows from the calculations presented in the above references (to the point, unquestioned till now) and from a series of resulting effects, the CMB is nothing more than the microwave background radiation of hydrogen atoms abundant in the Universe. This compels us to cast doubt on the above results (see (4) and (5)) and, accordingly, on the modern cosmological model on the whole. We will show this below. In the light of the aforementioned data, the Big Bang concept has now no firm justification and for further use it must be thoroughly debated and reconsidered with taking into account of the new data presented in [3, 4].

Let us turn to the foundations of physics. As follows from the last revelations [5], in a general case, elementary optical spectra are defined by the formula of energetic transitions where there are not customary quantum numbers (integer numbers *n* and *m*), but instead of them there are roots of Bessel functions, *i.e.* right radial solutions:

$$\frac{1}{\lambda} = R_\infty \left(\frac{e_p^2(kr_m) z_{p,1}^2}{z_{p,m}^2} - \frac{e_q^2(kr_n) z_{q,1}^2}{z_{q,n}^2} \right) \tag{6}$$

where

$$e_\nu(z_{\nu,s}) = \sqrt{\frac{\pi z_{\nu,s}}{2} \left(J_\nu^2(z_{\nu,s}) + Y_\nu^2(z_{\nu,s}) \right)}, \tag{7}$$

$$R_\infty = \frac{\upsilon_0}{4\pi r_0 c} = \frac{\alpha}{4\pi r_0}. \tag{8}$$

R_∞ is the Rydberg constant: υ_0 is the oscillatory speed of the first stationary wave shell of the radius r_0 (Bohr radius), $\alpha = \frac{\upsilon_0}{c}$ is the fundamental constant reflecting the scale correlation of conjugated threshold parameters, oscillatory and wave, inherent in wave motion [6] (called in modern physics the fine-structure constant); $z_{\nu,s} = kr_s$ are roots of Bessel (radial) functions $J_\nu(z_{\nu,s})$ and $Y_\nu(z_{\nu,s})$ ($Y_\nu(z_{\nu,s})$ is also called the Neumann function), $k = \frac{\omega_e}{c}$ is the wave number, ω_e is the fundamental frequency of atomic and subatomic levels ($\omega_e = 1.869162505 \times 10^{18}\ s^{-1}$) [5, 7], $\nu = l + \frac{1}{2}$ is the order of Bessel functions, *s* is the number of their zero or maximal values.

Eq. (6) is in essence the generalized spectral formula deduced for the first time in a correct mathematical form unknown earlier in contemporary physics. All particular cases, including spectral series of the hydrogen atom, follow from this formula. Note that (6) does not require an electron (please, have a look at it attentively; it does not contain electron mass and charge). The presence of an electron is not obligatory. Why? According to the dynamic model of elementary particles [7], rest masses do not exist. A mass of an elementary particle has associated wave character and is the measure of wave exchange (interaction) of the particle with ambient. Therewith, an electron, characterized as an elementary period-quantum of the associated mass, is the minimal quantum of the rate of mass exchange, or an elementary exchange charge. It defines the quantum-period of an elementary action (moment of momentum) of the spherical field at the atomic and subatomic levels, and hence, the period-quantum of emitted energy. From this point of view, the H-atoms radiative spectrum is regarded as a result of the rebuilding of associated masses of the atoms: associated masses distinctive in exited states are transformed into associated masses characteristic for equilibrium states that is accompanied with emission of excessive energy.

As a particular case, from (6) it follows an existence of background radiation of the hydrogen atom occurred in a stationary unexcited state, in dynamic equilibrium with ambient. An accurate form of the equation, described the background radiation of the hydrogen atom, taken from [4], is:

$$\frac{1}{\lambda} = R_\infty\left(\frac{1}{n^2} - \frac{1}{(n+\delta n)^2}\right) = R_\infty\left(\frac{1}{n^2} - \frac{1}{\left(n + \sqrt{\frac{2Rh}{m_0 c}}\cdot\frac{e_p(z_{p,s})}{z_{p,s}} - \beta_n \frac{r_e^2}{r_0^2}\sqrt{\frac{2Rh_e}{m_0 c}}\cdot\frac{e_q(z_{q,d})}{z_{q,d}}\right)^2}\right), \quad (9)$$

where

$$h_e = 2\pi m_e \upsilon_0 r_e = 5.222105849\times10^{-28}\ erg\times s \quad (10)$$

is the orbital action of an electron in the equilibrium state (analogous to the Planck action quantum, h) caused by an electron proper rotation around its own centre of mass with the Bohr speed v_0, therewith, $r_e = 4.17052597\times10^{-10}\ cm$ is the radius of the electron wave shell originated from the formula for associated masses [7]; $\beta_n \approx 1$ is the numerical factor, equal to 1 or slightly different from 1. All details concerning the derivation of (9) one can find in [4].

The results of calculations by (9) show that a spectral line of the background radiation of the hydrogen atom in the stationary state ($n = 1$ and $p = q = 0$) has the wavelength

$$\lambda = 0.106315\ cm. \quad (11)$$

This value is within a maximum of an equilibrium spectral density of the cosmic microwave background radiation and corresponds to an absolute temperature of the blackbody of

$$T = 2.72774\ K. \quad (12)$$

It was found as well that differences of the background terms (spectral lines) with high accuracy coincide with the experimental values for the Lamb shifts in the hydrogen atom [4, 8]:

$$L_{1,s} = 8172.837\ MHz, \qquad L_{2s-2p} = 1057.8446\ MHz \tag{13}$$

The latter revelation (obtained without use of hypothetical virtual particles of QED) is an additional firm proof justified a validity of both Eq. (9) and all effects originated from its solutions. The validity of (9) is also confirmed by the fact that on the basis of an approach, lying in the base of its derivation, for the first time in physics the formula of an anomalous magnetic moment of an electron has been deduced, just like the aforementioned Lamb shift, without use of the notion of virtual particles [4, 9]. A calculated value of the anomalous magnetic moment of an electron has turned out with the high precision coincident with the experimental data.

In the light of the aforementioned results, an accepted explanation of the nature of cosmological redshirt in modern physics based on observations of the CMB gives rise to doubt. In particular, we assume that the observed fluctuations in a cosmic microwave background temperature in the space of the Milky Way [2] reflect fluctuations in a distribution of hydrogen there. By all appearances, the density of hydrogen must be higher in the plane of galaxy, than outside - in the ambient space. Actually, microwave background radiation of hydrogen from our galaxy dominates along its plane, where stars and, generally, matter are mainly concentrated. This is clearly seen on the WMAP maps of the sky on the equator; and the radiation is quite small away from the equator.

Thus, on the basis of the data presented in [3, 4], one can state that cosmological redshift does not relate to the mythic Big Bang. In view of this, let us consider an origination of the redshift resting upon the basic concepts of dialectical physics, namely taking into account the wave nature of elementary particles (according to the dynamic model of elementary particles [7]) and internal elementary processes accompanied a generation of quanta-waves by atoms.

A source of light is a wave excitation of a spherical shell (field) of hydrogen atoms, constituents of all atoms of the periodic table, *i.e.*, free hydrogen atoms ($z = 1$) and hydrogen atoms located (and bound) in nucleon nodes of the shells of composite atoms ($z \geq 2$).

Within the bounds, inside polar-azimuth nucleon nodes differently disposed in an internal spherical space of various atoms (of different atomic numbers z), constituent H-atoms have the different relative freedom of motion (oscillations) that conditions the specific clear-cut distinction of their optical atomic spectra one from another. For this reason, the structure of these spectra is qualitatively similar, in some extent, to the optical spectrum of an individual (unbound, free) hydrogen atom. Distinctions of atomic spectra of different atoms depend on the difference in the number and geometrical disposition of completed nucleon nodes in them resulted in a different field structure (configuration) of their internodal bonds and, hence, a multitude of possible forms of intra-nodal oscillations of hydrogen atoms located in the nodes.

The visible spectrum of light from the free hydrogen atom (the Balmer series) displays four wavelengths: 410.2 *nm* (H-δ, violet), 434.1 *nm* (H-γ, violet), 486.1 *nm* (H-β, blue-green), and 656.3 *nm* (H-α, red) that correspond to emissions of electromagnetic energy during transitioning from the upper excited energy levels $n \geq 3$ to the level $n = 2$ (*n* is the principal quantum number).

According to dialectical physics [5], during motion in a transient process, an electron in the hydrogen atom causes the wave perturbation. The myriad of particles of the subelectronic level is involved in this process. They have nothing in common with mathematical points-photons of zero size, zero rest mass, and, correspondingly, zero rest energy. These are a huge world of particles which belong to the level lying below the electron level. For them, Earth is in the highest degree the "rarefied" spherical space. These particles pierce the Earth just freely as asteroids pierce the space of the solar system and galaxies. Just their directed motion, fluxes, called "magnetic field" surrounds a conductor with a current, a bar magnet, our Earth and fills up interplanetary, interstellar, and intergalactic spaces. It is the cylindrical field-space of the subelectronic level [10].

An analysis conducted in [10, 11] shows that it is acceptable to identify neutrinos with subelectronic particles, every of which has the associated mass substantially smaller than the electron mass. These particles fill up cosmic space and are, apparently, those material medium owing to which the propagation of electromagnetic waves is realized in nature. Namely we assume that the propagation of electromagnetic waves (including the light band) in space occurs like propagation of common material waves, for instance, sound waves in an ideal gas. Masses of subelectronic particles, responsible for the propagation of the waves, are turned out to be equal in order-of-magnitude to the masses which were ascribed to neutrinos in last years.

Subelectronic particles of cosmic space (like particles of a gas), oscillating with the speed *v*, represent discrete components of the wave, whereas the propagation of their disturbance (wave motion) with the phase speed *c* (analogous to the phase speed *u* of sound in a gas) is the continuous component of the wave. The wavelength expresses the discrete side of the wave space, defining a natural quantum of its extensiveness, $\lambda = \dfrac{2\pi c}{\omega}$.

As was mentioned above, H-atoms are elementary emitters, determining the structure of optical spectra of all atoms. Energy of a wave quantum of a microgalactic field of the Universe is proportional to the frequency ω; it can be presented as

$$\varepsilon_x = \hbar_x \omega . \qquad (14)$$

In this equality, $\hbar_x = m\upsilon r$ is the moment of momentum (action) of a particle with mass *m* that participates in a wave excitation of a spherical field of hydrogen atoms, both free and bound in nucleon nodes of composite atoms. If $m = m_e$, $\upsilon = \upsilon_0$, and $r = r_0$ are, respectively, electron mass, Bohr speed, and Bohr radius, *i.e.*, parameters of the hydrogen atom in an equilibrium stationary state, then the action

$$\hbar_x = \hbar = m_e \upsilon_0 r_0 \qquad (15)$$

coincides in magnitude with the fundamental constant of physics, the reduced Planck constant, $\hbar = \frac{h}{2\pi}$.

Energy density of the microgalactic field of the Universe is proportional to the frequency ω as well; it is equal to

$$w_\varepsilon = \rho_\hbar \omega, \qquad (16)$$

where $\rho_\hbar$ is the average density of wave action, the constant magnitude, because the action itself is constant.

A wave process, appearing at a level of the multi-dimensional field-space of the Universe, generates waves going into an infinite series of embedded field-spaces of lower and higher lying levels. Accordingly, because of the infinite embeddedness of fields, while moving, wave quanta going deeply inward the field-spaces of the Universe will lose their amplitude and, hence, a total energy with distance. It is a negligibly small effect in a scale of the solar system, and accumulating must manifest itself at huge distances of the cosmic level (at least comparable with and rather exceeding intergalactic distances). The longer these distances, the longer energy looses.

As follows from (16), the wave motion at significant distances in cosmic scale must be accompanied with the decrease not only amplitude and, accordingly, the total energy, but also with the decrease of the average energy density w_ε and, hence, because of the constancy of $\rho_\hbar$, with the decrease of the frequency ω of propagated wave quanta with passed distance.

Insignificantly small energy looses, occurred at relatively small cosmic distances, accumulated during a continuous recession of waves with distance must be noticeable at significantly bigger distances that is observed in reality. By virtue of this, the length of waves, coming from objects far remote from the solar system, turns out to be increased in the red region of the visible spectrum that is detected at present as cosmological redshirt.

The same mechanism naturally reveals the reason, why the night sky is dark for man. The wavelengths increase by a redshirt factor of (1+ z). Since emitted energy varies as 1/λ, redshifted radiation has reduced energy by the factor of (1+ z). So distant stellar objects are not only faint due to their distance, but their observed light loses energy by the (1+ z) factor as well. The largest cosmological redshift ever observed is z = 8.2 [12].

Thus, cosmological redshift takes place due to a decrease in energy density of emitted wave quanta with distance resulted in the decrease of their frequency. What is a possible internal mechanism of this phenomenon? An innate feature of any wave process in any real media, and infinite cosmic space is not exclusion, if we do not regard it as an absolute vacuum (emptiness), is a damping (and finally, a fading) of waves. The extent of this phenomenon differs for various media and depends on distance. A wave damping in natural media leads to

a decrease in amplitude with time (distance). Frequency of damping waves is also reduced as compared with the eigenfrequency of radiation of a wave source.

Thus, as we have assumed, subelectronic particles, oscillating around their equilibrium states in space, are elementary transmitters of disturbances, as discrete parts of a wave process and having masses unequal to zero; *i.e*., they are responsible for the propagation of waves of an electromagnetic spectrum. In such a case, generalities of a theory of oscillations can be applied for consideration to them.

All subelectronic particles, participating in the propagation of disturbance (waves), located along an imaginary line connecting a source with an observer in space (in an approximation of pointlike objects), can be considered as a unit oscillatory system. Then, at a small damping, amplitude of oscillations of the system will decrease with time following the equality

$$x = a_0 e^{-\beta t} \cos(\omega t + \alpha), \tag{17}$$

where β is the damping coefficient, a_0 is the initial displacement of an oscillator (amplitude at an initial moment of time), α is an initial phase of oscillations; ω is the frequency of damping oscillations. The latter depends on the extent of damping and is defined by the formula

$$\omega = \sqrt{\omega_0^2 - \beta^2}, \tag{18}$$

where ω_0 is the eigenfrequency of the oscillating system equal to the frequency of a source of radiation.

A total energy of the system is proportional to amplitude squared; therefore, the energy of the system decreases with time as

$$E = E_0 e^{-2\beta t}, \tag{19}$$

where E_0 is the initial energy of the system at $t = 0$.

Observed frequency of emitted quanta, ω, and frequency of the source for the observer, ω_0, are related with the redshift z as

$$\omega = \frac{\omega_0}{1+z}. \tag{20}$$

Let us to estimate now, on the basis of the formulas presented above, the damping coefficient β of the given system for the quanta emitted from the IOK-1 galaxy (Lyman-α radiation, $\lambda_0 = 121.6$ *nm*) that has been observed with a redshift z = 6.96. This galaxy is considered as one of the oldest and most distant galaxies found in 2006; and it is assumed that its age, about 12.88 billion years, has been more reliable established [13].

At the redshift $z = 6.96$, we have

$$\frac{\omega}{\omega_0} = \frac{1}{7{,}96}. \tag{21}$$

Hence, according to (18), the damping coefficient β for the Lyman-α radiation with the frequency $\omega_0 = \frac{2\pi c}{\lambda_0} = 1.55 \times 10^{16}\ s^{-1}$, has the value

$$\beta = \sqrt{\omega_0^2 - \omega^2} = 0.992\omega_0 = 1.538 \times 10^{16}\ s^{-1}. \quad (22)$$

During a time interval equal to $t = 12.88 \times 10^9\ years = 4{,}062 \times 10^{17}\ s$, an exponent in (19) achieves a magnitude of

$$2\beta t = 6.25 \times 10^{33}. \quad (23)$$

Respectively, during this time, energy of the system at damping oscillations decreases exponentially in $e^{2\beta t}$ times and, in respect to the initial energy E_0, takes the value equal to

$$\frac{E}{E_0} = e^{-2\beta t} = \frac{1}{\exp(6.25 \times 10^{33})} \quad (24)$$

Above obtained magnitudes are within the orders typical for parameters of cosmic scale phenomena.

Conclusion

The above described explanation of the origin of cosmological redshifts is supported by unquestioned strict solutions of the wave equation resulted in the discovery of an existence of microwave background radiation of hydrogen atoms [3]. The latter is independently supported by the fact that the same formula obtained for the background radiation of hydrogen atoms uncovers the true cause of the Lamb shifts in the hydrogen atom [4, 8], as turned out, having nothing in common with mystic virtual particles. Moreover, on the basis of the same wave approach, an anomalous magnetic moment of an electron for the first time was deduced with the high accuracy also without use of mystic virtual particles [4, 9].

The hydrogen concept on the origin of CMB can be independently verified by direct experiments which, we hope, will be designed and performed in the future in connection with this discovery. As concerns the Big Bang conception, alas, the latter cannot be ever verified experimentally in principle. Moreover, as fictitious, this concept must not be used as a trusted basis for explaining any phenomena. But what we see. At the beginning, being unaware of its true nature, the observed CMB is arbitrarily considered as a relict radiation left over the mystic Big Bang, *i.e.* an explanation of the CMB origin is adapted (slanted) in favour of the created Big Bang myth. And in turn, the Big Bang myth itself, at the beginning regarded as allegedly proven indirectly due to an existence of the CMB itself, is accepted (postulated) currently in modern physics as once happened real fact.

What else one can add in this regard? It is nonsense when a real phenomenon is unfoundedly explained with use of a myth, and after all, this phenomenon, conversely, is used as a proof of the reality of the invented myth itself. A vicious circle: a cause of the real phenomenon (the CMB) is arbitrarily considered as the effect of the fictitious phenomenon

(invented myth, Big Bang), and *vice versa*: the effect, in turn, is considered as the cause. There is a mutual substitution of cause and effect, which, furthermore, relate to the different phenomena, real (CMB) and mystic (Big Bang).

Thus, the Big Bang and an allegedly resulting stretching of space are myths just like other created myths as, for example, a myth about virtual particles in quantum electrodynamics, or various fictitious features ascribed, unfortunately, currently to real nature.

In fact, on the basis of the myths physicists create a virtual reality which then is tacitly accepted and, finally, dogmatically considered as an objective reality. It is obvious; something is wrong in methodology of physics if such approaches (rather blunders) can prosper.

In conclusion, basing on the above presented arguments, elucidating the origin of cosmological redshirts, and especially on the discovery of microwave background radiation of hydrogen atoms with the absolute temperature of its blackbody spectrum of 2.728 K [3, 4], one can state that the Universe is not expanding. Accordingly, the Universe is eternal, infinite, and stationary, where all processes are interdependent and conditioned by the causation.

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09.09.2010