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On a Possible Rotational Redshift

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Abstract

During the last decades the critiques on Hot Big Bang Cosmological model have increased, because a series of observational data are not in concordance with it. The Standard Model has been founded on the space expansion phenomenon which in turn have been deduced from the redshift-distance and velocity-distance linear correlations for the large cosmic structures. At the date of its discovery, the redshift was interpreted as being caused by the Doppler-Fizeau Effect and from here, concomitant with its connection with the expansion phenomenon the cosmological redshift was reached. Later, many other causes have been identified which can determine the redshift of the radiation as: the Compton Effect, the differences in the gravitational potential of the universal field and even other intrinsic causes of the matter.

The author make an argumentation showing the possibility of a rotational movement of the visible universe (the Metagalaxy) and demonstrate that this movement can generate a rotational redshift, which is a velocity related redshift caused by the Doppler Effect. It acts in a similar manner with the cosmological redshift and can provide a new explanation for the redshift-distance and velocity-distance correlations, without the expansion being necessary.

Key words: *Metagalaxy, rotation, rotational redshift*

In 2005 a group of well known astronomers and cosmologists took the initiative of organizing a debate concerning the crisis in which the cosmology is found at the beginning of the third millennium.

If the twentieth century will remain in the history of astronomy, astrophysics and cosmology as the century in which it has been discovered the structure and the hierarchical organization of the Universe, this century also ended with a major controversial problem regarding the origin the content and the evolution of the Universe.

The history of a controversial paradigm

The unique development of the methods of scientific investigation in the last hundred years has allowed us to obtain informations from huge distances from space, distances of approximative 13,5 billions light years, using the complete spectrum of electromagnetic radiations. Moreover a part of the investigation equipments has been deployed into space to avoid the bad influences of the terrestrial atmosphere.

After A.H. Fizeau and W. Huggins have noticed in the second half of the 19^{th} century a small shift of the spectral lines to the red part of the spectrum in the light emitted by some stars, compared with the normal position of these lines, they took under consideration the process similar with the Doppler effect observed at some sound waves. Here upon they conclude that the stars at which this Doppler-Fizeau effect is noticed are receding from Earth.

Later, in 1912, V. Sliper has developed a method for the determination of the relative speeds between the sources of cosmic radiation and the terrestrial observers, based on this spectral shift. The same year he reported for the nebula in Andromeda a spectral shift to violet (blue-shift) corresponding to an approaching speed of ~ 300 $Km \cdot s^{-1}$. With this method there have been measured until 1929 a number of 29 radial cosmic speeds. Most of them indicated a spectral shift to red (red-shift), and the receding speeds founded were bigger and bigger [39].

On the basis of these scientific progresses in astrophysics, Edwin Hubble, using the most powerful telescope of that time - the Hooker telescope on Mount Wilson – has found in 1923 that the M31 nebulae in Andromeda is a galaxy and thus the Milky Way is not the unique galaxy in the Universe. After this discovery it has followed an intense hunt for galaxies, in which he and Humason have discovered thousands of such structures. Between 1923 and 1928 Hubble was concerned with the calibration of the intergalactic distances to obtain a scale of extragalactic distances and Humason has determined the radial speed of the galaxies. This was a major step in obtaining some luminous spatial marks, in the determination of the cosmic distances and the understanding of the Universe structure. At that time there have passed only thirty years from the moment when H. Shaply considered our galaxy as the center of the Universe and only a few years from the moment of the debate between H. Shapley and H. Curtis concerning the fact that the nebulae do or do not belong to the galaxy.

Hubble which has discovered and studied a considerable number of galaxies, has found that their redshifts (z) are bigger with the distance of the galaxy D:

$$z \propto D . \qquad (1)$$

Until 1929 it has been succeeded to determine 46 radial speeds and 18 distances [39]. Their correlation has lead to the discovery of a linear law which has the name of Hubble law:

$$v = H_0 \cdot D , \qquad (2)$$

where: v is the receding speed of a galaxy, D is the distance between from the observer and H_0 is the Hubble constant. Later, it has been considered that this “constant” changed its value with time and it become the parameter Hubble (H), the designation as “constant” being however maintained for its present value (H_0).

The Hubble law, along with the theory of relativity - which gave the explanation for the increasing of distance with redshift - have become the principal arguments for the underling of some cosmological models with an universe in expansion. The Hubble linear law has also given the logical arguments for those who rewound the expansion scenario back in time to an original moment of creation of the actual universe.

It is important to mention here that Hubble was an advocate of the steady state model of the universe until 1926 and even after this year he preferred a model without expansion [51].

A. Sandage, one of Hubble biographers, didn’t found in any of the Hubble’s papers, including the synthesis paper “The Readen of the Nebulae” (1936), that Hubble has given some special interpretation to the redshift. For Hubble, the redshift “represents a principle of the nature not recognized until our days”. Although he emphasized many times the importance of the linear feature of his law, Hubble was never tended to consider the expansion to be in a causal connection with some particular moment in the evolution of the universe.

The person who noticed that such a field of linear speeds, which is the universe described by the receding galaxies, allows for all the point in a manifold to be simultaneous in a particular point in the past seems to be O. Heckmann in 1942 [24]. This can lead to an initial singularity.

Along with the increasing volume and quality of observational informations, the theorists have excelled in developing new ideas and revolutionary theories.

First A. Einstein published in 1905 the special theory of relativity, based on "Poincare group" (the Lorentz group). This is in fact the transforming group of the coordinates of the same event between a fixed inertial mark and a moving inertial mark. This theory has also allowed a better description of how light acts. Einstein also published in 1916 the General Theory of Relativity, as a theory of the gravitational field. Based on this theory he made one of the first theoretical cosmological models with – the steady model – in 1917 [8].

Further on (1922, 1924) the Russian scientist A. Friedman used the equations of the general theory of relativity to give the solution of a dynamic universe than can either expand or contract [12]. A few years later, in 1927 the Belgian abbot G. Lémaitre found out the Friedman solutions and presented them in the conferences that took place at Cambridge. With this occasion he suggested for the first time that the Universe could have appeared from a seed of very high density – "the primary atom". Thus came into being the idea that the actual universe have been born from a very strong explosion of the "primary atom" named ironically by Sir Fred Hoyle the "Big Bang". This name was used by the BBC speaker of the science popularization TV program and repeated when this program was again broadcasted. Therefore this term became a real "brand" of the expansionist cosmological model.

At the beginning of the '30s H.P. Robertson starting from the Einstein postulate of the uniform and homogeneous Universe lay the mathematical conceptual basis for a relativistic cosmology. This cosmology was founded on a quadridimensional geometry structured on space-time Riemanniam metric [48]. The general theory of relativity thus served to the estimation of the physical distances between the points on an expanding space. Working on the same research direction A.G. Walker developed the formalism of a manifold in expansion (1936) whose metric was founded on other axioms, different from those of the general theory of relativity [53]. This metric was adopted for the spatial description of all the cosmological models that admit expansion. They form a class of cosmological models named Friedman-Robertson-Walker (FRW).

The Big Bang idea which points towards the moment of creation, was very convenient for the Catholic Church. The Catholic Church declares it to be in accordance with the biblical conceptions in 1951. Moreover, with the occasion of the International Congress of Astronomy at Rome in 1952, the pope Pius XII compared the Big Bang model with a "de luxe" Fiat "… because it is magnificent…"

Thus were created for the Big Bang the most favorable experimental, theoretical, popularization through mass media and support conditions from the most powerful Church. However until 1965, the astronomers and cosmologists were divided in two groups: those who advocated the Big Bang model and those who advocated the Steady State model supported and improved by H. Bondi and F. Gold (1948) and F. Hoyle (1948) [4,26]. Unlike the Big Bang model, the Steady State model allowed considered a non-expanding manifold which describes the universal space as an Euclidian space whose coordinates are not time dependent.

Two events that followed have decisively turned the balance in the favor of the Big Bang. First, the Soviet school of astrophysics through its most important personality – V.A. Ambartumian – officially recognized in 1958 the expansion of galaxies [1]. Then in 1965 when A.A. Penzias and R.A. Wilson accidentally discovered the cosmic microwave background. This radiation was detected as an audio bias which comes from all the directions of the Univese was predicted by many theorists among which: A.S. Eddington [7], A. Herman and R.Alpher (1953) [25], G. Gamow (1961). However, the physicists minimalized these predictions, considering them to be too speculative.

After its observational discovery, the cosmic microwave background radiation was systematically measured in many wave-lengths with more and more refined instruments. We mention the measurements made with the American satellites COBE (1992) and WMAP (2001) which lead to the obtaining of the complete maps for this radiation. These measurements showed that its intensity spectrum is very uniform and that it corresponds very well to the thermalized form of Plank with a value of 2.73 K. The ubiquity and the stability of this signal were interpreted in accordance with the black body theory as being the final stage of a source that acted in the faraway past at the scale of the Universe and then gone – the Big Bang. In other words the cosmic microwave background could be the residual radiation of a huge universal explosion and of the immediate consequent events when matter-radiation decoupling has emerged.

The interpretation of the cosmic microwave background as an observational proof for the Big Bang was the decisive factor that determined the majority of the scientific community to accept the Big Bang cosmology as the standard cosmological model. This model became in time the Hot Big Bang Model (HBBU) and it impose itself in the 7^{th} decade of the last century as the paradigm of the modern cosmology.

The enthusiasm of the cosmologists was however a short one. The echoes of the exceptional discovery of the cosmic microwave background didn't lose their power completely when some problems have already started to appear. These problems were generated by the disagreement between the new observational data and the predictions of the paradigm.

At the beginning of the '70s the astronomers have reported that the rotation velocities of the galaxies are not in accordance with the Newtonian laws of gravity. In other words their rotational movement requires a mass at least ten times bigger than the visible mass in the Universe. The "solution" to this problem came from the theorists. They have invoked the presence of an invisible kind of matter of unknown origin, which they named the "dark matter". Later it was used the term "quintessence" (the fifth Aristotelian essence after fire, air, water and earth). Then it followed nearly forty years of intense research, but the hunt for the "dark matter" has not led to any concrete result. The only certitude we have about this dark matter is that we don't know if it really exists, or it is only an illusory speculative supposition. Although some cosmologists claim that the black matter represents between 90 and 95% from the mass of the Universe, aside from some theoretical models which mention what it could be, we know nothing certain about it. Nevertheless dark matter is considered an explanation for the incompatibility of the paradigm with the observed reality which is designed to save the HBBM.

At the end of the eight decade of the last century, HBBM confronted also other major problems, this time theoretical problems. Among them without going into detail we mention here: the horizon problem, the flatness problem and the problem of the existence of the relict particles required by the Grand Unified Theory (GUT) of the fundamental forces (magnetic monopoles, gravitons and field moduli). To overcome these problems Alan Guth proposed in 1981 the inflation solution [21]. It is defined as a period in the evolution of the early Universe marked by the acceleration of the scale factor of space:

$$\text{INFLATION} \equiv \ddot{a}(t) > 0 \tag{3}$$

This is also a supposition, mathematically demonstrated but for which now any real support has not been found yet.

In 1988 two independent teams of astronomers which interpreted a set of observational data have reached to the conclusion that the expansion of the Universe is accelerated, contrary to the HBBM prediction which consider it decelerated. To give an explanation also for this result, the theorists invoked the presence of a more mysterious "dark energy" which is also an of unknown origin.

Thus we came to the conclusion that we live in a space that expands in an accelerated manner and in which the matter does not only dispersate but it is also found in a quantity ten times bigger than we observe with the modern techniques. Some supporters of the HBBM even propose an Universe composed of ~73% dark energy, 23% dark matter and only 4% baryons grouped in atoms and molecules. In other words, all that we observe in the Universe: stars with their planetary systems, galaxies, clusters and superclusters of galaxies, clouds of cosmic gas and cosmic dust represent only a small part from a big unknown.

It is normal that in the front of such a dilemma, more and more scientists to ask themselves questions concerning the accurate interpretation of the observational data and the objectiveness of the theoretical models. The first and the most justified question is: is the cosmological redshift, initially inferred from the Doppler-Fizeau effect, real? And if it is not, which are the causal alternatives for the radiation redshifts?

We are going to present such an alternative below.

The model of a rotating universe

The discovery of a large number of galaxies in an alert rate in the third and fourth decade of the last century has led us to the concept of Metagalaxy. As the astronomers and cosmologists extend their range of investigation, they realized that only a part of the Universe is accessible for their research. Thus it appeared the concept of Visible Universe, as a part of the Universe. The attempts to answer the question: "what is beyond the Visible Universe?" has moved the debate into the realm of hypotheses and theoretical speculations.

In 1957 H. Everett [9] interpreted the formalism of the Quantum Mechanics in the idea of the existence of some Multiple World. In this view there is a unique Universe but which is separated in more parts. We are a component of a branch in this Universe, which is our Metagalaxy. Other cosmologists, among which F. Hoyle and J.V. Narlikar emitted the idea of an Universe composed of more "bubbles" [27]. This idea was also supported by the physicists who have studied the theoretical implications of the Grand Unified Theory. Without entering in a justificatory analysis and for practical considerations, we shall take in consideration an Universe possibly formed from more similar Metagalaxies. We found this assumption on the fact that Nature has proved us that it always produced from the quarks to the galactic superclusters more specimens of the same kind and never only one of the same kind. This is why we don't find any reason for the World to be limited to our Metagalaxy. Such an Universe corresponds to the model proposed by A.D. Linde [37, 38].

Next we shall analyze only our Metagalaxy which could interact with other Metagalaxies.

We consider our Metagalaxy to be the biggest observable material system, which we are part of, composed essentially by matter in the form of plasma, linked by a gravitational field and structured in macroscopic subsystems which are also gravitationally interacting. These interactive subsystems are represented by the stellar systems, galaxies, clusters and superclusters of galaxies, clouds of cosmic gas and dust and intergalactic space. It has a approximative spherical form with the radius $R_{MG}=1.37\cdot 10^{10}$ l.y.~ $1,3\cdot 10^{26}$ m ~ 4200 Mpc, and for a average density of matter $\rho=10^{-26}$ $Kg\cdot m^{3-}$ it has a mass of:

$$M_{MG} = \frac{4\pi}{3}(R_{MG})^3 \rho \approx 9.2\cdot 10^{52}\,Kg$$

Because we belong to the metagalactic system as enclosed observers and because we don't have access to an external reference system, we cannot know from direct observation if the system is in a state of repose or in one of movement. From here a series of directly unverifiable hypotheses follow concerning the expansion, contraction, rotation or motion when compared to other Metagalaxies.

From all the mechanical motions in nature the rotational motion is ubiquitous in Universe at all scales. We found it starting from the elementary particles such as quarks, leptons and bosons to the cosmic macrostructures such as the metagalaxies and the clusters of galaxies. On the other hand we know from the Generalized Hermenautic Principle that the whole must be understood starting from the integration of the constitutive parts of the whole and we know from the Cosmological Principle that the same fundamental laws must govern not only the parts of the whole but also the whole. Therefore, if we accept the known observational experience and the two mentioned principles, we have no reason to believe that the Metagalaxy does not support a rotational motion around an axis which passes through its center.

The idea of the Metagalaxy rotation isn't a new one. We found it for the first time in 1924 at K. Lanczos [36] and from that time it reappeared often in the papers of many authors among which are: G. Gamow [13], K. Gödel [19,20], S.W Hawking [23], V.A. Ruban and A.D.Chernin [50], V.F. Panov [43], V.A. Korotki and I.N. Obuchov [34], L.P. Fominsskiy [11], A.V. Gluşkov [14] etc. The theorists have intuited this kind of motion and they have even elaborated some cosmological models with rotation and the empirists have inferred the rotation through their observational data.

From the first class of scientists we must remember K. Gödel who presented in 1950 a cosmological model with an infinite universe, without expansion but with rotation [20]. In this universe every point is rotating around an axis X^3 from a reference frame q (x0, x1, x2, x3). The tests of the cosmological models with rotation has independently led more researchers to estimate some rotation speeds for the metagalaxy $\omega \sim 10^{-11} - 10^{-12}$ rad yr^{-1} ($10^{-18} - 10^{-19}$ rad s^{-1}) [42,43]. Other scientists have calculated a rotation angular momentum [40, 41, 43] and they have showed the possibility of a geometrical interpretation of this rotation [35, 31].

The analysis of a large number of observational data also has suggested the fact that the Metagalaxy has a rotation motion. The first arguments were given by P. Birch in 1982. He studied the emission of radio waves for 132 strong radio sources [3]. He measured the position angles of these sources and the polarization inferred from the anisotropy of radiation and he found a difference between these position angles and the polarization found when compared to their position of the sources on the sky. This difference has been interpreted as an effect of the Universe rotation with a velocity $\omega=10^{-13}$ rad yr^{-1}. This result was initially disputed by Phinney and Webster [45] who reanalyzed next year their data and confirmed the interpretation given by Birch [46]. This confirmation has been also made by other researchers e.g. Kandall and Young [33] or Bietenholtz and Kramberg [2]. Later, C. Wolf has analyzed the rotation of the polarization plane of the electromagnetic waves which was indicated by many studies and he consider, among other possible causes (the quantum gravity, the intrinsic gravity of the space-time etc.)[54], the existence of a preferential axis of the Universe – the rotation axis [54].

The results of an extended study published in 2005 by A.V.Glushkov, brought evidence in the same direction. Glushkov studied the spatial distribution of 48921 quasars, 16133 Seyfert galaxies with the redshift $z \leq 6$ and 535 galactic superclusters from the Veron-Celty Catalogue [52]. He found a non-uniform distribution of the cosmic matter i.e. an anisotropy at global scale for the distribution of the analyzed structure and also a large discrepancy of the quasars with the Hubble law. The explanation for these findings is, along with the contribution of the gravitational potential, the rotation of the metagalaxy. This rotation is performed around an axis which corresponds to the small N-S diameter of the Metagalaxy. The concentration of some black holes near the poles of the metagalaxy is considered to be a supplementary proof for the rotation compare to a supposed axis of rotation and a geometric center of the Metagalaxy, our galaxy has an excentric position [14].

Other scientists bring as a support for this hypothesis the line up of the galaxies with the principal plane of the superclusters [6, 10, 15, 16, 32] just as the bipolar anisotropy which results from the maps of the cosmic microwave background radiation of 2.73K.

Next we are going to consider the Metagalaxy to be a undistortionable sphere with the radius R_{MG}, the mass M_G, the mean density ρ_{MG}, the rotation velocity ω_{MG}, with a homogeneous distribution of matter in an isotropic space at the global scale. Such a sphere in rotation has an angular rotation momentum:

$$I = \frac{2}{5} M_{MG} \cdot R_{MG}^2 \cdot \omega_{MG} \cdot \tag{4}$$

On the other hand Muradyan [40.41] which interpreted the rotation of the metagalaxy exclusively using the matter criterion has considered a rotation momentum:

$$I = \left(\frac{M_{MG}}{m_p} \right)^{\frac{3}{2}} \hbar , \tag{5}$$

where: m_p is the proton mass=$1.672622 \cdot 10^{-27}$ Kg and $\hbar$ is reduction Plank constant=$1.055 \cdot 10^{-34}$ m^2 Kg s^{-1}.

From (4) and (5) we can obtain the rotation velocity:

$$\omega_{MG} = \frac{\left(\frac{M_{MG}}{m_p} \right)^{3/2} \hbar}{\frac{2}{5} M_{MG} R_{MG}^2} = \frac{5 M_{MG}^{1/2} \hbar}{2 m_p^{3/2} R_{MG}^2} \ . \tag{6}$$

We introduce the values from above in (6) and we obtain:

$$\omega_{MG} = 0.0629 \cdot 10^{-18} \,\mathrm{rad\,s^{-1}} \cong 2.2 \cdot 10^{-12} \,\mathrm{rad\,yr^{-1}} .$$

The rotation velocity of the Metagalaxy must satisfy two conditions. The first is the condition imposed by Poincaré [47], in which the centrifugal force caused by rotation must equilibrate with the gravitational force applied to an unitary mass located on the surface of the metagalactic sphere. The second condition is a condition of limit that imposes the peripheral velocity of a point located on the surface of the metagalactic sphere to be smaller than the speed of light.

The stability condition can be written as:

$$m \omega_s^2 R_{MG} = \frac{G M_{MG} m}{R_{MG}^2} \ . \tag{7}$$

where G is the Newton gravitational constant = $6.672 \cdot 10^{11}$ m^3 $Kg^{-1} s^{-2}$.

From (7) we obtain the value for the rotation the expression for the stability condition:

$$\omega_s = \left(\frac{G M_{MG}}{R_{MG}^3} \right)^{\frac{1}{2}} \ . \tag{8}$$

After the introduction of the values and calculations, from (8) we obtain:

$$\omega_s = 1.67 \cdot 10^{-18} \,\mathrm{rad\,s^{-1}} = 5.27 \cdot 10^{-11} \,\mathrm{rad \cdot yr^{-1}} > \omega_{MG}$$

The ratio $\frac{\omega_S}{\omega_{MG}} = \frac{5.27 \cdot 10^{-11}}{2.2 \cdot 10^{-12}} \approx 2.39 \cdot 10$. Therefore, the maximal centrifugal force caused by rotation, which is proportional with the square of the rotation velocity, is for the conditions of stability ~ 571 times bigger than the centrifugal force induced by the rotation of the Metagalaxy, and thus its stability is ensured. In the same time it can be noticed that the action of gravity is not compensated by the centrifugal force. Others are the force fields that equilibrate the action of the gravitational field so that the Metagalaxy cannot collapse. It is likely that among these forces the electromagnetic interaction plays an important role.

The limit condition imposed by the velocity of light can be written for the periphery of the galaxy as:

$$v=\omega_{max}R_{MG}\leq c \,, \qquad (9)$$

where: c is the speed of light=$2.99792458\cdot10^8$ m s^{-1} and ω is the maximum possible rotation velocity. From (9) results:

$$\omega_{max} \leq \frac{c}{R_{MG}} \leq \frac{2.99792458 \cdot 10^8}{1.3 \cdot 10^{26}} \leq 2.31 \cdot 10^{-18} \text{rad} \cdot \text{s}^{-1} \cong 7.29 \cdot 10^{-11} \text{rad} \cdot \text{yr}^{-1}$$

It can be found that $\frac{\omega_{max}}{\omega_{MG}} = \frac{7.29 \cdot 10^{-11}}{2.2 \cdot 10^{-12}} = 3.31 \cdot 10$. Also this condition is satisfied by the rotation velocity of the Metagalaxy which is about 33 times smaller than the critical velocity.

However the value for ω_{MG} found by us is comparable with the values indicated by the above mentioned authors.

At the rotation velocity ω_{MG}= $2.2\cdot10^{-12}$ rad yr^{-1} it corresponds a rotation period: $T = \frac{2\pi}{\omega_{MG}} \cong 2.86\cdot10^{12}$ yr. V.G. Krechet and I.V. Sandina have calculated for the Gödel Model of the Universe $T\approx2.6\cdot10^{11}$ yr. i.e. with an order of magnitude smaller [35].

If we take into consideration the rotation velocity of the Metagalaxy, we found that it determines a difference in the peripheral speed for the objects located at distance difference of 1Mpc compared to the rotation axis equal with:

$$\Delta v= \omega_{MG} \cdot\Delta r=0.069\cdot10^{-18} \cdot3.085671\cdot10^{20}\cong21.3 \text{ Km s}^{-1} \text{ Mp}^{-1}$$

This peripheral speed produces a radial component along the visual path of an observer located in a random point of the Metagalaxy which can be interpreted as receding speed of the source (fig. 1).

The possible effects of a rotation motion of the Metagalaxy can be at a global scale the emergence of a centrifugal force upon the gravitational field and of an apparent radial speed component, which acts as a receding speed. At local scale they can be: the vacuum asymmetry, the formation of some Coriolis forces and for the radiation, a velocity related rotational redshift.

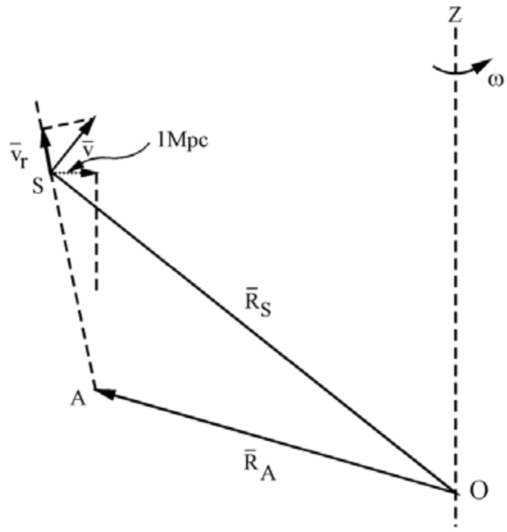

Fig. 1. The apparent recession velocity $\overline{v}_r$ as a radial component along the visual radius A-S of the peripheral speed $\overline{v}$: A – the observer; S – the radiation source; R_a and R_s are the polar radii for the two cosmic objects

The rotational redshift and its implications

In the next part we are going to demonstrate that between a random source of electromagnetic radiation and an observer, both having known metagalactic coordinates, the distance traveled by the photons is bigger than the real distance between the two cosmic points, if the Metagalaxy is in rotation. This path difference is equivalent to a recession of the observer from the source during the travel of the cosmic radiation. It creates the semblance of a receding speed of the source whose physical effect is the redshift of the radiation through the Doppler-Fizeau effect.

Let us suppose that the Metagalaxy is a undistortionable at the global scale, composed by plasma maintained in equilibrium by a mixed gravitational-electromagnetic field. This sphere of radius R_{MG}~$1.3\cdot10^{26}$ m (~4200 Mpc) and mass MG~$9.2\cdot10^{52}$ Kg, is in a rotation motion around an OZ axis oriented along the N-S diameter. Its motion is in the counterclockwise direction with an angular speed ω. Any point P in the interior or on the surface of this sphere has a univocally determined univocal position through its metagalactic coordinates: the polar radius R_P, the longitudinal metagalactic angle θ_P, and metagalactic latitude φ_P. These metagalactic coordinate can be written as P (R_P, θ_P, ϕ_P) (fig. 2).

We make the convention that the manifold of the Metagalaxy is not expanding and it acts at a global scale as an Euclidean space which admits a Newtonian mechanics. We consider in the interior of the Metagalaxy at a random moment t a source of electromagnetic radiations S(R_S, θ_S, ϕ_P) and in the same moment an observer A (R_A, θ_A, ϕ_A). The radiation emitted by the source is received by the observer at the moment t_0, after it traveled the distance between the source and the observer. Because of the rotation of the Metagalaxy, in this time interval $\Delta t=t_0-t$, the observer has moved to the point A_0 (R_{A_0}, θ_{A_0}, ϕ_{A_0}) describing a circle arc with the corresponding angle at center $\alpha=\omega(t_0-t)$. From this reason the distance D_0 from the source to the observer c travelled by the radiation in the time interval Δt is different from the real distance D between the two cosmic bodies (fig. 3).

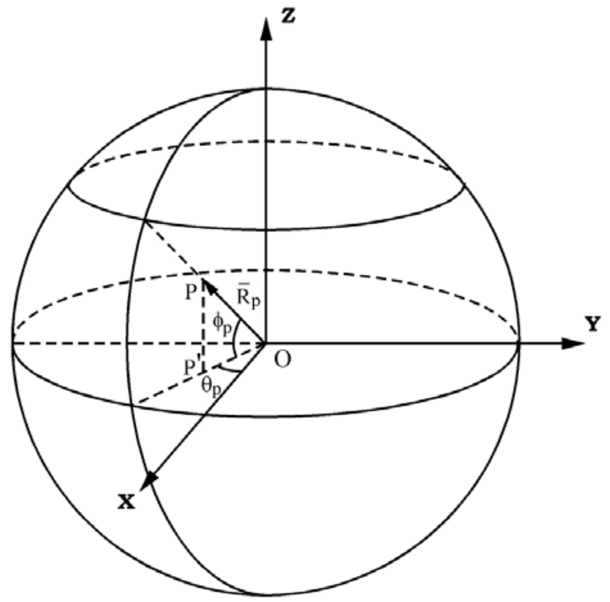

Fig. 2. The polar coordinates of a point P located in the Metagalaxy

The position of the two bodies is determined through the position vectors $\overline{R}_S$, $\overline{R}_A$ and $\overline{R}_{A_0}$ and the distances between them through the vectors $\overline{R}_{AS}$ and $\overline{R}_{A_0S}$. As vectorial expressions these distances are:

$$D=\overline{R}_{AS}=\overline{R}_A-\overline{R}_S \ , \tag{10}$$

$$D_0=\vec{R}_{A_0S}=\overline{R}_{A_0}-\vec{R}_S \ , \tag{11}$$

from which results the path difference:

$$\Delta D=\Delta\overline{R}=\overline{R}_{A_0S}-\overline{R}_{AS}=\overline{R}_{A_0}-\overline{R}_S-\left(\overline{R}_A-\overline{R}_S\right)=\overline{R}_{A_0}-\overline{R}_A \tag{12}$$

If we project these vectors on the three axes of Cartesian reference system with the origin in the center of the Metagalaxy (12) can be written:

$$\Delta\overline{R}=\left[\sum \bar{j}_i^2\left(x_{i_{A_0}}-x_{i_A}\right)^2\right]^{1/2}, \tag{13}$$

where the indexes i=1,2,3 indicate the projections of the vectors on the three axes x_1=x, x_2=y, x_3=z and $\bar{j}_i$ are the versors of the three coordinate axes.

With the rotation motion of the Metagalaxy, the observer is moving on the circumference of a circle which is parallel with the latitude φ_A of the sphere with the radius $\overline{R}_A=\overline{R}_{A_0}$. As a consequence all the successive position of the observer have the same latitude ($\phi_A=\phi_{A_0}$) and the projections of the vectors $\overline{R}_A,\overline{R}_{A_0}\ldots$ on the OZ axis are equal: $Z_A=Z_{A_0}=R_A\sin\phi_A$. That s why in the equation (13) the difference between the vectors and the OZ axis is 0 and it can be written as:

$$\Delta\overline{R}=\left[\bar{j}_1\left(x_{A_0}-x_A\right)^2+\bar{j}_2\left(y_{A_0}-y_A\right)^2\right]^{1/2} \ . \tag{14}$$

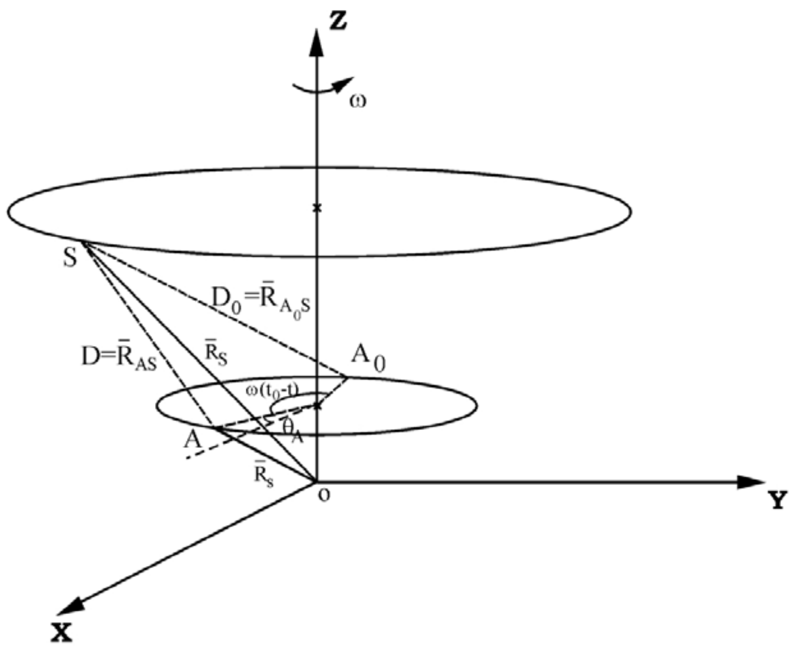

Fig. 3. The distance D_0 crossed by the radiation from the emission moment t until the reception moment t_0 is different from the real distance D between the source S and the observer A.

We make the transformations to polar coordinates and we can write:

$$\bar{x}_A = \bar{j}_1 R_A \cos\phi_A \cos\theta_A \tag{15}$$

$$\bar{x}_{A_0} = \bar{j}_1 R_A \cos\phi_A \cos[\theta_A + \omega(t_0 - t)],$$

from where it results that:

$$\bar{x}_{A_0} - \bar{x}_A = \bar{j}_1 R_A \cos\phi_A [\cos(\theta_A + \omega(t - t_0)) - \cos\theta_A]. \tag{16}$$

In the same way:

$$\bar{y}_A = \bar{j}_2 R_A \cos\phi_A \sin\theta_A \tag{17}$$

$$\bar{y}_{A_0} = \bar{j}_2 R_A \cos\phi_A \sin[\theta_A + \omega(t_0 - t)],$$

from where results:

$$\bar{y}_{A_0} - \bar{y}_A = \bar{j}_2 R_A \cos\phi_A [\sin(\theta_A + \omega(t_0 - t)) - \sin\theta_A]\ . \tag{18}$$

Next, introducing (16) and (18) in (14), squaring, making the sum and appling the trigonometric relations between the angular functions, we obtain:

$$\Delta\bar{R} = \bar{j}_{1,2} R_A \cos\phi_A \sqrt{2(1 - \cos\omega(t_0 - t))}\ . \tag{19}$$

From (19) we realize that the scalar of the radiation path difference depends on the distance between the observer and the center of the Metagalaxy $R_A\cos\varphi$ and the angle of metagalactic longitude $\omega(t_0\text{-}t)$ described by the observer from the moment of the radiation emission to the moment of its arrival. This path difference is bigger as the observer located further from the axis of rotation and in a position closer to the equatorial plane of the Metagalaxy. The influence of the rotation speed and of the time requested by radiation to reach the observer is presented in table 1.

Table 1. The influence of the angle $\omega(t_0\text{-}t)$, described by the observer during the travel of the radiation from the source to his position on the path difference crossed

$\omega(t_0\text{-}t)$	0	$\pi/4$	$\pi/2$	$3\pi/4$	π	$5\pi/4$	$3\pi/2$	$7\pi/4$	2π
$\cos\omega(t_0-t)$	1	$\frac{\sqrt{2}}{2}$	0	$-\frac{\sqrt{2}}{2}$	-1	$-\frac{\sqrt{2}}{2}$	0	$\frac{\sqrt{2}}{2}$	1
$\sqrt{2(1-\cos\omega(t_0-t))}$	0	$\left(2-2^{1/2}\right)^{1/2}$	$2^{1/2}$	$\left(2+2^{1/2}\right)^{1/2}$	2	$\left(2+2^{1/2}\right)^{1/2}$	$2^{1/2}$	$\left(2-2^{1/2}\right)^{1/2}$	0
$\frac{\Delta R}{R_A\cos\phi_A}$	0	0.765	1.414	1.848	2	1.848	1.41 4	0.765	0

The positive path difference ΔR, crossed by the radiation which is moving from the source to the observer compared with the real distance between the two bodies, is due to the recession of observe from the source as a consequence of the hole system rotation. The path difference is bigger as the time during which the radiation is traveling is bigger i.e. as the source is farther. This path difference can cause a velocity related redshift through the Doppler-Fizeau effect. We name this redshift here a rotational redshift.

The existence of the rotational redshift implies the existence of another cause for the redshift, other than the cosmologic one and it proves that the recession of the galaxies is an apparent phenomenon which was deduced from an exclusivist interpretation of the observational data.

Conclusions

The supporters of the Big Bang paradigm based their cosmologic model exclusively on the interpretation of the radiation redshift as cosmological redshift caused by the space expansion. To support the expansion, which it is not proved by any other observational data, they ignore the possibility of any other cause that could produce the redshift, including the rotation of the Universe.

In our paper we have assume a model for the visible Universe (Metagalaxy) with rotation, considering that it is developed in an isotropic Euclidean space. We have imposed these conditions for a better understanding of the role played solely by rotation in the redshift generation. It was proved here that a rotation of the Metagalaxy can produce a rotational redshift. Alone the rotational redshift is not an alternative to the cosmological redshift, but it is an explanation for a part of the total redshift. Its value depends on the velocity speed ω_{MG} and on the observer position compared with the axis of rotation. In addition the rotational redshift gives an explanation for a part of the recession velocity of the galaxies and the quasars. This apparent velocity depends on the position of the radiation source and of the observer when compared to the center of the Metagalaxy.

The possibility for the existence of a rotational redshift, indicated for the first time by us, demonstrate that the cosmological redshift can have some alternatives. There are indeed more causes that could produce this phenomenon and thus more types of redshift. All these gathered together lead to a total redshift. This problem is the subject of another paper.

The existence of an alternative to the cosmological redshift imposes the necessity of finding another alternative to the Big Bang cosmological paradigm.

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Asupra unui posibil redshift rotațional

Rezumat

În ultimile decenii s-au înmulțit criticile asupra modelului cosmologic standard al big bang-ului fierbinte, deoarece o serie de date observaționale nu concordă cu acesta. Modelul standard a fost întemeiat pe fenomenul expansiunii spațiului care la rândul său a fost dedus din corelațiile liniare redshift-distanță şi distanță-viteză a marilor structuri cosmice. La data descoperirii, redshiftul, a fost interpretat ca fiind datorat efectului Doppler-Fizeau şi de aici s-a ajuns, odată cu legarea lui de fenomenul expansiunii, la redshiftul cosmologic. Mai târziu au fost evidențiate multe alte cauze care pot provoca redshiftarea radiației, precum: efectul Compton, diferențele de potențial gravitațional ale câmpului universal şi chiar cauze intrinseci ale materiei.

Autorii fac o argumentare arătând posibilitatea unei mişcări rotaționale a universului vizibil (metagalaxiei) şi demonstrează că această mişcare poate genera un redshift rotațional, care este un redshift vitezist datorat efectului Doppler. El se comportă asemănător redshiftului cosmologic şi poate furniza o nouă explicație pentru corelațiile redshift-distanță şi distanță-viteză, fără ca expansiunea să fie necesară.