Dark Energy as a Key Player in the Evolution of Cosmic Objects

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Abstract

Researchers have been searching for the speed at which the universe's expansion is slowing for decades. The dominant cosmological model predicted the inevitable process of braking. The discovery of the opposite process should have alerted researchers. However, the basic cosmological model has not changed at all. Although it is estimated that approximately 70 percent of all existing mass energy is dark energy, its role is not fully understood. In this paper, we show that the evolution of cosmic objects and their systems at all hierarchical levels occurs due to the interaction of ordinary matter with dark energy. Moreover, the interaction also increases the mass of ordinary matter. The mass increase occurs due to the conversion of some part of the dark energy into mass. Namely, it happens both due to a decrease in the mass defect of atomic nuclei and because of the fission of the same nuclei. It is noted that the role of dark energy should be studied much deeper than is currently being done, considering the known laws of physics.

Keywords: *Dark energy, baryon matter, interaction, energy exchange; activity phenomena, energetic resources.*

1. Introduction

Scientific schools form and develop based on several hypotheses and a main paradigm as the backbone for all overlaying theories and models. Over time, the theoretical models can be lightly modified due to the new empirical data but the main ideas remain unchanged. In other words, any scientific school carries out its inertial system of thinking. That is natural since any global change in the scientific backbone makes a revolutionary changing the whole main ideas which is undesirable for any scientific school.

Modern cosmology is based on two key ideas - the Kant-Laplace hypothesis (KLH) about the space objects' formation and the Big Bang hypothesis (BBH). Everything that we observe and measure, which relates to space objects, their systems, and ways of their evolution, clearly or implicitly agrees with these instruments and what follows from their application. If any observational data contradicts the key ideas, a new physical factor is usually invented to fit the scientific backbone. This method of free parameters can provide any fitting you need for the desired limited time interval and space volume. This method was first applied by Ptolemy in his geocentric system of the Universe, using many free parameters to construct his system of the world.

When in the 30s of the last century Fritz Zwicky, one of the brilliant astrophysicists discovered that the velocity dispersion of galaxies in the clusters is very high for stability, required inexplicitly by the KLH, he suggested the well-known hypothesis on the existence of dark matter ((Zwicky, 1933, 1937). It happened almost a century ago, then it was a convenient tool parameter in various unresolved problems and became irreplaceable for the interpretation of galaxies' rotation curves. It was accepted a priori that dark matter was everywhere, although it has not been revealed until now.

Equally suitable for many physical situations appeared to be the gravitational tool called black holes. It became intensively usable after two centuries of its description by John Michell. At the end of the last century, astronomers were still very cautious when speaking about black holes, located within real astronomical objects. However, the situation changed rapidly, and a black hole of the appropriate mass in the center of cosmic objects became a sign of a good scientific manner. It was needed both for energetic and gravitational issues.

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On the other hand, nobody was looking for dark energy ((Perlmutter et al., 1999, Riess et al., 1998). At least, after the discovery of the Universe expansion when the antigravity term in Einstein's equation of gravity lost its importance, it became not actual. In 1997 Alan Sandage published a list of 21 key problems, to be solved in the 21st century, and the problem of determining the rate of deceleration of the Universe expansion was on his list. Amazingly, the next year the first paper on the acceleration of the Universe's expansion was published. So, it was something that nobody was looking for. Dark energy was introduced as the only player required to accelerate galaxies' recession velocity. In other words, the acceleration of galaxies is happening due to interaction between the dark energy carrier, whatever it is, with baryonic objects, i.e., galaxies.

This paper considers the physical consequences of the interaction between the baryonic objects and the carrier of dark energy. Unlike the cases listed above, the introduction of dark energy itself, if we consider it in a self-consistent way, is dictated by natural laws but not accepted a priori hypotheses. However, an issue exists to emphasize always when this energy is under discussion. This is the fact that the interaction between baryonic matter and the carrier of dark energy is encoded in the method of its discovery or making a cosmological tool. Indeed, it could not be revealed or introduced without observed acceleration of galaxies which in turn resulted from the interaction between these two types of substances. Then, if the baryonic objects interact with the carrier of dark energy, one should consider the physical consequences of such interaction obeying the physical laws and regularities.

2. Energy of baryonic objects vs dark energy.

The total energy of all cosmic objects and their systems is accepted to be negative based on their stability. The stability paradigm has been used for a long time and is one of the cornerstones of modern understanding of the Universe construction. One should analyze all the relevant physical processes, occurring in these objects and their systems at all hierarchical levels, to consider the possibly accurate physical picture backed by physical laws and objective facts.

Modern physics suggests that dark energy fills all space at all geometrical scales homogeneously with very low density. According to the definition, dark energy is purely positive since it implements physical work accelerating the Universe's expansion.

It does mean that two interacting systems, representing the baryonic world with its objects and various aggregates of the objects from one side and the carrier of dark energy from the other side differ dramatically. The first one possesses positive energy, implementing work and the second one is characterized by a lack of energy. Then the second law of thermodynamics states that the first one should transfer some portion of energy to the second one.

The result of such interaction is seen in the cosmological scales as the acceleration of galaxies' removal. Therefore, it was revealed comparatively easily, like how the Universe expansion effect was discovered in the 30s of last century. However, there was no hint about the expansion effects at the smaller scales. There were two main reasons for this. First, expansion effects should be negligibly small, if any, especially for cosmic systems like our planetary system considered a balanced one. Second, the dominant paradigm of stellar and galactic cosmogony is based on the KLH, requiring that all objects and their systems are formed from rare clouds possessing negative total energy, and, therefore, they can't expand after reaching a balanced state.

It could be expected that the discovery of dark energy should change drastically all the approaches to old problems of cosmology and cosmogony. Indeed, a new reservoir was found which contains around 70 percent of all mass/energy of our Universe. It should be kept in mind if we consider the behavior of the much smaller part, interacting with it and gaining some non-zero portions of energy from it. Energy is a cumulative quantity which means that in the process of interaction, it accumulates in the objects and can reach a noticeable amount even if its density is very low. Then one should consider the problem in much more detail. Let us write the virial theorem (VT) for any system of cosmic objects, which has the following form:

$$W = 2T + U, \tag{1}$$

where $T$is the kinetic energy, and U is the potential energy of the system. Any system of objects is balanced if the virial theorem is zero. The system is contracting, if VT is negative, and it is expanding when it is above zero. Then, let us suppose the systems of cosmic objects have reached a balanced state sometime during their formation process, as the adopted hypotheses state. Even in that case, they will inevitably

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gain an energy portion, $\Delta E > 0$ during the time, and the virial theorem should be positive. Moreover, the portion $\Delta E > 0$ should gradually increase over time while the interaction between two substances continues.

Therefore, we conclude, that in the presence of dark energy, all systems of baryonic objects should be expanding or should become expanding independently from the size of the system. On the other hand, it does mean that one should look for expansion effects at smaller scales, especially in gravitational systems, which are considered balanced ones from the traditional point of view. In not balanced systems it should be extremely complicated to reveal geometrical changes equal to the Hubble growth of lengths amounting to 7.0×10^{-11}per year.

Starting the comparative study of the influence of dark energy on various systems one should keep in mind that modern science considers dark energy homogeneous for all scales. It does mean that its total amount in any volume is proportional to that volume. Consider a spherical baryonic object of mass M and radius R. Its volume is

$$V_s = \frac{4\pi}{3} R^3. \tag{2}$$

Then the amount of dark energy in this volume should be $E_{de} = V_s \rho_{de}$, where $\rho_{de}$is the density of dark energy. The gravitational energy maintaining the object's integrity has the following form:

$$E_{gr} = -kG\frac{M^2}{R}. \tag{3}$$

One can introduce a coefficient

$$\eta = \frac{|E_{gr}|}{E_{de}}, \tag{4}$$

showing, let's say, the "measure of resistance" (MoR) of this object. The bigger this coefficient, the more resistant the object to changes forced by dark energy. It is easy to find then that

$$\eta \sim \frac{\rho_{gr}^2 R^2}{\rho_{de}}, \tag{5}$$

where ρ_{gr} is the average density of the given baryonic object. The MoR for a family of objects possessing different masses does not change with the mass of $\rho_{gr} R = const$. It increases with mass if $\rho_{gr} R$ grows up with radius and decreases in the opposite case. For instance, this coefficient for the Sun is about 25 times greater than the one calculated for the Earth. The same coefficient can also be calculated for stellar systems including galaxies and their clusters.

3. The Earth-Moon system.

Perhaps the binary system Earth-Moon is one of the cosmic systems studied most minutely. It is well established that the Moon retreats from our planet at a rate 3.82 ± 0.07cm per year (Dickey et al. (1994)). Traditionally this speed is explained using the tidal mechanism. There is no doubt, that the tidal mechanism is a correct working instrument for the mentioned physical process. However, there is an issue that makes this mechanism vulnerable. The angular momentum lost by our planet is not enough to provide the mentioned rate of the Moon's retreat. It is easy to show, that there is a lack of angular momentum of about 25 percent even if we assume that no other losses occur.

The researchers, who are aware of the history of this hypothesis, know also, that initially, the situation was not so critical. All estimates of the lunar retreat had given much lesser value to its rate and the deceleration of the Earth's axial rotation, on the contrary, was accepted to be greater. However, the improvement in measurement accuracy over time gradually changed the situation making it worse. Therefore, the situation at present requires new approaches. A needed solution may be the influence of dark energy, which injects a certain portion of energy into the Earth-Moon system. The received additional energy expands the system. Since we do not know how much is the injected energy, we can use the geometrical effect of expansion observed for galaxies as the first approximation and make a scale transformation for the Earth-Moon distance.

We have considered this problem in detail, involving all the effects relevant to this issue, including the possible increase in the radius of the Earth. By the way, many researchers usually criticize the hypothesis on the growth of the Earth's radius, emphasizing that such an effect could be noticed by observing the corresponding changes in the coordinates of the quasar, proceeding from the assumption that the increase in the radius of our planet should be resulted by its inflation affecting the radio telescopes basement. However,

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the radius of the Earth can also increase due to the ejection of a corresponding amount of matter, which does not change the direction of radio telescopes. This is a separate issue, which can be considered in detail.

Our calculations show, that all the modern observational data available explain the lunar removal in a self-consistent way, showing also the contribution of each physical mechanism. Applying this approach, one concludes that the tidal mechanism provides only about 30 percent of lunar retreat while the dark energy gives the rest. No contradiction or lack of angular momentum appears. Moreover, this absolute accordance has been established only owing to improved observational data during the last decades. About forty years ago we could not notice this accordance.

4. Growing of the Astronomical Unit.

Another expansion phenomenon is connected with the enlargement of the Sun-Earth distance. According to the measurements, the average distance between our planet and the Sun increases on a tiny interval of 15 cm (Krasinsky & Brumberg (2004)). Although this is a small value, the known physical mechanisms cannot explain this removal. Therefore, some researchers try to use the tidal mechanism, though there is no observational data on the deceleration of the Sun's axial rotation. So, using this mechanism, one can use a sufficient number of free parameters to construct any convenient model.

We proceed from our conclusion that the Sun-Earth system should expand due to interaction with the dark energy carrier. Suppose one accepts the same geometrical approximation for calculating the Sun-Earth distance enlargement, as we did for the Earth-Moon distance. In that case, one finds a much larger value than the observed one – about 10.5m ((Harutyunian & Grigoryan, 2018)). The difference is two orders of magnitude! This seems to be a catastrophe for the physical picture we are presenting here.

It is evident that there are two possible versions, namely, our reasoning on the interaction between baryonic matter and the carrier of dark energy is not correct (not well-grounded) or there exists some physical mechanism not taken into account. Let's suggest the second version. From the general physical reasonings, one can conclude that the continuous mass growth of the Sun could prevent the high rate of the Earth's removal. Of course, from the classical point of view, we know only the mechanism of decreasing the Sun's mass. Nevertheless, let us consider the hypothesis on the possible mass growth and calculate its necessary rate which can diminish the removal speed from 10.5m per year down to 15cm per year.

One can easily solve this problem assuming the mass of the Earth is unchanged. Then one finds that the picture we observe can occur if the Sun's mass grows yearly. If this is true then one can make some significant conclusions. First, this effect cannot be a privilege only of the Sun. It means that all stars grow in mass, consequently, the mass of our baryonic Universe increases over time. This conclusion solves a long-standing paradox regarding the mass of the newborn Universe. What is the point? In the frame of the Big Bang hypothesis, when we go back into the past, the size of the Universe decreases but the mass remains unchanged (or slightly grows to be more precious). It does mean that after the Big Bang event and before the definite moment the baryonic Universe should have been within the Schwarzschild radius.

Calculations give the tiny value of $6.7 \times 10^{-11} M_{\odot}$ for the annual growth of the solar mass ((Harutyunian & Grigoryan, 2018)). It is significant, that if only 0.1 percent of the additional mass transforms into radiative energy, that is enough to provide solar luminosity. Amazingly, this mechanism provides the necessary energy using not very high-efficiency energy production.

5. In atomic nuclei dark energy transforms into mass and vice versa.

Our baryonic world consists of atoms with their mass concentration in atomic nuclei. A marvelous property of atomic nuclei (and separate baryons) is the so-called mass defect providing nuclei's existence. The mass of baryons in the nuclei is less than the free baryons' mass. Moreover, in various nuclei, the average mass of baryons differs significantly. It means that baryons can possess different masses depending on the physical conditions of the environment. That is very important.

Now let us consider the interaction between the dark energy carrier and atomic nuclei, keeping in mind, that dark energy homogeneously fills the space at all scales. Like gravitational objects, atomic nuclei's binding energy is negative and quantitatively equal to the mass defect of the given nucleus. Therefore, as a result of interaction atomic nuclei should gain energy. It is not important how much the portion of the energy is injected into the nuclei per unit of time, since injected energy is positive and energy is a cumulative substance and accumulates over time.

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Gaining energy due to the interaction with the carrier of dark energy has some definite physical consequences. The first one is the growth of the nuclear mass and, as was mentioned above, the reduction of the nuclear binding energy. Owing to this process the mass of the baryonic Universe grows over time. On the other hand, this effect leads to the destabilization of the nuclei involved in this process. It is obvious that after some critical level of binding energy, any nucleus will move into a range of radioactive nuclei since it sooner or later will reach its margin of safety. Then it should eject some energy to return to the safe state. This excessive energy might be ejected as radiation, mass, or both.

Therefore, as the second consequence of the interaction one can mention the radioactive decay and formation of less massive nuclei, the effect investigated in detail. One can formulate this conclusion in the following more comprehensive form: Lighter elements form from heavy ones due to the interaction of atomic nuclei with the carrier of dark energy. So, it means, that the relative number of light elements grows over time. This process is one of the direct manifestations of the second law of thermodynamics.

One can formulate the third significant consequence as follows. In the past, any given nucleus should have possessed a larger binding energy and a smaller mass than modern values. Therefore, nuclei consisting of much more baryons, than any today's nucleus, could exist in the past. The deeper one goes into the past, the more baryons can expect in the atomic nuclei. Moreover, the deeper in the cosmological past, the smaller the mass of the baryonic Universe.

This last conclusion is important because of a long-standing paradox that is usually kept silent. The fact is that, according to modern ideas about the Big Bang, all the laws of nature were in effect after the Planck time, and matter in the form of hydrogen and helium nuclei existed already a few minutes after the Big Bang. Thus, our baryonic universe at the beginning of its formation should resemble the last stage of a black hole formation, when all the matter was inside the Schwarzschild sphere. Then it is not clear how it could expand with acceleration.

6. Evolution of the baryonic matter.

As was mentioned in the previous item, the structural units of our baryonic universe are the atoms with their mass concentration mainly in atomic nuclei. Atoms or nuclei are objects of our Universe equivalent to stars, planets, galaxies, etc. We are sure that all objects and the Universe evolve, we have created models for calculation and demonstrate the evolutional changes, using our knowledge of physical laws and regularities. However, there is no hint about the evolution of atoms, atomic nuclei, and elementary particles. Where comes from this "discrimination"? Its reason could be hidden in the quantum-mechanical character of the microworld objects. We have been taught and were thinking in studentship that all elementary particles are indistinguishable and identical, that there are no differences between two protons or two electrons, and that they are the same as were born during the Big Bang event. Nevertheless, it was already known that baryons change their mass while being a part of atomic nuclei. It means that the physical conditions determine the mass of these particles. On the other hand, it hints that the change in physical conditions due to the expansion and evolution of the Universe could also change the particles' mass. Our above analysis shows that it is not implausible, and one should look for observable "fingerprints" of this process. Let's look at some of these fingerprints here. One such "fingerprint" is seen in galaxies' metallicity. Researchers have known about some of them for a long time and even found explanations within the framework of traditional cosmology. Since the 1970s, the mass-metallicity relation has been known, stating that the more massive (luminous) galaxies possess higher metallicity. This relationship has a natural interpretation in the frame of paradigm considered here. From formula (5) it follows that the larger the galaxy, the slower its evolution. On the other hand, one of the consequences of evolution is the destabilization of atomic nuclei and radioactive decay, which results in the formation of lighter elements, including hydrogen. Therefore, the faster the evolution process, the lower the metallicity. So, the low metallicity of dwarf galaxies in this paradigm differs dramatically from that used by traditional cosmology. We argue that the low metallicity of galaxies is not a result of their formation in the early epochs after the big bang, but a consequence of the more rapid evolution of baryonic matter. Another effect associated with the metallicity of galaxies is easily and naturally explained if the evolution of baryonic matter is considered. We are talking about a negative metallicity gradient with distance from galactic nuclei found in almost all galaxies. The fact is that within the framework of this paradigm, the formation of any galaxy occurs due to the ejection of matter from the core. Suppose the proto-galaxy did not have or had a small rotational moment. In that case, the mass ejections are caused only by the influence of dark energy, occur from the outer layers, and are distributed

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more or less isotropically. If the proto-galaxy has a significant rotational moment, then the centrifugal force, which is strongest in the equatorial area, is also added to the influence of dark energy. Therefore, emissions can occur from deeper layers, where the evolution of matter is longer than on the surface. This can explain both the high metallicity of the disk compared to halos or elliptical galaxies, and the metallicity gradient in both cases. The disk's high metallicity is ensured by baryonic matter being ejected from the deeper layers of the core. The negative metallicity gradient results from the fact that the farther from the galaxy's center, statistically, the more time the matter has evolved under new conditions. Another "fingerprint" is related to the "Hubble tension" paradox ((Harutyunian, 2021)). The gradual increase of measurements finally has led to the strange situation that the Hubble constant measured by two different methods gives different results. The values differ from each other on the level. All groups involved in these measurements assert that all methods used are correct and the final results should be the same. However, there is an issue, which has not been considered. The difference occurs between the results obtained using the real cosmic objects (galaxies' distances and velocities) from one side and the geometry of microwave background radiation from the other. Since the value obtained by the first method is larger, it hints that the reason for this difference could be hidden in the properties of matter. Indeed, if our conclusion on the growth of the masses of atomic nuclei due to evolution is correct, a physical mechanism leading to an additional spectral blueshift can be mentioned. This effect follows from the Rydberg formula written for the hydrogen atom

$$\frac{1}{\lambda_{mn}} = Ry\frac{1}{hc}\frac{M_p}{M_p + m_e}\left(\frac{1}{m^2} - \frac{1}{n^2}\right), \tag{6}$$

where $Ry = \frac{m_e e^4}{8\varepsilon_0^2 h^2}$ is the Rydberg constant. In general instead of protons mass M_p one could write $M_n$for denoting hydrogen-like atoms consisting of several baryons. We see that the wavelengths of spectral lines depend inversely on the reduced mass of the nucleus and electron

$$m_r = \frac{M_n m_e}{M_n + m_e}. \tag{7}$$

When the nucleus and electron masses increase, spectral lines get blueshifted. It means that the closer a galaxy the longer its evolution path and the more its blueshift. In other words, the measurements should include some additional spectral shift increasing the Hubble constant value. One can easily calculate how much the masses of the nucleus and electrons should grow to provide the observed difference of Hubble constant value. The difference is 6.6 km per sec per Mpc. The distance of 1 Mpc in terms of time equals 3.26 million years. One should proceed from the fact that these additional 6.6 km/sec per Mpc appear due to the increase in mass over 3.26 million years. Then one obtains the annual blueshift for the atoms

$$\Delta z_{year} = 6.75 \times 10^{-12}, \tag{8}$$

which in turn should be given by the change of the reduced mass (7) as follows

$$\Delta z = \frac{\Delta\lambda}{\lambda} = \frac{m_{r2} - m_{r1}}{m_{r2}} = \frac{\Delta m_r}{m_r} = 6.75 \times 10^{-12}. \tag{9}$$

This value is an order less than we have obtained for the solar mass growth. It seems natural, since in this case only the evolutionary change plays a role while the solar mass grows through the contribution of the massive nuclei's decay processes. So the Universe's mass growth occurs more rapidly than the increase of the nuclei's mass.

7. The need to change the main paradigm.

Our scientific hypotheses and corresponding theories are models of natural regularities simplified in more or fewer degrees. Only the improved observations and more accurate experiments can serve as correction tools for our ideas update. On the other hand, on the base of scientific ideas research schools and whole directions create which in turn provide the further life and safety of existing dominant ideas. Therefore, one can speak about the inertia of thinking which provides the survival of the aged and useless ideas.

Modern telescopes continuously reveal new phenomena and facts that can't be interpreted naturally in the frame of old ideas on the formation of cosmic objects and their systems. One of the most striking facts is the discovery of "mature" galaxies located at a distance of about 13.4-13.5 billion light years. The

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galaxy JADES-GS-z13-0 revealed by the JWST, is located at an extremely distant point of the Universe and currently holds the record for the most confirmed distant galaxy we have ever discovered with a redshift of z=13.2 ((Robertson et al., 2023)). Because of its huge distance, one can conclude that we see this galaxy as it was only about 300 million years after the Big Bang. It does mean that 300 million years after the Big Bang there were already mature galaxies possessing several hundred million solar masses.

There is another strange thing that is not easy to explain in the adopted by cosmologists framework. It is widely accepted that the most luminous objects are quasars. However, the most distant objects are galaxies, not quasars. The quasar UHZ1 at the redshift of approximately 10.1 is the most distant known quasar ((Bogdán et al., 2024)). Of course, this redshift is comparable with the ones of the most distant galaxies but, strangely, quasars suggested the most powerful extragalactic emitters are not discovered at higher redshifts than galaxies.

So we would like to return to our conclusions on the baryonic matter's evolution. At any hierarchical level, dark energy-induced evolution stimulates a mass ejection process from baryonic objects. Galactic nuclei are the most massive baryonic objects containing vast amounts of baryonic embryos in their entrails. If some mass of this substrate is ejected from the deep layers of the nucleous entrails it should have some remarkable properties. The first is the redshift of the belated in the evolution matter of the ejected mass. The second should be the intensive emission of radiation energy from this matter suddenly moved into different physical conditions. The dipper is the original location of the ejected mass, the larger the redshift, the stronger the radiation.

The new paradigm does not require any beginning or birth of our Universe. The Universe existed and exists in infinite time and infinite volume. It only evolves under the constant influence of dark energy. The evolution process occurs according to the same universal scheme, i.e., due to the interaction of various substances one of which possesses the positive dark energy and others – the negative energy of different attraction processes. We live in a period of evolution when negative attraction forms of energy are the gravitational and strong forces. Namely, this process provides the dominant role of the entropy growth law within all natural laws.

During this comprehensive process of interaction evolution of all objects takes place in one direction when any object gives birth to new objects belonging to its own or lower hierarchical levels. For example, a galaxy can generate new galaxies of lower mass, stars, gas, etc. Or, a radioactive atomic nucleus can eject an alpha particle, neutrons, electrons, and gamma radiation. All these processes increase the entropy. In this paradigm under consideration, the key player determining both the physical interactions and the general direction of processes is dark energy instead of gravitation, playing a key role in all modern physical hypotheses. When dark energy and its unknown carrier are involved one needs to consider the matter's structural features as well, while the gravitational configurations are at the center of our ideas, only the mass of objects plays an essential role.

8. Conclusion.

New observational data often contradict key ideas and hypotheses of modern theories of the formation of space objects. The scientific mainstream resolves these apparent disagreements by applying a method of free parameters, reminiscent of the epicycle model of the geocentric world system. However, it is clear that with the help of many free parameters, any process can be described using a completely unsuitable model. Therefore, the need to introduce many free parameters almost always indicates a discrepancy between the model and the true physical picture.

This situation almost always indicates the need for a critical revision of the basic hypotheses that form the basis of the paradigm used. First of all, you should pay attention to those assumptions that were made *a priori* and without proper empirical basis. In modern cosmology and cosmogony, there are several such, to put it mildly, not entirely substantiated assumptions. The most obvious among them seems to be the Kant-Laplace hypothesis about the formation of cosmic objects and their systems from more rarefied matter (gas-dust clouds) through its fragmentation and condensation. The second hypothetical tool is a gravitational monster called a black hole, which turns into a singularity over a finite time. The third not entirely certain hypothesis, in our opinion, is the Big Bang, which is considered the beginning of the formation of the material Universe and three-dimensional space and the beginning of time.

We would like to emphasize very important at least for us notion. It concerns the "Byurakan concept" of cosmogony, put forward by Ambartsumian in the last century. The paradigm under consideration mar-

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velously fits the concept and transparently shows why it could not be accepted decades ago when no hints existed about dark energy ((Harutyunian, 2022)). Moreover, we hope that this approach can provide tools to show the genuine value of the mentioned concept.

All aspects of the mentioned mental tools should be carefully studied to identify their weaknesses and vulnerabilities. We have focused on some of them in the present report, but many more appear almost everywhere. This issue publishes another work by the author and Arpine Torosyan, which indicates that the spectral blueshift of the nebula is not the result of this galaxy's approach, but that this galaxy has gone through a greater evolutionary path than our galaxy. In the future, we will try to prove this more thoroughly.

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