Can the Existence of Dark Energy Shed Light on the Dark Sides of the "Byurakan Concept"?

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Abstract

The Ambartsumian's idea on the existence of superdense matter and its decay due to evolution is considered using the new observational data. We suggest a new approach to the problem using the number density of baryons for describing the cosmic object instead of mass density. The atomic nuclei and baryons increase their mass due to the gradual decrease of the nuclear binding energy, which, in its turn, takes place as a result of the influence of dark energy. This effect increases the mass of all cosmic objects and the Universe as a whole. Apparently, the smart mechanism of transformation of the mass into energy and vice versa in the atomic nuclei level regulates mass density everywhere. The self-consistent change of the baryonic mass and their number density maintain the balance in the baryonic world.

Keywords: *Dark energy, baryon matter, interaction, energy exchange, nuclear binding energy*

1. Introduction

The roots of modern cosmogony and cosmology go far into Kant's post-Newtonian hypothesis on the creation of the solar system. The belief in the formation of more massive and dense objects from sparse and lower mass ones gradually became the cornerstone of the modern post-Kantian paradigm and serves the conditional science for more than three centuries. When Hubble (1929) discovered the expansion of the Universe, no noticeable change occurred in the basic ideas governing the evolutionary chains of the objects under consideration. We believe that the main reason for such a constant commitment to the conditional paradigm is most likely the firm conservative tradition within scientific schools.

Actually, all branches of science, going ahead, always try to maintain the existing basement built on some principal ideas. The principal idea, in this case, is the apriori concept that the expanding and therefore possessing of positive energy expanding Universe had innumerable inhomogeneity points possessing negative energy. The trick is that no one really knows how so many heterogeneities formed and no self-consistent explanation exists.

A completely different approach suggested Ambartsumian in the middle of the last century. This approach, known as the "Byurakan concept", used the analysis of observational data available at that time. Exactly 75 years ago, Ambartsumian published his epochal paper "Evolution of Stars and Astrophysics" (Ambartsumian, 1947) (see the English version in this issue), in which for the first time he showed that the star formation process is going on in our Galaxy. One can find in the mentioned paper a multifaceted analysis of the observational data, using methods of statistical dynamics. Actually, all of the physical conclusions drawn by the author are met with distrust and skepticism from the very beginning. Nevertheless, the same community eventually accepted everything, with the exception of one. The conclusion on the superdense pre-stellar condition of matter appeared to be very heretical for the established paradigm of star formation.

Roughly, the same thing happened with another completely new idea concerning the activity of galactic nuclei. Like the case of stars, the author again started with the research on the dynamic stability of multiple galaxies. The first report on this subject he represented at the IAU Symposium in Dublin in 1955 (Ambartsumian, 1955). Based on the results of this research the author arrives at the conclusion that clusters of galaxies did not reach the statistical balance. Then, taking into account that the probability of composing multiple systems from single galaxies is negligible compared to the probability of decay of such

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systems, the author arrives at the conclusion that galaxies in multiple systems were born together and have not yet had time to separate from each other.

More comprehensive description of the suggested concept along with the available related data and methods of research the author gave in his Solvay lecture in 1958 (Ambartsumian, 1958). This paper is like the one devoted to the star formation problems, namely, it is much conceptual and with consideration all available relevant data in detail. Again, the main conclusion he arrived at, was one insisting that objects' formation could begin from an unknown matter of very high density or a super-dense matter. Al dynamical processes and statistical estimates did not give room for other scenarios. Like the case with stars, the astronomical community finally adopted the main conclusions made on the base of these studies, except one concerning the formation from the superdense state of matter. It appeared that the laws of modern physics do not allow the existence of superdense matter of required masses.

This is, in fact, an impasse not only for the new concept but also for the stellar and galactic cosmogony as a whole. The fact is that all observational data speak in favor of the mentioned approach, which is quite transparent and does not require the inventive construction of complex scenarios. Nevertheless, apparently, the laws of physics do not support this point of view. Obviously, the physical picture cannot be self-consistent, satisfy all the requirements of statistical and dynamic analysis, but at the same time contradict the physical laws On the other hand, the scientific community emphasizes that the known physical laws constitute a complete set of natural laws, and therefore all conclusions drawn from them must be correct. Therefore, a very important detail of the concept has remained rejected over the past seven decades.

2. Dark energy changes the game rules

One of the consequences of the discovery of the accelerated expansion of the Universe at the end of the 20th century (Perlmutter et al., 1999, Riess et al., 1998) remains in the shadow of the great discovery of dark energy. With this discovery, it suddenly turned out that we do not know all the physical laws of Nature. Moreover, we did not know about the largest store of energy-matter in our Universe. Immediately prior to this momentous discovery, accurately measuring the deceleration rate of the universe was mentioned as one of the key problems in 21st-century astrophysics (Sandage, 1997). The existing gravitational theory predicted that the expansion of the Universe in any case should have a slowing down character. Measuring the rate of deceleration should have given a more detailed scenario of the fate of the universe. But instead, the scientific community was once again convinced that we simply did not know all the laws of Nature. There were and still are laws unknown to us, which will be discovered sometime in the future.

Undoubtedly, the discovery of dark energy had a huge potential to change our ideas about the structure of matter and could become a starting point for revising the laws of self-organization of matter at various hierarchical levels of our baryonic Universe. This should be kept in mind and emphasized periodically when thinking about the consequences of the existence of dark energy. Actually, the accelerating expansion of the baryonic Universe, together with the external "player" in the form of dark energy, does not at all represent some new version of the long-exploited Big Bang hypothesis. The discovery of a new phenomenon has actually completely changed the objective picture of the Universe, and now it is fundamentally different from the baryonic world that was considered born at the Big Bang.

The most important and significant from the point of physical view and for physical consequences property of the dark energy or its unknown carrier interacts with the baryonic matter. Evidently, it was clear from the very beginning. Indeed, if there were no interaction with baryonic matter, there would be no acceleration of galaxies. No acceleration of the expansion of galaxies, no discovery of dark energy could happen. Therefore, no doubt that the acceleration mechanism is the injection of the energy, called later dark energy. All the mentioned aspects together serve as a sufficient condition for proving the interaction between two different substances and the exchange of energies between them.

For further discussion, one should notice that dark energy is exceptionally positive energy, which according to modern conception homogeneously fills all space and performs a physical work gradually accelerating the expansion of the universe. It does mean that the absolute amount of dark energy in any given volume is proportional to the volume. If the density of dark energy is ρ_{de} then one can represent the energy contained in the volume V as:

$$E_{de} = V\rho_{de}, \tag{1}$$

It is obvious that a baryonic object occupying any volume experiences the influence of the dark energy

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filling the same volume. For modern astrophysics, the most essential issue is the behavior of the baryonic objects simultaneously occupying the same volume of space with dark energy and therefore interacting with its carrier. The acceleration of the expansion of the Universe is the most obvious and trivial consequence of the baryonic matter interaction with the carrier of dark energy. One should stress that researchers revealed the acceleration effect for cosmological distances, for much larger scales than Hubble discovered the expansion effect at the very beginning. Actually, the acceleration effect is something we should have expected to exist, knowing that the removal speed is proportional to the Hubble constant.

Indeed, let us denote the length of the segment AB by r and rewrite the Hubble law in the form

$$\frac{dr}{dt} = H_0 r. \tag{2}$$

Let us now formally differentiate both sides of the relation 2

$$\frac{d^2r}{dt^2} = \left(H_0^2 + \frac{dH_0}{dt}\right) r. \tag{3}$$

It is obvious that, if the Hubble constant does not depend on time, namely, if $H_0 = const$, the relation 3 will have the following form

$$\frac{d^2r}{dt^2} = H_0^2 r. \tag{4}$$

Certainly, the density of dark energy is very tiny. Its influence becomes noticeable, as shown the relation 4, for greater distances. Therefore, the majority of researchers do not even consider this effect for the smaller scales, fairly believing that any immediate effect is very tiny. Nonetheless, tiny does not mean zero. On the other hand, one should keep in mind that energy or work has a cumulative behavior, and the processes under consideration last for billions of years.

Another notion we would like to do is the following. According to modern conceptions, dark energy mainly works against gravity, accelerating the expansion of the universe. However, there is no scientifically backed explanation, as to why it could not act against other attractive energetic fields. From the general physical understanding of the situation, one can arrive at a conclusion that there is no hint that its behavior is purely anti-gravitational. Most probably, this is only the first revealed manifestation of the universal repulsion effect. It is natural that its discovery took place for its anti-gravitational influence since gravitation is the weakest force. The stronger the attractive force, the shorter considered distance, and the harder revealing of the repulsion effect.

3. Interaction between the baryonic world and the carrier of dark energy

Physical science took a rather long time for the Universe only its smallest component consisted of baryonic matter. The modern structure of the Universe is completely different because of the discovery of dark energy – the largest storage of the mass-energy. Its interaction with baryonic matter seems to be the most essential physical influence the baryonic world undergoes constantly, perhaps, since the very beginning of its existence.

Obviously, the energy must have its own carrier. Although we do not know what is the carrier of dark energy, for sure, it is, and this unknown substance interacts with baryonic matter. We will assume that the process of interaction of baryonic matter with a carrier of dark energy occurs according to the well-known laws of thermodynamics. The last statement is not provable, but it can be used based on general physical principles. Then one should agree to apply the second law of thermodynamics when calculating the energy balance due to the exchange of energy between interacting substances. This means that due to the exchange of energy, the interacting substance, which has less energy, receives part of the energy, and the other part loses.

Any system consisting of baryonic objects possesses kinetic and potential energy. It is known that all balanced systems have negative total energy

$$E_{tot} = T + U < 0 \tag{5}$$

and the virial theorem is equal to zero

$$W = 2T + U = 0. \tag{6}$$

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There are two very essential points one should carefully consider for understanding the energy exchange consequences of the interaction between baryonic matter and the carrier of dark energy. While estimating the physical changes in a system consisting of baryonic objects, consisting in their turn of baryonic objects belonging to the lower hierarchical levels, one should keep in mind that the virial theorem greater than zero always means that such a system should expand. The second point is that all baryonic objects and systems existing in a stable stage satisfy the condition 5. Those exist as a whole only owing to the lack of energy.

Taking into account these points, we inevitably arrive at the conclusion that due to the interaction between the carrier of dark energy and baryonic matter, there is always a transfer of energy from the first source to baryonic substances. From the point of view of modern physics, this conclusion is inevitable. However, some details require further clarification if one is trying to get a comprehensive understanding of such interactions.

The fact is that we usually consider the microcosm as a completely different world, although it is from the objects of this world that all the upper hierarchical levels of the baryonic world consist. The quantum behavior of atomic nuclei and elementary particles separates them from objects of the next levels. All researchers know that quantum objects of the same name are identical and indistinguishable from each other. Moreover, it is accepted as an axiom that the objects of a microcosm do not undergo any evolution process and remain unchangeable for billions of years, while all other objects of the higher levels change over time drastically. Is it correct or not, one can find out only by carrying out a rigorous analysis of the relevant observational and experimental data.

Let us dwell briefly on the structural features of atomic nuclei. According to modern physics, atomic nuclei are composed of neutrons and protons, which, in turn, have quarks in their structure, tightly bound by the strong force. The neutrons and protons themselves exist in nuclei, bound to each other due to the residual strong forces penetrating outward from the hadron's interior. The structure of atomic nuclei, which is the basis of all baryonic structures, on the other hand, is the most accurately "calculated" self-consistent brick of the baryonic world, which exist owing to the mass defect or binding energy.

Regardless of the degree of development of the existing theories, all quantitative estimates describing the atomic nuclei and this physical phenomenon come from empirical research only. There is no doubt that many essential details of our knowledge on the structural features of atomic nuclei are the result of the use of the phenomenological approach. Obviously, the values of the mass defect of various atomic nuclei are among these extremely important data and are of purely empirical origin. Well-known empirical formulas, in turn, are simple fitting expressions derived from these values.

In fact, up to now, in our opinion, there is no clear understanding of the mechanism of change in the mass of nuclei, or we simply do not know it. Nevertheless, using all the known physical characteristics of atomic nuclei, one can argue without a doubt that the mass of hadrons decreases if they are in the nucleus of an atom. Moreover, this change is different for different nuclei, which means that a hadron can have different values of mass. Therefore, we can conclude that the baryon mass changes depending on various physical circumstances, without even specifying the real mechanism of this phenomenon. One can interpret this, like nuclei, as a defect in the mass of the baryons themselves, or find another explanation, but the fact of the existence of a mechanism that regulates the mass of baryons in accordance with physical conditions does not depend on this, and is undeniable. That is a very essential feature of the baryonic world as a whole.

So, what can happen with atomic nuclei due to their interaction with the carrier of dark energy? Taking into account the general viewpoint that dark energy fills homogeneously all spatial scales, one can consider the consequences of its interaction with the atomic nuclei and elementary particles under the governance of the laws of thermodynamics. The most credible conclusion seems to be the one asserting that the portion of dark energy transferred to the atomic nucleus will cover the lack of energy called nuclear binding energy. It does not matter at all how tiny or insignificant an amount of energy transfers to the nucleus per unit of time. It is very significant that this portion is larger than zero and that energy is of a cumulative nature.

Summarizing the above, we arrive at the conclusion that the interaction of the carrier of dark energy with atomic nuclei and baryons simply decreases the binding energy. However, on the other hand, a decrease in the binding energy leads to an increase in mass. Consequently, one can argue that energy exchange during such an interaction inevitably leads to an increase in mass. Then the considered interaction takes on a completely different meaning: the nucleus structure of baryonic matter gradually converts dark energy into mass, most probably keeping constant the number of elementary particles.

If our considerations are correct, then there should not be a doubt that the objects belonging to the microcosm also evolve heavily over time. Moreover, evolution occurs in the direction of the growth of the mass of these objects and, as a consequence, the entire baryonic universe. This conclusion, we believe, is

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exceptionally important for the interpretation of some widely known phenomena. We mention here one of that phenomena only. This concerns the paradox of the ongoing expansion of the universe.

Indeed, if all baryonic matter exists already since 370 thousand years after the so-called big bang, then the entire baryonic universe was inside the Schwarzschild radius. According to the laws of modern physics, the substance formed after the big bang should have immediately formed a black hole. However, it is expanding and, as it turned out, is expanding with acceleration. It is suspicious that in some strange way the researchers do not notice this egregious discrepancy.

4. The number of baryons and the mass of an object.

Our conclusion that evolving matter grows in mass due to interaction with the carrier of dark energy is unusual from a traditional point of view, but, of course, does not violate the law of conservation of mass/energy. However, one should consider this finding in more detail, as it predicts some structural changes that we believe may have far-reaching implications. These consequences are extremely important, for example, for understanding the chemical abundances of various space objects and the mechanism of the evolution of metallicity in general. In order to clarify the questions of interest, one can use the approach of a mental (or "as if") experiment, having the necessary tools of the corresponding physical laws to study the chain of changes that occur with atomic nuclei. Such changes can last for billions of years. Evidently, we cannot give any quantitative estimates for the duration of the processes or the cross sections of the processes that we are going to describe here. Our research approach is purely phenomenological in nature, and therefore we can only compare the result of our experiment with the corresponding observational data.

The most important thing to pay attention to is the process of decreasing the binding energy of the nucleus. This has at least two major consequences. First, as already noted, the mass of any given nucleus increases. In addition, the nucleus gradually loses its stability margin and finally passes into the class of radioactive nuclei. However, radioactivity is a statistical phenomenon and nuclear decay is a Poisson process. It is easy to understand that, having become radioactive, the nucleus continues its interaction, and the binding energy continues to decrease due to excessive energy accumulation in the nucleus. Therefore, over time, its half-life will constantly decrease, while the kinetic energy of the decay products increases.

The transition into the class of radioactive ones gradually changes the relative amounts of nuclei of various masses. The amount of light nuclei increases due to the decay of more massive atomic nuclei. This means that owing to the exchange of energies, the relative amount of nuclei, consisting of a smaller number of hadrons, and possessing at a given moment of time a relatively smaller mass, gradually increases. Thus, if we accept the concept of the interaction of baryonic matter with a carrier of dark energy discussed here, we arrive at the conclusion that the evolution of atomic nuclei leads to an increase in the number of nuclei consisting of a smaller number of hadrons. This, by the way, agrees with the law of increasing entropy but contradicts modern concepts of the formation of atomic nuclei.

According to the paradigm we are developing here, the masses of baryonic objects, and hence the mass of the baryonic universe, become time-dependent and continuously growing quantities. This is a non-obvious effect, and rigorous studies and a self-consistent approach are needed to detect and confirm it. On the other hand, the number of baryons in our baryonic universe is likely to remain unchanged. This assumption is obviously unprovable. Nevertheless, modern physics insists that the baryon number is a strictly conserved number, and so we and we start from this premise.

If the total amount of atomic nuclei become larger with time, the number of hadrons in each nucleus decreases, and the mass of each hadron increases, then we can draw a conclusion about the atoms of the cosmological past. To do this, one should understand what the reverse processes lead to. It is obvious that the deeper we penetrate into the past of baryonic matter, the more hadrons in atomic nuclei should find on average, and each individual hadron should possess of lesser mass. To what size the nuclei can be extrapolated is not yet known. In any case, we can talk about ancient hadron embryos, combined in very large numbers into proto-nuclei. Moreover, some intermediate versions of such proto-nuclei can exist in the central parts of baryonic objects of large masses.

Our conclusion about the growth of the mass of atomic nuclei opens up the possibility of searching for the spectral manifestation of this evolution. Indeed, the frequency of spectral lines depends on the reduced mass of the electron and the atomic nucleus. For the simplest hydrogen (or hydrogen-like) atoms the wavelength of a photon corresponding to the transition between energetic levels is given by the following formula

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$$\frac{1}{\lambda_{mn}} = Ry\frac{1}{hc}\frac{M_p}{m_e + M_p}\left(\frac{1}{m^2} - \frac{1}{n^2}\right), \tag{7}$$

where

$$Ry = \frac{m_e e^4}{8\varepsilon_0^2 h^2} \tag{8}$$

is Rydberg's energetic unit.

One can see that the wavelength is inversely proportional to the reduced mass of the electron and proton (nucleus)

$$\lambda \sim \frac{m_e + M_p}{m_e M_p} = \frac{1}{m_r}. \tag{9}$$

If our conclusion is correct and, indeed, there is a monotonous increase in the masses of elementary particles and the atomic nucleus, then in the spectrum of distant objects, in addition to the Doppler redshift, there must be some component due to the evolutionary lag of baryonic matter compared to our epoch.

The higher the reduced mass, the shorter the wavelength. This means that in the process of evolution of baryonic matter the spectral lines should shift to the blue side of the spectrum. In other words, less evolved atoms have redshifted spectra if compared with more evolved ones. On the other hand, the further the object is, the deeper in its past we observe it and the shorter the path length of its evolution. Thus, the further the object is, the bigger its non-Doppler redshift should be.

The first things that come to mind after this conclusion are the metallicity of cosmic objects and the redshift of galaxies caused by the expansion of the Universe. The question arises cannot a part of the redshift be due to insufficient evolution of the emitting baryonic matter? After all, a decrease in the reduced mass has the same effect on the spectrum as the removal rate. Actually, it is extremely difficult to separate one effect from another. One needs to find some process, which separates somehow these phenomena in manifestation.

5. Dependence of the Evolution Rate on Mass.

An essential issue relevant to the problem under consideration could be the dependence of the evolution rate on the mass of the given object. This is not a trivial issue, since our knowledge concerning the carrier of dark energy is extremely scant or practically zero. We have only some incomplete information on the external manifestation of its interaction with the baryonic objects and that is all. Therefore, one needs using of some circuitous way for finding a more or less realistic solution. We assume that the ratio of gravitational energy of a baryonic object and dark energy in the volume occupied by the object can serve as an indicator of object firmness against the dark energy influence. The larger the ratio the harder the evolution process is forced by dark energy.

Let us test it for the spherical object. The gravitational energy of an object of mass M and radius R is proportional to the second order of the mass:

$$E_{gr} \sim G\frac{M^2}{R}. \tag{10}$$

where

$$M = \frac{4\pi}{3}R^3\rho = V\rho. \tag{11}$$

Using the relations 1, 10, and 11 one easily finds for the mentioned ratio

$$f = \frac{E_{gr}}{E_{de}} \sim G\frac{M}{R}\frac{\rho}{\rho_{de}}. \tag{12}$$

It is clear from the relation 12 that for the objects of bigger mass the coefficient f. gets bigger if the density of the objects does not decrease faster than grows the ratio M/R . The early-type galaxies obey a narrow relation traced by their stellar content between the mass and size (Burstein et al., 1997). For high-mass galaxies, the classical relation confirmed by many authors has the following form

$$\log R_{1/2} \sim 0.54 \log M, \tag{13}$$

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while for the dwarf systems, the relation has a shallower slope

$$\log R_{1/2} \sim 0.3 \log M, \tag{14}$$

where $R_{1/2}$ is the half-light radius and M is the galaxy's stellar total mass.

Taking in to account that $R \sim R_{1/2}$, one arrives at the conclusion that the mass of high-mass galaxies depends on their radius approximately as $R \sim M^{1/2}$ and for the dwarf systems - $R \sim M^{1/3}$. It does mean that for the dwarf systems f increases with the mass, while this correlation gradually stops and disappears for the large mass ones. It turns out that in the case of dwarf galaxies, the smaller the mass of the galaxy, the more malleable its substance to evolutionary changes. Apparently, after a certain mass, this effect weakens, and then for very massive galaxies it is always bigger but does not depend on the mass.

This conclusion is very important. If the coefficient f really can serve as a measure of the evolution rate, one can conclude that for dwarf galaxies the fainter the object the bigger the evolution rate. Therefore, if we study, at least, early-type galaxies of various luminosities formed nearly at the same time, we can insist that the ones possessing lower luminosity (mass) have a long evolution path. Based on the conclusion above, we can expect that the fainter galaxies possess lower metallicity and lower redshift compared with their massive congeners.

The mass-metallicity relation is well established (Lequeux et al., 1979). Undoubtedly, the huge observational data provided by the Sloan Digital Sky Survey (York et al., 2000) gave an excellent possibility to improve thoroughly the statistics of both stellar mass and metallicity of galaxies in the local Universe and assess the significance of the mentioned relation. Tremonti et al. (2004) studied imaging and spectroscopy of ~53,000 star-forming galaxies at z ~ 0.1 to study the relation between stellar mass and gas-phase metallicity. This relation holds for a broad range of stellar masses (from $10^7 M_\odot$to $\sim 10^{12} M_\odot$), but its shape changes with varying stellar mass content of galaxies: it is steeper at low masses, then its slope changes in correspondence of a characteristic value of asymptotically flattening towards a saturation metallicity (see for references also Curti et al. (2020)).

Another effect, which we noted in the previous paragraph, predicted that the more massive the galaxy, the greater its redshift, all other things being equal. It is not so easy to verify such a statement, but if we use the galaxies of the same cluster, then we can assume in the first approximation that their distances and ages are approximately the same. Therefore, we used three known clusters of galaxies, namely, the Virgo cluster, the Fornax cluster and the Coma cluster for checking the prediction rightfulness. It appeared that the objects from the two closest clusters show the predicted redshift versus luminosity (mass) dependence, while objects from the Coma list of galaxies do not (Harutyunian et al., 2019).

It is not yet clear why the behavior of this effect is so different for the studied clusters. Most likely, we did not take into account some effects depending on the distance. This is indicated by the fact that the effect is observed with high reliability for nearby clusters, while no such correlation is observed for a distant cluster. It is necessary to study many clusters more comprehensively, including closer and more distant ones, in order to have better statistics. Obviously, the farther away the cluster, the more difficult the spectroscopy of dwarf members. Moreover, the difficulties of spectroscopic measurements necessary for a useful determination of redshifts are disproportionately difficult at large distances. Perhaps this is one of the reasons why the hypothetical effect could not be detected for the Coma cluster. However, the interpretation of mass/metallicity relation and mass/redshift relation, at least for the closest clusters of galaxies, make our considerations firmer and allows using them for the interpretation of other relevant phenomena.

6. The Number of Baryons Instead of Mass.

Considering the physical processes that occur owing to the interaction of macro or mega objects, physicists usually neglect their atomic structure and rely mainly on the masses that characterize the objects. When describing, for example, the movements of planets in the solar system, the researcher is not interested in the atomic structure of these planets, since the masses of objects and their speeds are sufficient to solve any kinematic and dynamic problems. This approach is justified if we consider the situation for a short period compared with the cosmological times. Otherwise, one should take into consideration the evolutionary effects, we described above. We believe that the evolution of atomic nuclei and elementary particles is the principal phenomenon, determining all evolutionary effects we observe in cosmic objects and their systems.

However, if the above physical picture of the interaction of baryonic matter with a carrier of dark energy is correct in principle, then we must reconsider some of our views regarding the manifestation of the properties

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of baryonic matter. ne should estimate both the quantity and quality of corrections inevitably appearing when an object or a system exists for a longer time, comparable with the cosmological. The first extremely important issue is to take into account the change in the mass of macro and mega objects due to the gradual increase in the masses of atomic nuclei and elementary particles, and the interrelation between the mass and the number of baryons originating the mass. Indeed, if the mass of baryons and their systems grows gradually increasing the mass of cosmic objects, then the amount of baryons gains a much more fundamental role in any physical interactions and becomes a conditioning factor for any further analyses.

From general physical considerations, one can assume in the first approximation that in any massive / multi-baryon object, a gradient of evolutionary changes towards the center should exist. The closer to the center of the object, the lower the "evolutionary age" of the corresponding particles of baryonic matter. This is due to the positive density gradient created by the object's own gravitational field. Indeed, the closer the considered part of the object is to its center, the greater the density of matter. Let's compare two small volumes of spherical shape and the same radius, one of which is closer to the center, and the other is closer to the surface layers. Then, by virtue of relation 12, we come to the conclusion that the ratio of the coefficients f is given by the square of the ratio of the matter density values

$$\frac{f_c}{f_s} = \frac{M_c}{M_s}\frac{\rho_c}{\rho_s} = \left(\frac{\rho_c}{\rho_s}\right)^2, \tag{15}$$

where the indices "c" and "s" stand for "center" and "surface".

On the other hand, within the framework of this paradigm, the shorter the period of evolutionary aging of matter, the closer it is to its original state. Thus, we arrive at an important conclusion that the physical conditions of the early periods of the evolution of the baryonic universe are preserved in the depths of massive/multi-baryon objects. Moreover, the more massive the object, the greater the temporal depth of its interior. We do not yet have any tool for a quantitative assessment of how much the clumps of matter of an object located at different depths lag behind in evolution, and how this lag depends on depth. We can only assume that the more massive the object, the greater the differences in the "evolutionary age" that we can register. One can also predict that over time, due to the injection of dark energy into the baryon structure of ordinary matter, the mass of the latter will increase and its instability will arise, and in order to restore stability, the object must throw out the excessive energy and mass. What this energy and mass are, apparently, should depend on the size of the object and the duration of the energy accumulation period.

Bearing in mind the considerations above, we can somewhat change the wording of Ambartsumian's "Byurakan concept". For the sake of accurate describing the physical state of the interior of any huge object, instead of large masses of superdense protostellar matter, we must speak of clumps of a huge number of baryons, the evolutionary path of which was much shorter than the evolutionary age of already formed stars and interstellar matter. Due to the evolutionarily lagging matter ejection, which inevitably occurs when the instability reaches a critical point, the ejected clump of matter suddenly appears in space, which possesses different physical conditions.

What can happen to this clump in terms of physical transformation? The same thing happens with a piece of ice taken from the refrigerator and placed next to the stove. It very quickly changes its phase state and turns into a liquid, which corresponds to a given temperature. In this process, some molecules overcome the attractive forces and move far away. In other words, takes place liquidation and evaporation from the surface layers of the solid piece of ice. Obviously, the clump of matter we are considering, ejected from the bowels of a massive object, must also accelerate the process of evolution in order to adapt to existing conditions.

This leads to the chain decay of all atomic nuclei that are much larger than the critical size and cannot exist under external conditions. The process is similar to radioactive decay, but far exceeds the scale of the processes we know on Earth. The rapid process of energy release and the formation of ordinary baryonic matter occurs most intensively in the near-surface layers of the ejected clump (or its fragment, if fragmentation has occurred as well). Owing to this process, the outermost layer of the clump evolves first and forms a kind of a hot atmosphere around the main body, which in turn slows down the decay of deeper layers, thus creating a quasi-stable state for this fragment like a star. The further life and evolution path depends on the physical characteristics of the ejected clump and the degree of its evolutionary retardation.

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7. Conclusions.

Our hypothesis on the evolutionary aging of baryonic matter due to interaction with dark energy seems appears to support Ambartsumian's concept of superdense matter. However, "superdense" does mean in this case a huge number of baryons in the volume unite but not a very big mass. Observational facts that we studied in this connection, speak of the gradual increase of baryonic mass due to energy injection into atomic nuclei and elementary particles. For atomic nuclei, this process decreases the nuclear binding energy and accordingly increases the mass. The same most probably happens with the elementary particles, which exist owing to the binding energy as well. Therefore, one can speak about the "potentially big masses" in the depth of stars and galactic nuclei, which still exist in the form of baryonic embryos.

Although some facts fit excellently our ideas on these subjects, we are going to carry out a more comprehensive analysis of relevant observational data. If this hypothesis is correct then physical consequences should manifest themselves everywhere. Of course, the effect could be very small or even negligible, but it should exist and show up when the observational accuracy is appropriate for it.

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