On the Stability of "Stable Systems" in the Presence of Dark Energy

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Abstract

The influence of dark energy on baryon objects and their system is considered. For such an analysis, the concept is adopted, according to which the entire baryonic Universe interacts with dark energy on all cosmic scales. It is shown that the interaction of baryonic objects with a carrier of dark energy inevitably leads to the injection of energy into the baryonic world with tangible physical consequences. The consequences seem quite dramatic, since the accumulation of energy in the baryonic world changes the virial theorem for all objects and systems, making them more and more unstable. This process of stability loss takes place at all spatial scales, including the micro world, where baryonic matter experiences the dark energy influence. It results decaying of all cosmic objects beginning with atomic nuclei and reaching the clusters of galaxies. Evolution under the influence of dark energy can take place in two different ways depending on the existence of the angular momentum of the body and its value. If the angular momentum is small, the object under the influence of dark energy obtains a more regular shape, otherwise at the equatorial plane would appear a structure consisting of less evolved matter.

Keywords: *dark energy, baryon matter, interaction, energy exchange, virial theorem, instability, objects' formation, evolution, metallicity*

1. Introduction

At any stage of the evolution of science, researchers have a certain set of tools with the laws of Nature that can be used for physical research. This toolkit is enriching constantly over time due to new discoveries. Any new discovery has the potential to change the basic ideas underlying our knowledge. Therefore, any new discovery requires special detailed studies for the introduction of needed changes and corrections. At the same time, newly discovered laws of nature can have very far-reaching consequences that do not clarify our ideas, but completely change them. This is the only way for the evolution of our scientific paradigms.

The history of science shows that researchers always try to keep all established ideas intact. They usually prefer to add new loose parameters to fit new observable facts or patterns to existing models and ideas. Major changes in beliefs that are highly valued by different paradigms occur very rarely and slowly when the inertia of the old type of thinking is reduced to a negligible level. Perhaps this approach underlies cognition through the human psyche. Undoubtedly, this is a question more philosophical than physical or astrophysical. However, when choosing a methodology for ongoing research, existing implicit trends should be taken into account.

Interestingly, from the very beginning of more or less serious cosmogonic studies of space objects and their systems, everything was considered stable and dynamically balanced. Even for the universe as a whole, Einstein introduced an anti-gravitational constant to keep it in a stationary state. All cosmogonic models based on the Kantian-Laplacian primitive hypothesis require stability at the final stage of the formation of an object/system. Apparently, this state of affairs is subconsciously more acceptable to a person. However, since this is not always true, researchers have often encountered paradoxes that have arisen because of this.

Then, as you know, it turned out that the Universe is actually non-stationary and it is expanding (Hubble, 1929). Very soon, the researchers decided that the expansion of the universe is exactly the effect that was predicted by Friedman (1922) and Lemaître (1927). In a strange way, most researchers did not even think that the real Universe had either homogeneity or isotropy, as the authors assumed when solving the corresponding problem.

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Moreover, detailed observations later showed that the Moon is rapidly moving away from the Earth (Dickey et al., 1994), and the Earth is moving away from the Sun (Krasinsky & Brumberg, 2004). In both cases, the observed data does not fit into our traditional scientific understanding. Nevertheless, tidal effects are certainly noted as the removal mechanism, although in the first case, they do not correspond to the observed speed, and in the second case, there are no data on the change in the Sun's spin at all.

Finally, at the end of the millennium, instead of the expected measurement of the deceleration of the expansion of the Universe, the scientific community encountered its accelerated expansion (Perlmutter et al., 1999, Riess et al., 1998). Of course, it was impossible to predict such behavior within the framework of the simple big bang hypothesis. Therefore, the discovery of an accelerating expansion should be recognized as a very dramatic change in our understanding of physical reality. Is the scientific community ready for such an unprecedented change? This seems very unlikely. However, most researchers accepted this change readily and without hesitation.

2. Dark energy

The most intriguing issue brought into consideration due to the universe acceleration phenomenon should be the possible consequences of the interaction between the baryonic matter and the carrier of the acceleration energy whatever it is. There is no doubt that the carrier of dark energy interacts with baryonic matter. The very discovery of dark energy took place because this interaction causes to accelerate the recession of galaxies. In other words, we learned about the existence of dark energy only because of how it interacts with baryonic objects, which are galaxies. So, one arrives at an inevitable conclusion that the carrier of dark energy interacts with the baryonic objects. This conclusion has far-reaching effects, which are very essential for the correct understanding of the going on processes. First, one should consider the physical consequences for the interacting systems using the available toolkit of the relevant physical laws. Therefore, one should apply the second law of thermodynamics here describing the process energetically. This law insists that due to the interaction of two various systems of objects the exchange of energy takes place in such a way that the system possessing lower energy gains some portion of energy from the other side of the interaction. Dark energy is positive since it implements physical work. On the other hand, all objects and their systems considered stable possess negative energy. What does it mean? The stability of a system (object) is a well-defined concept. Such a system has negative total energy and the null virial theorem:

$$E = T + U < 0 \tag{1}$$

and

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

What do we know about dark energy and its carrier? Frankly, no more than what we could determine from the very beginning of the discovery of dark energy. The part of researchers who accept the existence of dark energy (the majority) also believes that it fills all space uniformly on all scales. The homogeneity of distribution and excessively low density are probably the most significant characteristics of dark energy. It is precisely its low density that is often cited as an argument against the possible influence of dark energy on a small scale. However, at the same time, one essential detail is forgotten, namely, that the energy of a substance is cumulative and has the property of accumulation if the interaction continues in time. Therefore, a qualitatively different mechanism works, about which the proverb "a drop wears away a stone" was invented. Let us suggest that due to the interaction between the carrier of dark energy and any system of baryonic objects the latter gains some small non-zero portion of energy per unit of time. Then the relation (2) will change and will have

$$W = \Delta E > 0. \tag{3}$$

This is correct for any system, which obeys the relations (1)-(2) and interacts with any system with positive energy. In parallel with the accumulation of energy in the system, the latter sequentially passes into other energy states, which can be considered quasi-stationary, but in no way - stable. If the virial theorem is positive, it leads to the increase of the geometrical sizes of the given system of objects to reach an equilibrium. In other words, the expansion effect in the systems of cosmic objects is the natural reaction of the system to the interaction with the carrier of dark energy. The Universe as a whole shows this effect more clearly than all its subsystems with its accelerating expansion. To detect the expansion of systems of lower hierarchical classes, special methods of measurement are usually needed, and sometimes the courage

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to reject the hypotheses that prevail due to historical reasons. Taking into account the physical properties of dark energy that we have adopted, it is possible to determine a certain characteristic parameter that somehow shows the ratio of destructive dark energy and gravitational or other energy responsible for the integral existence of a given object or system. The spatial distribution of dark energy is uniform, meaning that the amount of energy is proportional to the volume considered. For the sake of simplicity, we will use the ratio of these energies in a given volume:

$$\eta = E_{de}/E_{\text{int}}\ . \tag{4}$$

It is clear from the physical meaning of this parameter that the system we are considering is the more easily subject to the influence of dark energy, the greater the value of this parameter. Any system consisting of objects with masses possesses gravitational energy given by the relation

$$E_{gr} = -G\sum_{i\neq j}\frac{M_i M_j}{R_{ij}}, \tag{5}$$

where R_{ij} is the mutual distance between i -th and j -th objects. If, in order to simplify the picture, we assume that all objects have the same mass M , and instead of mutual distances we take some average value R, then for rough estimates we obtain

$$E_{gr} \approx -G\frac{N(N-1)M^2}{R} \approx -G\frac{(NM)^2}{R}. \tag{6}$$

For the particular case of one homogeneous spherical object, the more correct calculations give a similar result:

$$E_{gr} = -\frac{3}{5}G\frac{M^2}{R}, \tag{7}$$

where R is the radius and M is the mass of the spherical object: The examples given show that the gravitational energy in these cases grows as the second power of the mass of the system or object, divided by the size. If we assume that the mass is proportional to the volume of the object, then we get that at the same density, the gravitational energy is proportional to the fifth power of the size. The amount of dark energy in the same volume is proportional to the third power of the size. It follows from what has been said that relation (4) for objects of the same type decreases with an increase in the size of the objects. And this, in turn, means that in objects or systems of the same type, the effect of dark energy on the physical characteristics of an object or system decreases with increasing mass (size). However, if we consider objects and systems that belong to different hierarchical levels of the universe, this regularity will not be preserved. Here we estimate the parameter (4) for various structural units. As a first example, let us take clusters of galaxies. Suppose our hypothetical cluster consists of 1000 galaxies with masses $\sim 10^{11}M_\odot$, and the size of the cluster is about 5 Mpc. We first transform (4) into the relation

$$\eta = k\frac{R^4}{(NM)^2}, \tag{8}$$

where

$$k = \frac{4\pi}{3}\frac{\rho_{de}}{G} \tag{9}$$

is a constant. Putting the corresponding values into the relation (8), one can easily obtain

$$\eta_{cl} = 6\times 10^4 k. \tag{10}$$

The next hierarchical level is occupied by galaxies. Therefore, the same ratio should be estimated for galaxies as well. Masses of galaxies vary in a wider range than for the clusters of galaxies. Their mass range is wider for the elliptical galaxies. Actually, there are dwarf galaxies, which do not differ from the globular star clusters and the largest ones have masses of hundreds of Milky Way. Their masses span from several hundred thousand up to tens of trillions of solar masses. If we assume the normal galaxy possessing a mass of $\sim 10^{11}M_\odot$ and radius 25kpc, we find for the introduced parameter

$$\eta_{gal} = 6\times 10^2 k. \tag{11}$$

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On the other hand, when this parameter is calculated for a dwarf galaxy, characterized by a radius 0.5 kpc and a mass $\sim 10^7 M_\odot$, we find

$$\eta_{dgal} = 10^4 k. \tag{12}$$

Obviously, this parameter is useable only for rough estimates. Nevertheless, it gives some idea of the variation of dark energy/gravitational energy ratio for various cosmic objects. The general physical approach to the problem under discussion tells us that this ratio is responsible for the time scales if we consider the evolutionary changes in the gravitational systems due to the dark energy influence. We again emphasize here that we hypothesized the above inevitable interaction between dark energy carriers and baryonic objects on all spatial scales, which could be studied using modern research toolkits, including all empirical and theoretical tools. There is one issue, we would like to stress as well. While estimating the parameter introduced in this section, we would like to mention that for the baryonic objects, namely, galaxies larger masses are used. In the clusters, obviously, not all the galaxies have a mass $\sim 10^{11} M_\odot$, the majority have much fewer masses. Moreover, masses of galaxies are given with their hypothetical component of dark matter. For example, dwarf spheroidal galaxies, have luminosities in the range $10^5 \div 10^7 L_\odot$ as though possess the masses$10^7 \div 10^9 M_\odot$. One can find easily that the reason for such a high mass-to-luminosity ratio is the big value of the velocity dispersion and, consequently, the forced involvement of dark matter. This situation is kind of confusing. Within the framework of our hypothesis or paradigm, which states that all baryonic objects participate in interaction with a dark energy carrier, which, in turn, inevitably leads to the transfer of energy to baryonic objects and their systems, an expansion of these systems must occur, since the virial theorem becomes essentially positive, even if before it was zero. The fact is that our hypothesis appears owing to the existing observational data and known laws of physics. On the other hand, the idea of the existence of dark matter was dictated by the unproven Kant-Laplace hypothesis, which to this day regulates all the mechanisms of the formation of space objects. Moreover, if the existence of dark energy is an observational fact and apparently accepted by the scientific community, then the need for dark matter simply disappears.

3. Clusters of galaxies and galaxies

Clusters of galaxies are the largest baryonic structures in the observable universe, which yield some categorization. Of course, larger structures exist as well, called superclusters, but those are simply some kind of conglomerates, composed of clusters and groups of galaxies. We will not dwell on the analysis of the advantages and disadvantages of these classifications, but I would like to mention one classification - simple and visual, which was one of the first. We are talking about regular and irregular clusters, which differ from each other not only in appearance but also in composition. In short, regular clusters have more "regular galaxies", which are elliptical and lenticular galaxies, while irregular clusters are dominated by spiral and irregular galaxies.

The estimate we obtained in the previous section is more suitable for regular clusters. However, it can also be used for irregular clusters. In both cases, there is a rather large velocity dispersion, which is usually a sign of the instability of any system. The estimate we obtained in the previous section is more suitable for regular clusters. However, it can also be used for irregular clusters. In both cases, there is a rather large velocity dispersion, which is usually a sign of the instability of any system.

Nevertheless, the idea of the existence of dark matter first appeared due to studies of kinematical conditions in clusters of galaxies (Zwicky, 1933, 1937). Nearly a century ago Zwicky was the first to notice that galaxies in clusters possess an extremely high-velocity dispersion, which makes these structures non-stable and predicts their expansion. That was the real situation, shown by the observational data. Zwicky could make the most evident inference, dictated by the relevant observational data, Moreover, the scientific community was aware of the expansion of the universe already, and it was obvious that clusters' kinematics resembled actually the kinematical situation at the larger scales of the universe structure.

Zwicky, a very famous and professional astrophysicist, was unable to overcome the inertia of thinking that the clusters were the result of the condensation of more rarefied matter and reached a balanced state due to compression. If we take such a formation mechanism as a basis, then obviously the cluster formed in this way cannot expand. It is this approach and belief in the existing hypothesis that led to the introduction of the idea of dark matter. Nothing more. If Zwicky had been a little more daring and believed more in observational facts than in the speculative conclusions of authoritative predecessors, there would not have been an almost century-long search for dark matter.

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However, he preferred to come up with an artificial possibility of reconciling new data with old ideas and introduced a new free parameter called dark matter. The virial theorem when the dispersion of velocities is used instead of velocities has the following form:

$$\sigma^2 = \frac{1}{5}\frac{GM}{R}, \tag{13}$$

for example, represents the relation between velocity dispersion σ and particles (galaxies) total mass M and system's radius R for the spherical homogeneous distribution of particles. Putting here for Coma cluster $\sigma = 1000 km/s$, $2Mpc$ one can find easily $M = 2 \times 10^{15} M_{\odot}$. Assuming that there are two thousand galaxies in the Coma cluster, we obtain the average mass of a galaxy $\sim 10^{12} M_{\odot}$ which is a very large value.

Anyway, a long time passed after the introduction of dark matter, and many new discoveries took place during this period, including the most relevant one for the issue under consideration. Undoubtedly, saying most relevant we bear in mind dark energy, which drastically changed the situation. Unfortunately, the majority of researchers take this discovery as the next simple tool to fit observational data the old cosmogonic ideas. Nevertheless, this discovery showed, first of all, the big defects of the vulgar big bang hypothesis.

The next hierarchical class after clusters of galaxies, of course, are the galaxies themselves. Let us turn again to the "regular" objects of this class, which are elliptical galaxies. As is known, normal elliptical galaxies show a velocity dispersion of about 200 km/sec. The velocity dispersion of dwarf spheroids can reach up to 80 km/sec. These values together with accepted values of their radiuses give huge values of the mass equal to $10^{12} M_{\odot}$ and $8 \times 10^9 M_{\odot}$, correspondingly.

Guided by the same ideas, we also obtain huge values for the masses of galaxies. This is a long-established technique, and the majority of researchers have no doubts about its correctness. However, once again it is worth repeating that the cornerstone for using this formula is the assumption that all given systems are gravitationally bound and in a stationary or balanced state.

4. The nearest space.

Let us consider the immediate vicinity of the Earth, namely, the Earth-Moon and the Sun-Earth systems. For both systems, the available observational data show a gradual increase in the distances between objects. The Moon removal velocity is 3.82 ± 0.07 cm per year (Dickey et al., 1994) and the Earth's recession velocity amounts to 15 ± 4 cm per year (Krasinsky & Brumberg, 2004). Researchers traditionally attribute these expansion phenomena to tidal effects in the said system. We have repeatedly mentioned in our articles that in the Earth-Moon system, where the corresponding observational data are available with the required accuracy, the calculations do not confirm the tidal mechanism or support it as a second auxiliary tool when applying the Hubble expansion effect to smaller scales.

As for the change in the distance between the Sun and the Earth, there is no observational data on a decrease in the Sun's spine. Therefore, no calculations to test the correctness of the proposed hypothesis is possible. Based on this, and also taking into account the paradigm that the carrier of dark energy interacts with baryon objects at all scales and constantly transfers a certain amount of energy to them, we, remaining within the framework of this paradigm, considered this issue and found, in our opinion, self-consistent solution (Harutyunian & Grigoryan, 2018). In our interpretation, there are two main mechanisms at work, and both are associated with the impact of dark energy.

The fact is that in our approach when the interaction of the carrier of dark energy with baryonic matter is assumed on all scales, such interaction also includes atomic nuclei. Due to this interaction, they constantly absorb some, apparently, an extremely small amount of energy per unit of time. But in view of the cumulative property of energy, the "mastered" amount of energy is gradually growing. This process is accompanied by two very important phenomena that are interconnected. Excess energy reduces the binding energy of atomic nuclei, thereby increasing their mass by reducing the mass defect. But, on the other hand, a decrease in the binding energy destabilizes the atomic nucleus, gradually bringing it closer to the state of radioactive decay.

Naturally, all this is based on known observational data and the laws of physics, which today are well known to us and have been empirically tested many times. However, this is not yet sufficient to prove that in the situation we are considering these laws operate in exactly the way we assume. Therefore, various empirical schemes are required to test the validity of our reasoning, as well as observational data that

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contain ”fingerprints” of those physical processes that occur according to our scenario of the evolution of water matter under the influence of dark energy.

One such ”fingerprint” is the chemical content of space objects. We will return to this issue in the next section. Here we just intended to remind the reader about the removal of the Earth from the Sun, which is the result of the injection of dark energy into the gravitational system, on the other hand, is slowed down by the same injection of energy into atomic nuclei and an increase in the mass of the Sun.

The parameter η , introduced above for a qualitative assessment of the ”strength of influence” of dark energy on the gravitational system, can also be calculated for small scales, which are the distances of the Earth from the Sun and the Moon. But in these cases, instead of spherical formations, we are dealing with systems that are geometrically flat. To put it mildly, it is not very clear how dark energy affects baryon objects, and what part of it has a direct impact. Therefore, we will assume that this process involves that part of the volume of space, the points of which are between space objects. These parts of space are enclosed in volumes of truncated cones, the bases of which in one case are the Sun and the Earth, and in the second case - the Earth and the Moon. It is clear that the height is given by the distance of these objects. Thus, we have the volume

$$V_{de} = \frac{\pi R}{2}\left(r_1^2 + r_2^2\right), \tag{14}$$

where r_1 and r_2 are the radii of two interacting objects (Sun and Earth or Earth and Moon) and R is the average distance between them. The gravitational energy of two-body system, which we consider here, will have the following simple form:

$$E_{gr} = -G\frac{M_1 M_2}{R}, \tag{15}$$

and consequently the parameter η should will be

$$\eta = -\frac{V_{de}\rho_{de}}{E_{gr}} = \frac{3k}{8}\frac{R^2\left(r_1^2 + r_2^2\right)}{M_1 M_2}, \tag{16}$$

where k is given by the relation (9).

Calculations give the following tiny values for required parameter: $\sim 10^{-13}k$ for the Sun-Earth system, and $\sim 10^{-15}k$ for the Earth-Moon system. It is easy to see, that for the Earth-Moon system the parameter η is about 10^{19} times less than for clusters of galaxies. However, when we calculate the ratio

$$\mu = \frac{\sigma}{R}, \tag{17}$$

where σ is dispersion for clusters of galaxies and increase of the radius of lunar orbital radius per second, we obtain more or less similar values, which are close to the Hubble constant value, being larger for clusters.

5. Evolutionary scenarios.

Various phenomena of the activity of space objects in the form of instability and non-stationarity are undoubtedly associated with the appearance of excess energy, from which the object must be freed in various ways. As the primary cause of evolutionary processes, active phenomena were first indicated in the works of Ambartsumian. Along with this, the question of the source of energy that controls these phenomena was very non-trivial. After the discovery of dark energy, this question gets its natural and logical answer. Indeed, the amount of dark energy is considered to be the largest in comparison with all other types of energy-mass, and also the carrier of dark energy interacts with baryon objects of all hierarchical levels. And finally, when interacting, energy always flows in one direction - toward baryonic objects.

Any object has some ”limit of stability” in relation to the amount of internal (excess) energy. We keep in mind that the interaction of baryonic objects with a carrier of dark energy occurs continuously. Even with very small portions of energy transfer per unit of time, over time, the amount of ”mastered” energy increases unhindered and can reach the ”stability limit” if the object is somehow not simultaneously released from all the received energy. This process destabilizes the object, which leads to the need to release the accumulated energy.

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

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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. Above, we assumed that the ratio η of the amount of dark energy in the volume occupied by an object to the gravitational energy of a baryonic object can serve as an indicator of the object's compliance under the influence of dark energy. The greater the ratio, the stronger the process of evolution is forced by dark energy.

It varies from object to object for two reasons. First, the amount of dark energy is considered to be strictly proportional to volume, and gravitational energy is proportional to the second power of mass, which means proportional to the second power of volume. Second, the density of a baryonic object varies from object to object and within the same object. With the same density, it turns out that objects of smaller mass are more easily amenable to the evolutionary influence of dark energy. But one thing remains unchanged. This is that the given body receives a certain amount of energy, which must be mastered according to the laws of physics.

Let us test it for the spherical object. The gravitational energy of a homogeneous object of mass M and radius R as follows from the relation (7) is proportional to the second order of the mass:

$$E_{gr} \sim -G\frac{M^2}{R}. \tag{18}$$

where

$$M = \frac{4\pi}{3}R^3\rho = V\rho. \tag{19}$$

What does mean energy injection into the object? It changes the total energy of the object, but we do not know yet how it would distribute in the body. The body is made up of atoms, and we assume that they are also affected by dark energy. Such an impact, according to the second law of thermodynamics, increases the energy of atomic nuclei, which leads to a decrease in the binding energy and an increase in the masses of the nuclei.

We repeat that it does not matter how much the mass increases per unit of time, since this process continues as long as there is a given nucleus and it interacts with the carrier of dark energy. We are still interested in the fact that the mass of atomic nuclei increases, thereby increasing the mass of the given object. This further reduces the energy of the object, instead of increasing it. This means that the radius should increase or the mass ejection from the object should happen.

No doubt, the situation is not an easy one for comprehensive understanding. Various changes can happen when permanent energy injection is going on. The mass increase changes the quasi-stability between compressing and expanding pressures. We do not have any calculated model to estimate quantitatively all processes taking place during the energy injection. This excessive energy partially can transfer into heat, which in its turn will increase the inner pressure against mass growth.

Let us make here one more important remark, which may help to understand how some features of the structure of cosmic structures are formed. We are talking about the existence of two types of the stellar population in galaxies and their relationship with the regular and non-regular forms of the distribution of objects, namely, stars in galaxies and galaxies in clusters.

Even a superficial study of the mentioned structures allows us to come to the conclusion that all regular structures are devoid of or have only an insignificant rotational moment, while irregular ones, on the contrary, have a significant rotational moment. Therefore, it is not unreasonable to assume that in the absence of rotation, the proto-structure (proto-galaxy, proto-cluster), under the influence of dark energy, in order to free itself from excess energy, ejects clumps of matter isotropically from the surface layers of the proto-object.

However, if the latter has a significant rotational moment, then in the equatorial region, mechanical centrifugal force is also added to the ejection mechanism due to the influence of dark energy. At the same time, matter can be ejected not only from the outer layers but also from deeper layers, where the matter has gone through a shorter evolutionary path than in the outer layers (Harutyunian, 2022). The shorter the evolutionary path, the higher the metallicity. Such a scenario quite accurately explains the existence of two types of population, their striking difference in metallicity, and the existence of a metallicity gradient in galaxies.

6. Concluding remarks.

Based on our hypothesis of a continuous interaction between baryonic matter and a carrier of dark energy, we considered the possibility of the existence of stable structures of baryonic objects with the virial

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theorem equal to zero. This question is very important from the point of view of choosing the concept of cosmogonic models.

In the model accepted by most researchers at the present time, all cosmic structures are in an equilibrium state, and, according to the model, they have reached this state due to the compression of a more rarefied substance. This state of affairs excludes the possibility of the existence of such systems with the virial theorem greater than zero. Here we argue the opposite, based on the fact that any even equilibrium system of baryon objects, interacting with a carrier of dark energy, no doubt continuously receives a certain amount of energy from it and passes into the class of unstable ones with energy-increasing with time.

We also briefly reviewed Ambartsumyan's well-known assertion that the evolution of cosmic objects is due to active processes, which show that everywhere active processes are accompanied by excess energy. We hypothesize that various manifestations of excess energy are portions of dark energy transformed into baryon structures.

A lot of observational facts fit our ideas on these subjects. We consider very briefly here the scenario of galaxy formation to show how can be explained first and second type stellar populations and also the metallicity difference between them. We are going to continue our research in this direction and carry out a more comprehensive analysis of relevant observational data.

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