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THE METHODOLOGICAL PROBLEMS OF "HUMAN-SIZEDNESS" OF MODERN COSMOLOGICAL THEORIES

Abstract

The article is picking up new methodological approaches to the study of the Cosmos and the understanding of the place of a human being in the Universe. The article has a methodological character and is presented in the form of the analysis and synthesis of various aspects of the study of this problem.

The article considers theoretical and methodological aspects of cosmology, the analysis of modern scientific theories, the scope of their applicability. The obtained outputs can be used in cosmological modeling and in the studies of anthropological and existential aspects of cosmology.

The authors conclude that there is only nondirective proof of the study of calculated predictions when investigating the early stages of the evolution of the Universe. Theorists simulate the processes of evolution of the Universe and compare the simulation results with the available empirical data. There is a possibility to change initial conditions within certain limitations to obtain the outer facts. The extrapolation of Friedmann model at earlier stages of the evolution of the Universe is permissible only up to certain limits, whereupon «normal» laws fail and abstract formulas remain, which critically do not accept experimental verification. Neither of modern relativistic cosmological theories erase a problem of the anthropic principle, i. e. they do not respond to a question of the place of a human being in the Universe.

Key words: anthropic principle; cosmology; the Universe; methodology.

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МЕТОДОЛОГИЧЕСКИЕ ПРОБЛЕМЫ «ЧЕЛОВЕКОМЕРНОСТИ» СОВРЕМЕННЫХ КОСМОЛОГИЧЕСКИХ ТЕОРИЙ

In the middle of the twentieth century, there has been formulated the so-called anthropic principle, the main point of which is to reply the questions: why could there appear Reason in the Universe cognizing it? Why do the physical conditions of the Universe tend to the formation of complex structures up to the rational beings?

With the latter, we pose a question, what is the place of a person in this world. Whether he is the output of the "incredible coincidence", or there exist some mechanisms in the Universe that make this process naturally determined. The worldview of a man depends on the solution of the problem, his attitude to the world and himself.

For this reason, methodologically the question of cosmological theorization is very important, which would take into account the "human-sizedness" component.

Currently the problem is not examined, as modern scientific theories do not account for it.

Let us discuss it in more details.

The ground of modern relativistic cosmology is the general theory of relativity. The theory describes the space entirely; therefore it is possible to build a model of metagalaxy hinged on it. Metagalaxy will be understood as a part of the existence that is available to empirical observation and theoretical analysis. The model developed by the author of GRT is the simplest in which the Universe is stationary, and has a finite volume, but holds no boundaries. The simplest geometric surface of this type is a spherical Riemann space, all points of which are equally valid, and that possesses a finite volume. It is important to emphasize that according to GRT the geometrical properties of space are not independent: they are determined by the distribution of matter. The existing heterogeneity in the distribution of matter tends to quasisphericity, but in general this universe should be limited and have a finite volume.

Its radius can be found by the formula: $R = \sqrt{\frac{2}{\gamma\rho}}$, where γ is a constant, and ρ is the average density of matter in the Universe. This formula is for the so-called cylindrical world in which space has constant curvature and does not depend on time.

Einstein had serious methodological difficulties when building the metagalaxy model. The calculations have shown that the world built in this way can not be sustained. The least radius deviation from the calculated values will tend to the escape of the steady state, the density of matter will change and metagalaxy will go out of balance. Einstein believed that the world was steady and not changing. It was possible to agree with the author of GTR only by introducing the additional equation term, which would be responsible for gravitational repulsion. It was a limitation of the theory. The author believed that such forces would be found by the analogy with the electromagnetic interaction, becoming apparent both in the form of gravitation and repulsion. This belief was hinged on the fact that the assumption of constant radius of metagalaxy seemed inevitable to Einstein.

Thus, the Einstein model of the world was a self-contained cylindrical space, which can be described in a Gaussian coordinate system that corresponds to the boundaries of applicability of the general theory of relativity, on the basis of which this construction was built. The model does not allow strong discontinuity (discontinuity in the space-time continuum, singularities) and cannot adequately describe the various quantum effects, space-time "kinks" and "holes". Also it is necessary to note that the cosmological evolution has no meaning in the framework of this model, because in general metagalaxy is considered to be stationary.

In addition, Einstein's theory does not describe the whole Being, but only its limited scope, which can be described by mathematical equations. From the cosmological point of view, we describe very large, but a certain fragment of reality, not the entire Universe. This means that the model hinged on Einstein's theory may not qualify for a description of something beyond, and this model cannot describe the effect of Being on metagalaxy. Thus, the ontological scope of applicability of GTR is identified, and any theory which is built on it can describe only metagalaxy and cannot go beyond it, both in space and in time.

In addition to the Einstein cosmological model, there was created De-Sitter model in 1917, which corresponded to the spherical world. This model was also hinged on the general theory of relativity, but it had fundamental differences. De-Sitter considered vacuum metagalaxy with the complete absence of matter, but the curvature of space-time existed. The presence of matter made further corrections. Einstein's space was flat, and the presence of mass and the gravitational field tended to its curvature, and the space of De-Sitter had the curvature and was expanding.

This model was theoretical in nature and it was not considered as reflecting the objective reality, since it is clear that the matter exists in metagalaxy. However, the Sitter model had a crucial methodological importance: the evolution of metagalaxy in cosmology was mentioned for the first time. Thus, 1917 should be considered the year of the evolving Universe origin. There were many questions and the main was: how it all began?

The possible answers were mathematically received by A.A. Friedmann in the article "On the curvature of space" in 1922. The author was aimed to obtain the general solution of the cosmological equation, from which the Einstein and De-Sitter models would follow as special cases.

Some coefficient M is introduced in the Friedmann equation for the space-time interval, the square of which is the coefficient before the time coordinate x_4. It is a function of four world coordinates. If to assume $M = \cos x_4$, that the De-Sitter Universe is obtained from the Friedman's equation, if we put $M = 1$ – Einstein model. Friedmann makes the following conclusion after mathematical calculations: "Thus, stationary world can be cylindrical world of Einstein or spherical world of De-Sitter" [5]. That is Friedmann`s equation are fully consistent with the principle of compliance and, in addition, that is a sequitur the possibility of the existence of non-stationary world. Through the analysis of various cases of solutions of the equation, Friedmann comes to the conclusion concerning the possible existence of three different worlds: a monotonous world of the first kind, monotonous world of the second kind and periodic world.

The monotonous world of the first kind corresponds to the radius of metagalaxy in which restrictions are not imposed on it and we can calculate the point in time at which the radius of metagalaxy is equal to zero. Then its age will be equal to the period of time during of which this radius is changed from 0 to R_o, to the present status. The monotonous world of the second kind differs from the first by the fact that the initial radius value is not zero, and corresponds to a certain value x_o, which depends on the mass of metagalaxy and its density. Periodic world is limited by radius, depending on the parameters of metagalaxy as well. The question which solution corresponds to the real world remained open, because the empirical data was not sufficient in Friedmann's times for theoretical calculations and answering the question – what was our world like. Thus, the Friedmann's equation gave three options, one of which excluded singular state.

The first reaction of Einstein was a sharp criticism of this work; he kept the idea of the stationary model of the Universe. However, in six months, he changed his mind when he spoke with Friedmann's colleague Krutkov, and published an article in which he accepted his mistake. Thus Einstein turned from the enemy of Friedmann model to its supporter. His support had a great influence on the fate of the model of evolving metagalaxy, and it was recognized by the scientific community and got the name "dynamic evolving model", marking the beginning of the evolutionary cosmology.

However, the modified variants of the theory began to emerge, and these theories attempted to get rid of evolution, because it suggested the idea about the origin and evoked the idea of the creation of the world, which was unacceptable for science. So, in 1925 J. Lemaitre proposed a theory, in accord with the evolution of the Universe began with the extension of some compact bunch of matter, which corresponded to a monotonous world of the second kind. Then it reposed for a long period of time, which could be regarded as a relatively stable state, which corresponds to Einstein model. However, this approach did not solve the main problem, besides the experimental confirmation of the extension made it unsustainable.

More radical model was developed by F. Hoyle: he made an attempt to combine the expansion of the Universe and its stationarity. The Hoyle model proclaimed full equality of all points of space (this is the idea of Einstein) and all points of time: the universe is expanding, but it has no beginning, because it is always like per se [2]. The last statement was named a perfect (or ideal) cosmological principle.

The idea is that the birth of new objects between the existing objects occurs in the process of expanding of metagalaxy in the way metagalaxy remains constant in time. The author of the idea suggested to check this principle monitoring long (so very old) galaxies: if it is true, they should be the same as now; if it had a beginning, then they should be more compact. Monitoring of the nearest space does not allow detecting such a birth, because only one particle appears in one cubic meter of space for 300 thousand years according to the calculations, and it is impossible to detect small space distances. At present the observations of long galaxies confirmed that the hypothesis of Hoyle was wrong. However, it was seen as an alternative of Friedmann model nearly half a century.

It is interesting to note the fact that for the first time the term "Big Bang" was introduced to science by Hoyle. Criticizing the dynamic evolving model at the lectures in 1949 he noted that the idea of an explosion seems to him "totally unsatisfactory". It was said before the observations of distant galaxies and subsequently this term was reserved to the model of Friedmann. Currently, the "Big Bang" is interpreted as the expansion of space itself, like an inflationary bubble. It should be noted that no objects in space are away from each other, and points of space itself are removed from each other by increasing the amount of space. Therefore, we need to consider this term as a metaphor and not in the direct sense of the word. Representatives of creationism very often forget about it when criticizing Friedmann model.

The hypothesis of the "hot Universe" of G.A. Gamov was a significant addition to the theory of the expanding of metagalaxy, the foundations of which were laid in 1946. A significant addition is the fact that metagalaxy was extremely hot and dense at the early stages of evolution. You must also use the laws of thermodynamics, nuclear physics and elementary particle physics to describe such a state of matter in addition to the laws of gravity. We can say that the hypothesis of Gamov created a new branch of science, which was subsequently named astroparticle physics.

This model has allowed describing the stages of the evolution of matter in metagalaxy in more details. Now scientists spoke not just about the expansion, but about a qualitative transformation of matter and radiation. About a quarter of protons due to the high temperature fusion reactions turned into helium nuclei (alpha particles). The temperature dropped as a result of the cosmological expansion. When it reached to 4000 K, protons, alpha particles and electrons recombine atoms of hydrogen and helium was formed in the result. Further the synthesis of substances stopped, it broke up into separate fragments, which began to form galaxies, stars, and planets under the influence of gravity.

Thus, it should be noted that there were several different approaches to the evolution of the Universe in the process of formation of relativistic cosmology. Some of them supplemented and specified Friedmann model, others tried to find an alternative explanation.

Currently, the Big Bang model is being accepted, the age of our metagalaxy is estimated equal to 13,7 billion years with an accuracy of less than 10 %. The theory does not answer the questions: why the Big Bang happened and where the initial lump of matter appeared. But further the evolution of metagalaxy traced good enough for a whole and for its individual parts.

Now let us dwell on the experimental evidence for the Big Bang theory. As it was noted by I.D. Novikov, the processes occurring in the first seconds since the beginning of the enlargement had important implications for today's Universe. We can restore the character of the processes using the traces they left behind [9]. These "traces" and their consequences enable to verify the cosmological processes in the early stages of the evolution of the Universe, although there is a limit beyond which this is impossible. Therefore, the following indirect confirmation must be seen as a supporting one of the possible variants of the evolution of the Universe, which are not contrary to observations, but which do not exclude the possibility of alternative explanations.

The first important argument in its favor is the cosmological red shift of lines in the spectra of stars and galaxies that E. Hubble opened in 1929. According to the Doppler effect, the removal rate of stars and galaxies from us is determined by him. We observe the proportional dependence of the offset of lines from the distance. That is, the further away a galaxy is from us, the faster it removes from us. However, there are a number of methodological problems associated with the interpretation of this fact.

If we take the experiment data obtained by E. Hubble in 1929, we will have the proportional dependence of the frequency shift from the optical path length of the beam of light, and nothing more. We can conclude about the extension of metagalaxy according to this data, but it should be noted that this is not the only possible explanation. We can produce a number of arguments that explain the observed effect with the help of other reasons.

If we assume that all space is filled with some substance, for example, physical vacuum, the photons lose energy when driving in this substance, and, consequently, reduce its frequency, which tends to red shift. It is clear that the more far distance photon comes, the more resistance it feels and the more energy it loses. Another possible explanation is the hypothesis of aging photons. The reducing energy is not linked to the distance in this interpretation, but to the time: the longer the photon is, the more energy it loses. Again, have a proportional dependence of the frequency shift from the optical path length of the beam of light, because the motion of the photon from distant objects is proportional to their distance. Since these effects are only on long distances, order mega parsec, we can't check them in the laboratory.

But the generally accepted explanation using the Doppler effect is faced with certain difficulties. This effect depends on the speed of removal of the emitted light of the object and neither from the distance and nor from the time. If two objects are removed from each other in space, the frequency of received light will decrease compared to the emitted.

In the model of the expanding metagalaxy, the objects are removed from each other not due to the motion in space, but due to the expansion of space itself. In this case the energy will also be reduced, but the physics of the process will be different from the Doppler effect. Moreover, if the expansion takes place, each object in space (including standards) should also be extended by the same law. Therefore, we can see the expansion of space only from the outside. Just as slowing down the time in the moving reference system relative to the fixed, according to the special theory of relativity. If the observer is in the moving frame of reference, he will not notice the time dilation.

One more interpretation is possible. The gist of it is that empty space increases its size, and the objects remain unchanged in space. In this case, we need to acknowledge that the objects are not related to space and exist by themselves, which is in contrast to the theory of relativity.

Thus, the red shift in the spectra of distant galaxies can be explained not only by the Doppler effect, but also by other alternative hypotheses, which just both accept and reject the extension. For this reason, unambiguous correspondence cannot be between red shift in the spectra of distant galaxies and the expansion of metagalaxy.

The second argument is the existence of relict radiation that fills the space completely, which is a result of the evolution of electromagnetic radiation generated in the first instants after the Big Bang. And this radiation could appear only in the bitterness metagalaxy that corresponds to the model of G. Gamov. Until the middle of the 1960-s it was not clear whether the universe was hot or cold in the early stages of its evolution. The decisive moment that marked the beginning of the second stage in the development of modern cosmology, was the opening of microwave background radiation with temperature $T_\gamma \sim 2.7$ K. Penzias and Wilson in 1964-1965, coming to us from the most distant regions of the Universe. The existence of such radiation was predicted by the hot Universe theory, which became widely accepted immediately after the discovery of relict radiation [6, p. 19].

The most important fact is that the Planck character of the spectrum of the relict radiation is an evidence of the existence of the state of the local thermodynamic equilibrium between quanta and space plasma in the past. This condition allows us to build a detailed thermal history of early metagalaxy with the indication of the characteristic stages, when there was a change of qualitative structure of matter due to mutual transformations of elementary particles of a different kind [1]. We cannot speak about direct experimental observation, but the different theoretical explanation Planck character of the spectrum of the relict radiation is hard to find. This suggests that metagalaxy was in a state of thermodynamic equilibrium at the early stages of evolution. This balance was broken under the influence of gravity, which enabled the evolution of space objects.

In fact it was recorded by D. Mather and D. Smoot. In 2006 they were awarded the Nobel Prize in Physics for the opening of the anisotropy caused by the presence of "germ" of galaxies and their clusters. This discovery allows us to answer one of the most important issues of modern astrophysics: how and why different patterns occurred in the distribution of matter in the expanding Universe [4]. That is the relict radiation anisotropy acts as a picture of the past of the Universe. However, it should be noted that the existence of the relict radiation does not directly prove the expansion of metagalaxy. It proves only that at the early stages the temperature and density were high. Cooling and reduction of density is easily explained by the extension, but we can explain these facts differently. Once again, unambiguous correspondence of relict radiation and expansion of metagalaxy is not observed.

It can be stated that in the description of the evolution of the universe we have a number of observational data from the distant past, which confirm theoretical calculations indirectly. However, the process of metagalaxy evolution is impossible to reproduce fully, so we need to talk not about testing, but the fact that the obtained experimental data do not contradict with the theory and this theory can be considered as one of the possible scenarios of the world development.

There are a number of difficulties when we try to extrapolate the events in the more distant past, which is not available to the modern observations. The evolution of matter in the space of time from 13,5 billion years ago to the present time (which corresponds to the most distant objects observed through a telescope) does not cause any fundamental objections. There is no reason to modern laws of physics at that time not to be carried out, but issues about the initial stages of metagalaxy evolution and especially about the cause of the expansion are very critical.

Although modern accelerators conditions recreate conditions of the initial stage of expansion, we do not find it possible to speak of a direct experimental observation of the "beginning of the beginning". The laws of nature are unknown to us at ultra-low volume and very large densities. Gaussian coordinates and General theory of relativity are not applicable, as Friedmann model. We can't recreate such conditions in the laboratory and the application of the models for a "normal" state of matter gives absurd results. In addition, we cannot answer the question of what it was before the expansion, within the framework of these theories, because extrapolation theory in the negative time region is not physically meaningful. Linde notes that in the work of Landau and Lifshitz it is written about the impossibility to continue the Einstein equation in the negative – time region, so it is meaningless to ask what it was before [7]. But it only shows that this theory is not applicable to describe the state of the objective reality before the extension.

Moreover, over the last 10-15 years in observational cosmology scientists have discovered a number of facts that do not fit in Friedmann model without additional assumptions. The most striking example is found by S. Perlmutter, A. Riess, and B. Schmidt the accelerated expansion of the Universe, which in 2011 was awarded the Nobel Prize in physics. Now we realize that the universe up to 95 % consists of the objects we know nothing about: this is the so-called dark matter and dark energy. And only 5 % we can see [10]. It is evident that to expect the GTR to be able to describe these objects is not necessary.

Thus, we can distinguish the following methodological aspects in the study of the evolution of matter at the level of metagalaxy:

1. There is only nondirective proof of the study of calculated predictions when investigating the early stages of the evolution of the Universe. Theorists simulate the processes of the evolution of the Universe and compare the simulation results with the available empirical data. There is a possibility to change initial conditions within certain limitations to obtain the outer facts.

2. The extrapolation of Friedman model at earlier stages of the evolution of the Universe is permissible only up to certain limits, whereupon "normal" laws fail and abstract formulas remain, which critically do not accept experimental verification.

3. There is a number of experimental data that cannot be substantiated by the theory of relativity and require additional analytical study.

4. Neither of modern relativistic cosmological theories erases a problem of the anthropic principle, i.e. they do not respond to a question of the place of a human being in the Universe. For this reason, it is necessary to consider methodological approaches to the "human-like" cosmological theorization, which would include a consideration of these methodological problems. This is highly relevant, since understanding of the laws of the Cosmos will allow each person on the earth go to the next level of the development and organization of social life, which will solve current global problems and shift the society into the noosphere – the harmonious interaction of society, technology and nature.

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