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ABOUT RECESSION OF GALAXIES

cosmological essay

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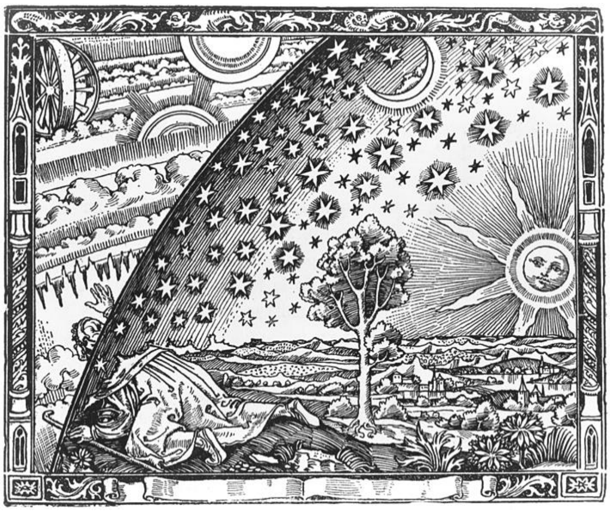
Vintage engraving

But the Emperor hasn't got anything on!- a little child said.
H. C. Andersen

Abstract. In this paper, we consider the mechanics of galaxies recession based on the postulate of the effect of gravity on them, as the only possible interaction at intergalactic distances, and this makes a more adequate representation of the observed galaxies. It is determined that each galaxy after its birth with zero speed at the edge of cosmos, is subjected to a stable influence of gravity (external attraction). At the same time the duration of this influence for each galaxy is naturally limited. When the acceleration ends, each galaxy moves by inertia at its own acquired speed. It is for these reasons that the recession of observed galaxies is described by the Hubble parameter. The first few galaxies in cosmic history were not subject to this gravity and, by definition, had zero velocity relative to the microwave background radiation. In cosmos there is always a sharp boundary at a certain radius - either this is the movement of galaxies with acceleration, or uniform one. Some prototypes of this gravity start from Einstein's cosmological constant and develop to the so-called dark energy. The source of gravity is located outside cosmos, and the mass of cosmos is constantly growing from the outside and its flat three-dimensional space does not expand.

With such a consideration of the latest discoveries of distant galaxies at JWST, the possibility of observing only old galaxies has been established; young or early galaxies cannot be observed in principle.

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Along the way, the development of the topic allows us to reduce to trivial explanations such parameters that are still difficult to explain within the framework of the existing paradigm, such as the spongy structure and spatial uniformity of the cosmos, the origin of galactic filaments and voids as well as other astronomical entities and phenomena after which there are no significant dark spots left in cosmology.

The work uses the results of the theory of the Big Bang, namely for the phase transitions of matter from a time of 10^{-43} seconds to millions of years.

1. Introduction.

The earliest phase of matter at the time of the birth of the universe according to modern views, firmly based on laboratory data, is recognized as quark-gluon plasma, the earlier phases are assumed. Currently, the theory of Big Bang recognizes more than a dozen phase states of matter (this can be found everywhere in the Internet), and this is far from the limit, the limit is only in the energy possibilities of cognition of hot plasma. Within the framework of the Big Bang theory, these processes, starting from stellar structures, are known closer to the limit of 10^{-43} seconds. And these phase transition are fully recognized by us, but no more than that.

Modern string theory partially removes the problem of the original matter at the birth of the universe **[1]** and makes it possible to describe the original matter itself, but the possibility of string theory to reduce the multidimensional space of the original matter to a three-dimensional space has not yet led to any unambiguity **[2]**. With all these successes, the explosion itself as the cause of the scattering of galaxies in cosmology persists[2], despite all the well-known shortcomings in the reconstruction of the universe born as a result of the Big Bang. And that require either the presence of additional hypotheses[3] or to be kept silent. One of the weak postulates of the Big Bang is the singularity[4], in the volume of which, to explain the observed recession of galaxies from one point, it is necessary to squeeze the entire universe. The relationship between general relativity and quantum mechanics has its own, less grandiose singularities, in which it is not entirely clear how to understand matter, time and space. Recognizing the existence of the universe at 10^{-43} seconds after its birth with a density of 10^{97} kg/m^3 and a temperature of 10^{32} K, it is not all necessary to recognize its volume, correlated with the Planck discrete of 10^{-35} m. According to the principle of Occam's razor, the idea of the existence of any initial matter not in the form of a singularity, but in its inherent, most likely distributed state, is more acceptable than the idea of the existence of the same matter, fantastically compressed to the minimum imaginable size. If we do not limit the volume of the original matter, then its theoretical justification is quite possible.

According to modern views, one of the early phases of the existence of the original matter at the birth of the universe is assumed to be the matter of the Planck era **[4]**, since it is expressed in digital form, and not in the form of assumptions.

To justify the proposed purely theoretical development, it is assumed that all galaxies (not only observable ones) form a spherical three-dimensional *cold cosmos*, and a *hot shell* is located around it. The hot shell is spherically layered and from layer to layer undergoes several phase transitions **[5]**, more or less studied in the framework of the Big Bang theory, with unchanged parameters of each layer. The inner layer of the hot shell is the coldest, while its outer layer is the hottest and is in contact with the initial matter. All the layers of the hot shell move outwards in a coordinated normal, forming behind them new layers of the cosmos. In the outer layers (initial phases) of the hot shell, a new mass is constantly born. High-energy hot shell particles also have a gravitational charge. Under their summary attraction, the galaxies of the cosmos first accelerate, and then move by inertia.

With the existence of the hot shell around the cold cosmos, it becomes possible to justify the

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[2] For example, conformal cyclical cosmology by Penrose and Gurzadyan **[3]**.

[3] Such as the hypothesis of initial non-homogeneity spectrum, the hypothesis of inflationary expansion, the hypothesis of four-dimensional space of the Universe, the hypothesis of dark energy, inabsorbtivity of microwave background radiation etc. The further in time the BB theory exists, the more additional ad hoc hypotheses, some kind of layering of additional hypotheses.

[4] The singularity was needed just as the geometrical point of recession of galaxies. The singularity should be transformed somehow for the recession to take place. The bang explains a little except the incomprehensible demonstration of recession and complicates the cosmological model.

recession of galaxies by the only possible interaction at intergalactic distances namely the gravity, more real than an explosion.

One can be arbitrarily skeptical about the proposed reconstruction of the universe and its parts, but according to its results it is more convenient, more harmonious and more natural than the sum of theories (hypotheses) of the Big Bang theory [**6**],[**7**], collected ad hoc and not arising from the idea of an explosion..

2. Genesis. Hot shell. *Let's assume* that prior the birth of the universe the initial matter in the form of an extremely hot plasma with multidimensional space **[1]** extends indefinitely. In a hot plasma, fluctuations[5] constantly occur, and the more significant the fluctuation with reduced temperature, the less often it occurs. The large fluctuation that we are interested in occurs once in an "infinitely" long time. *Let's also assume* that some small region of the original matter has undergone a major fluctuation and thus has undergone a phase change. Because of its lower energy, the matter of a large fluctuation is more stable. Therefore, a single act of fluctuation of the original matter could give rise to a self-sustaining process in the form of a spherical front. We *also assume* that this self-sustaining process is continuous on the spherical surface of the resulting cooled region, and the front of the transformation of the original matter moves outward along the normal to the surface of this region[6]. The speed of this front is not the speed of any particles, but the spatial (phase) speed of the process. It can be more or less, but for convenience of presentation, this phase velocity is equated to the speed of light[7] **c**.

Is it possible that such a cooled region really exists? To answer this question, we will change the concept of the Big Bang in two of its aspects: 1 - the point of origin of the universe was not singular, i.e. did not contain the entire universe, 2 - the birth of the universe was not a one-time act, but once started, then continues continuously. These points are in agreement with the opinion of F. Hoyle, who was very skeptical about the Big Bang (BB) **[8]**.

So at 10^{-10} seconds after the beginning of the nucleation of the cooled region, the hot ball, having undergone several phase transitions, the last of which was quark-gluon plasma, had a radius of 3 cm. Everything that is outside the hot ball - even more hot source matter - is outside. Inside the emerging new universe, as in the theoretical substantiation of the BB, the cooling proceeds according to the hyperbolic law. In our case, the closer to the center means colder (in the BB situation, the later the colder, but immediately in the whole space). In the above example (as always in general) the time of transformation of the initial matter on the periphery of our universe is conditionally equal to zero (tending to zero), and the time from the beginning of generation for the center of the universe is already 10^{-10} seconds, and this is also the age of the universe at the moment in question. In accordance with this distribution of time along the radius, the temperature and density of matter change. At the center of the universe at a point in time 10^{-10} seconds (the end of lepton epoch) the matter consists of free quarks and anti-quarks, leptons and photons and has the temperature of 10^{15} K and the density more than the density of atom nuclei. That is these parameters in the center[8] are always significantly lower than on the periphery, where they, figuratively speaking, "go off scale".

Phase transitions of matter inside the formed universe in its finished form proceed in accordance with the BB theories **[6]**, **[7]**, but with the significant difference that these processes do not follow one after another in time throughout the entire universe. On the contrary, all these processes are present simultaneously with their spatial stratification along the normal to the hot shell. That is, an early hot ball consists of a certain number of spherical layers (or epochs, or eras, as is customary in the BB theory), different in the phase state of matter. In this case, the temperature and density decrease in the direction of the center according to the well-known

[5] Like in Tokamak, for example.

[6] Like phase boundary between the crystal and the melt.

[7] The velocity cannot be less than 0,1**c** otherwise the dimensions of the universe should be less than its visible dimensions.

[8] The center might include a set of some centers situated in different places and times but they unite into some general center at some time. The term "the center of the universe" is just the abstraction analogous to the term "mass center" because the universe must have its mass center. Introduction of the term "center of the object" makes the object finite.

hyperbolic laws of the BB model. In other words, the qualitatively different matter of the hot ball is located in spherical layers nested one into the other, that is, in each inner layer the matter is not only colder, but also qualitatively different, the matter of a different phase state. Over time, all these layers form a spherical hot shell around the future space. The formation of the hot shell is completed when the temperature in its center has dropped to hundreds of degrees Kelvin, which is the beginning of the formation of cold space inside it. In terms of time, this amounted to a million years after the beginning of the "creation" of the universe, when the radius of the outer sphere of the layered hot shell reached a million light years. At about the end of this period, the universe cooled enough at the center to produce hydrogen and helium atoms.

For the central region, the innermost phase of the hot shell has ended. In space that just began, gaseous clouds of hydrogen and helium (within 2 billion years) began to turn into galaxies, and the hot shell itself continues to move outward at the speed of light. And further, in all its thickness and in terms of the sizes of the layers, and in terms of the processes in them, the layered hot shell forever exists as a stable formation millions of light years thick, only with the passage of time its radius increases. That is, with an increase in the radius of the hot shell, the surface density of its layers is preserved.

So, as in the BB theories, at the turn of time 10^{-43} – 10^{-42} seconds, the gravitational interaction separated from the rest of the interactions, somewhat later, some particles, not without the participation of the Higgs boson, acquired mass. Matter in the form of mass is just beginning to emerge at this turn of time. In the future, after gravity, strong, weak and electromagnetic interactions with their own sets of phase states of matter will be singled out into separate types of fields. But in the BB theory, all processes are one-time, and the selection of fields, and the transformation of matter occur simultaneously in the entire space of the universe, i.e. the mass of the universe after the explosion of the singularity is constant, since all matter was concentrated in the singularity. And in the proposed model, the birth of the universe has a beginning, but in the subsequent birth of the universe continues continuously on its periphery, i.e. the mass of the universe, as well as the size of the universe, has been constantly increasing since its inception.

In general, according to its phase states, the universe can be conveniently divided into cold and hot. In the cold universe (space), such phase states as solid, liquid, gaseous and plasma are possible, while the observed space (metagalaxy) is located in the middle region of the cold universe. In a hot universe (shell), the first three phases are impossible.

3. The gravity of the hot shell. Behind the extreme layer of cold space, namely the layer of hydrogen and helium, there is a layer of recombination of light nuclei and electrons, then a layer of synthesis of light nuclei, and so on up to the time matter of 10^{-43} seconds, i.e. to the edge (beginning) of the permanent birth of the shell. All these layers within an elementary solid angle experience gravitational interaction with each other and are subject to photon (and similar) pressure.

For the question of the acquisition of speed by galaxies, it suffices to trace in one version the gravitational interaction between the layer of hydrogen-helium clouds and all its more peripheral layers, and in the other, the layer of primary nucleosynthesis following the layer of recombination of light nuclei and all its more peripheral layers. If, in the second variant, mutual attraction to more peripheral layers is experienced, then, *presumabl*y, the layer of nuclear synthesis does not acquire any mutual, any noticeable speed due to the limited time (minutes) of the existence of this layer within the hot shell. Another thing is a layer of hydrogen-helium clouds. Its density is very low, and it has ceased to be subjected to the pressure of photon radiation, because for the emission of photons, the hydrogen-helium plasma is opaque. But, most importantly, the time of the effect of gravity on this layer is more than a million years, and accordingly to this time, the speed of hydrogen-helium clouds will be greater. Consequently, after, relatively speaking, its formation, the layer of clouds experiences (within the limits of an elementary solid angle) acceleration caused by attraction to the hot shell, and acquires an already noticeable speed.

To consider the acceleration of galaxies (clusters of galaxies) in the first approximation, we can consider the influence of the cosmos and the hot shell on them separately. Under this condition, one can consider the influence of a hot shell in its idealized form, for example, in the form of some layer of a real hot shell and without taking into account phase transformations in its thickness, and its existence as a simple geometric displacement relative to its center while maintaining its average density. By analogy with BB, all velocities and accelerations directed from the center are positive. Operating with the concept of "hot shell", it is necessary (in the first approximation) to delimit the hot shell from what remains after its "passage" - from the new cosmos, which is formed immediately after the "passage" of the hot shell. This space in the first approximation does not move, and the hot shell moves at a tremendous speed.

The continuous displacement of the hot shell in its step-by-step expression for a stationary test body **m** inside it represents, with each step, a new discrete mass, with which, before this step, the test body **m** did not yet have gravitational interaction. This is the fact of the constant attraction of the test body **m** to the hot shell. The motion of the hot shell is phase, and the test body **m** experiences real gravity from it. Due to the constancy of the average density of an idealized hot shell, when it moves outward, gravity from it within an elementary solid angle and in any one direction has the same value for any positions of the hot shell (for any of its radius). And the gravitation of the new cosmos, located just behind the radius of the body location **m** and growing in the radial direction, under the same restrictions, has a constantly increasing value. The intensity of the gravitational field of a hot shell within an elementary angle does not depend on the distance to it - the area (mass) of the shell section corresponds to the square of the distance to it. Actually, if the shell has been formed long ago, then the test body **m** does not experience acceleration; or if the speed of gravity is infinite, then the test body **m** also does not experience acceleration from any shell.

In a very simplified form, the gravitational effect of the shell can be represented as follows. Let's mentally create in empty space simultaneously a test body **m** and a spherical shell with mass **M** (**M**>>**m**) so that the body **m** will be located with some eccentricity **e** (Fig. 1-a). It is assumed that the creation of the shell and body **m** occurs instantly, i.e. this time is much less than the ratio of 2**e** to the speed of light. Due to the finiteness of the velocity of propagation of gravity, the body **m** will initially experience attraction from the part of the shell closest to it (Fig. 1-b). At this moment, the body **m** will undergo an acceleration directed from the center, which will act until the gravitational field of the shell from its opposite part reaches the location of the body **m**, more precisely, the field will not pass the distance 2**e**. And only after that the body will stop accelerating forever. Naturally, the acceleration time of the body **m** depends only on the absolute distance 2**e** and does not depend on the radius of the shell, or does not depend on the ratio of 2**e** to the radius of the shell (Fig. 1-c), and during this time (2**e**/**c**) the force of attraction of the body **m** to shell is always present.

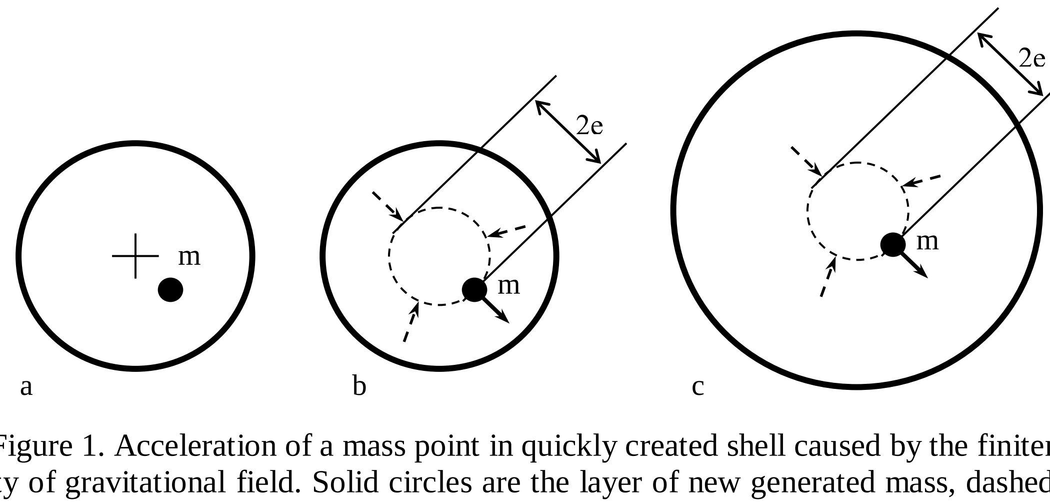

Figure 1. Acceleration of a mass point in quickly created shell caused by the finiteness of the velocity of gravitational field. Solid circles are the layer of new generated mass, dashed lines and arrows are the front of the expansion of gravitational field of the shell. Solid arrows are the gravitation forces.

The prototype of this gravitational field is the cosmological term lambda, introduced a hundred years ago by Einstein into the general relativity equation to counteract the tendency of galaxies to the center of the universe. Later, to explain the so-called accelerated expansion of the universe, cosmologists coined the gravity repulsion and dark energy, although there are many types of energy. Cosmologists have confused themselves so much that even opponents of BB cannot refuse the expansion of the universe (space) and the constancy of the Hubble parameter.

In our case, it is convenient to consider the gravity of an idealized hot shell (see Fig. 2) in its various radial positions, for example, **e**, 2**e** and 3**e** within the elementary solid angle **φ** (solid circles). It should be noted that the value of **e**, being the location constant of the body **m**, numerically in years ($\mathbf{e}_t$) also reflects the age of the center of space at the time of the appearance of the test body **m** from a cloud of hydrogen and helium, and the line **e** (plane **e**) divides the space into positive space (in Fig. 2 - upper) and negative (in Fig. 2 - lower) parts.

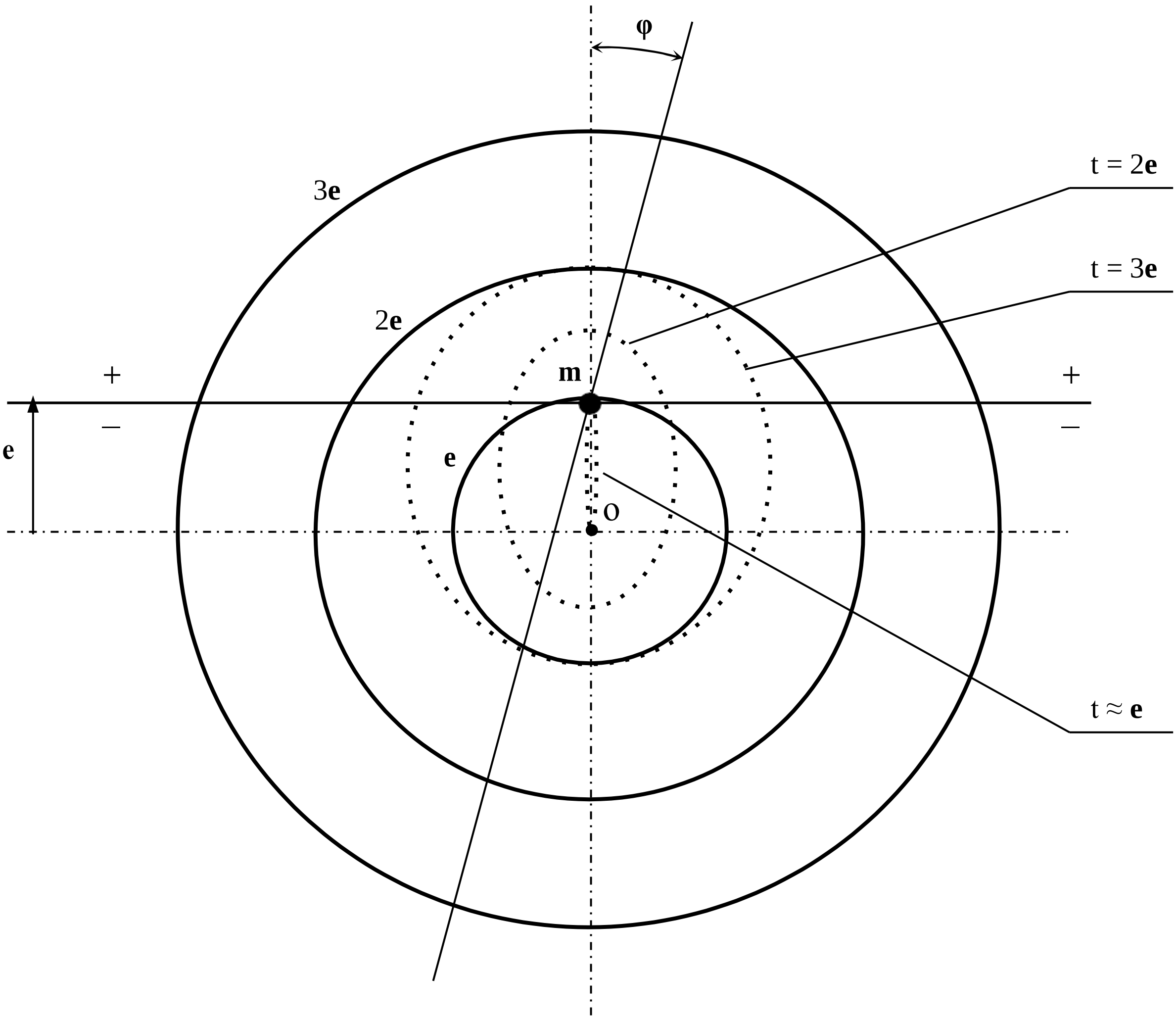

Figure 2. The diagram of time development of the attraction of the test body **m** to the hot shell (solid circles) and to the galaxies of the cosmos (dotted ellipses).

In the first approximation, one can refuse to consider the gravitational interaction in directions close to the perpendicular to the eccentricity axis, since they are almost equal in time and strength and have a small projection on this axis. The strength of the gravitational field of the hot shell is the same in all indicated positions of the hot shell, but gravity within the angle **φ** from the negative area of the hot shell from any of its specified positions in time arrives at the point m by 2$\mathbf{e}_t$ later than gravity from its positive area, after which they are mutually compensated. Accordingly, the test body **m** immediately after its formation from the hot shell experiences acceleration during the time 2$\mathbf{e}_t$. And after a time 2$\mathbf{e}_t$, when the hot shell takes position 3**e**, the gravitational front from the negative part of the hot shell will approach the test body **m** for the first time, and the test body **m** will forever cease to experience acceleration from the hot shell. That is, gravity will continue to come from any two opposite directions, but after the time 2$\mathbf{e}_t$ it is always in a compensated form. Therefore, any test body **m**, relatively speaking, from the moment of its formation from the hot shell (the moment **e**) experiences acceleration from the idealized hot shell (and actually from the entire hot shell) during the time 2$\mathbf{e_t}$ years, and acquires a speed proportional to the time $\mathbf{e_t}$. It is possible that the test body **m** has some relatively small initial speed, which its elements acquired while still within the hot shell, but relative to the values of $\mathbf{e_t}$, this is a very short time.

At the moment 3**e**, when the hot shell moved from the test body **m** to the distance of 2**e** light years (3**e** placement), the test body **m** would reach its maximum velocity and would further move by inertia with constant velocity as a first hypothesis. So the galaxies (for example **m**), situated at one third of the current radius of the cosmos (3$\mathbf{e}_r$) move by inertia. And at this interval (inside the sphere with the radius **e**) their constant velocities are determined by the Hubble parameter that is their velocities depend on the distance to the center. This is so because the intrinsic acceleration time of any galaxy (2$\mathbf{e}_t$) is determined by its eccentricity **e** at the first third of the cosmos. And the galaxies placed further at other two thirds of the current cosmos radius suffer the acceleration caused by the hot shell (at any age of universe), and their velocity decrease with the radius to almost zero value at the edge of the cosmos (close to the hot shell). At this interval the velocity depends on the radius *presumably* linearly with the negative coefficient 0,5**H** where **H** is the Hubble parameter (for the young universe when the maximum velocities of the galaxies didn't exceed 0.1**c**). When the relativistic galaxies appear with the time this simple picture changes because the graph of the galaxies velocity dependence on the time (from the moment of the begin of generation of the galaxy) asymptotically approaches to the light velocity and the peak of the triangle velocity graph flattens more and more (see Part 9 and Figure 3).

Let's assume the value of acceleration $\boldsymbol{a}_o$, affecting all the galaxies moving much slowly than the light to neglect the relativistic effects. The acceleration $\boldsymbol{a}_o$ is the vector sum of the accelerations caused by the hot shell and the galaxies of the cosmos (Part 4) acting for the time 2$\mathbf{e}_t$ $\mathbf{e}_t$ is the time it takes for light to travel the distance **e** ($\mathbf{e_r}$). The maximum velocity of every galaxy at the time $\mathbf{t} = 3\mathbf{e_t}$ is $\mathbf{V} = \boldsymbol{a}_o \cdot 2\mathbf{e_t}$ (2$\mathbf{e_t}$ is the time of acceleration and the acceleration of the galaxies is considered to be constant for simplicity). Comparison of this relationship and the expression of the Hubble parameter $\mathbf{V} = \mathbf{H} \cdot \mathbf{e}_r$ (without taking into account relativistic correction of **H** parameter[9]) results in

$$\boldsymbol{a}_o = \mathbf{H} \cdot \mathbf{e}_r / 2\mathbf{e}_t.$$

Taking into account that, $\mathbf{e}_r / \mathbf{e}_t = \mathbf{c}$, we obtain

$$2\boldsymbol{a}_o = \mathbf{H} \cdot \mathbf{c}.$$

More precisely $\mathbf{H} = 2\boldsymbol{a}_o / \mathbf{c}$, because $\boldsymbol{a}_o$ is the reason whereas **H** is the consequence, that is the value of Hubble parameter is determined only by the acceleration $\boldsymbol{a}_o$.

Following the values of **H** and **c**, we can calculate the acceleration

$$\boldsymbol{a}_o = 0{,}5 \cdot 2{,}2 \cdot 10^{-18} (^1/\text{s}) \cdot 3 \cdot 10^{10} (\text{cm /s}) = \mathbf{3 \cdot 10^{-8}} (\text{cm /s}^2).$$

And, despite such a microscopic (by earthly standards) acceleration, with an increase in the age of the universe, i.e. with a corresponding increase in time 2$\mathbf{e_t}$, galaxies become relativistic as their velocity increases from its zero value.

The value of the maximum (final) velocity of a relativistic galaxy formed at time $\mathbf{e_t}$ and for which the hot shell has moved away from it at a distance of 2**e** light years, that is, the galaxy accelerated for 2$\mathbf{e_t}$ years, has a non-linear character and is presented (without intermediate calculations and, for simplicity, without taking into account the variability of acceleration from the shell) as follows:

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[9] The difference in the values of the distance to the far galaxies observed nowadays determined by linear Hubble parameter and by standard candle method (the last one gives larger values) is considered as the expansion of the space in BB theory. In fact this is the relativistic correction to the Hubble parameter (see Part 4).

$$\mathbf{V} = \mathbf{c} \cdot \frac{\exp\left(\frac{2\,\boldsymbol{a}_o \cdot 2\mathbf{e}_t}{\mathbf{c}}\right) - 1}{\exp\left(\frac{2\boldsymbol{a}_o \cdot 2\mathbf{e}_t}{\mathbf{c}}\right) + 1}$$

The presented formula was obtained without taking into account the movement of the galaxy under the influence of the shell's gravity, that is, without taking into account the increase in the duration of the acceleration from the shell's gravity. Taking into account the movement of the galaxy will lead to an increase in the maximum speed of the galaxy due to an increase in the duration of the acceleration from the positive gravity of the shell, which is caused by the delay in the arrival of gravity from the negative gravity of the shell. The movement of the galaxy is equivalent to an increase in its eccentricity, and this leads to an increase in the time for the onset of the moment of compensation of gravity from the entire shell.

It may be surprising that a very small acceleration acts on the test body. But it must be kept in mind that the gravitational effect of the hot shell on the resting test body m relative to it decreases in accordance with the light (near light) speed of the hottest shell (without being distracted by the fact that this is the phase velocity). Since, in general, at relativistic speeds, the intensity of the gravitational field changes (within the angle **φ**). In other words, the effect of the gravitational charge $(\mathbf{GM})^{0.5}$ decreases when the velocity of the galaxy becomes relativistic, where **G** is the gravitational constant, **M** is the gravitational mass, and the gravitational field changes when the shell is moving away from the galaxy **[9]**. If astronomical observations could determine with an acceptable error at what distance from the center of space the galaxy, having stopped accelerating, had just entered the constant (maximum) speed mode, then this would be a fixed value of one third of the radius of space. And this is a rather sharp, albeit mobile, boundary by cosmic standards. At radii greater than this value, galaxies stop accelerating, and less than this value, they move uniformly. In the next two-thirds of the radius of space, galaxies accelerate from zero speed to maximum. It can be conditionally assumed that at present the first third of the radius of space is 13.3 billion light years (a metagalaxy), since approximately at this distance an increase in the speed of galaxies up to about light is observed. And it does not matter that the galaxies, located at a distance of 13.3 billion light years, and having their own speed, somehow moved away from us during the arrival of light from them. The radius of space is obviously growing faster and during this time has increased by 13.3 billion light years (taking into account the time of arrival of light from a distant galaxy). Therefore, now the universe has a radius of about 53 billion light years (3·13.3 + 13.3), and its age is also about 53 billion years. If, after its formation, the galaxy already experiences constant acceleration, but its speed is still close to zero, then this is the edge of space, its periphery, the region near the hot shell, where (and nowhere else) galaxies are formed. The part of space that occupies the far two-thirds of the radius of space is the space where galaxies will accelerate to the maximum speed inherent in each galaxy. Apparently, we cannot observe all this space of galaxies, and we cannot observe the second half of the space of space (now it is more than $20 \cdot 10^9$ light years) in principle (Section 4). Now we "see" only the rear of the hot shell - its microwave background radiation, which was formed 20 billion years ago at a radius of 20 billion light years. During the arrival of this radiation to us, the radius of the universe has also increased by 20 billion light years. With the improvement of the observation technique to at least 20 billion light years[10], and with an accurate determination of distances, it will be possible to observe galaxies, the speed of which does not increase with increasing distance, but decreases, but they all move with acceleration (Section 4 and Fig. 3).

So, the speed acquired by the galaxy is peculiar by definition and is caused by acceleration from the hot shell, but for each eccentricity of cosmic space, the duration of this acceleration is different. Thus, the Hubble parameter found by astronomical observations confirms the chosen model of the expansion of galaxies, since the presented mechanics of the expansion of galaxies reveals the dependence of the speed of galaxies on their location radius. It must be assumed that

[10] In just a few decades, this can probably be dealt with..

taking into account the Hubble parameter for small values of the eccentricity of the galaxy is not entirely correct, since at the same time, the peculiar velocities of galaxies are difficult to separate from their chaotic speed (the time 2$\mathbf{e_t}$ is small), which is confirmed at a radius of about $15{\cdot}10^6$ light years (now, earlier it was a smaller area). And that does not find an explanation in the BB theory. For relativistic galaxies, the Hubble parameter changes due to the nonlinear dependence of the velocity on their radius, i.e. it is necessary to introduce its relativistic expression into the Hubble parameter (Sec. 4). At average radii of galaxies, the Hubble parameter reflects the ability of the hot envelope to accelerate galaxies. Thus, presumably, there is a division of the cosmos into the zone of action of the constant velocities of galaxies, and the zone of their acceleration from the hot shell. That is, even at first glance, space, like the hot shell, consists of different layers[11] (taking into account the layer of clouds and the layer of the first galaxies).

4. Application experience.

Modern researchers of distant galaxies, based on the theory of the Big Bang, have difficulty in interpreting the parameters of distant galaxies, for example, the recently discovered galaxies ALESS 073.1 (**z**=4.75), SPT 0418-47 (**z**=9.6) and UDFj-39546284 (**z**=11.9). Basically, these researchers are confused by the contradiction between the young age of galaxies and the state of their developed maturity. For example, Federico Lelli, leader of the group that discovered the galaxy ALESS 073.1, put it this way: «Galaxies like ALESS 073.1 challenge our understanding of the evolution of galaxies» **[10]**. Filippo Fraternali, co-discoverer of the galaxy SPT0418-47, shared the following: «It was a big surprise to find that this very young galaxy is so similar to our neighboring spiral galaxies, and contrary to all theoretical models and previous observations» **[11]**. Here: ″our neighbors″ are old galaxies, and the new galaxy is ″very young″. And his colleague Simone Veghetti stated: «What we saw was rather mysterious: despite the high rate of star formation and the associated high-energy processes, the galactic disk SPT0418-47 turned out to be the most ordered of all ever observed in the early Universe» **[11]**. Indeed, it is impossible, remaining within the framework of the Big Bang, to explain all this[12].

These difficulties are resolved by the hypothesis of the gravitational expansion of galaxies, because the hypothesis resolves the weaknesses and contradictions of the Big Bang theory. According to this hypothesis, it all comes down to the fact that we can only observe old galaxies. The light of young, and even earlier galaxies, is still only coming towards us, and will reach our location only in 10 - 30 billion years. This, only at first glance, strange conclusion follows from Sections 3 and 6 of the presented work. It is possible that quasars are the privilege of young galaxies (which we don't see yet), and that in aging galaxies, quasars eventually die. In any case, there are few quasars in the cores of old galaxies in the middle part of space.

The resolution of modern difficulties is illustrated in Figure 3 (**c** is the speed of light), which shows the distributions of the velocities of observable and unobservable space galaxies both in the modern universe (solid blue line) and in our earlier universe (dashed green line), as well as in our future universe (dashed-dotted red line). All these universes are shown as their instantaneous state - without taking into account the time of arrival of light from galaxies. For the sake of simplicity of the image, the drawing has a qualitative character, because a factor of 2.7 has been artificially added to the formula for the speed of galaxies. The distribution of galactic velocities is based on the fact that galaxies, after their birth, first accelerate, and then, when the gravity that causes their acceleration is compensated, each moves with its own constant speed by inertia (for more details, see Section 3).

The distribution of galaxies with a constant speed is presented on the left side of the graph (the galaxies are located along the entire radius of space, i.e. along the distance scale) and is subject to the Hubble parameter, but for the modern universe, this parameter is non-linear due to the non-linearity near the light speeds of galaxies. This distribution of velocities correlates with the coordinate axis of the distances on the left side of the graph from zero distance to the vertical point "A" and is expressed by the Hubble variable parameter formula (taking into account the above assumptions of the velocity formula).

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[11] This could disprove the research presented according to Popper's criterion if the observations didn't confirm the layered structure of the cosmos.

[12] Without another ad hoc additional hypothesis, which will appear immediately. Who would doubt that.

$$\mathbf{V} = \mathbf{c}\cdot\frac{\exp\left(\dfrac{2\boldsymbol{a}_{\hat{\imath}}\cdot 2\mathbf{e}_{\mathbf{t}}}{\mathbf{c}}\right)-1}{\exp\left(\dfrac{2\boldsymbol{a}_{\hat{\imath}}\cdot 2\mathbf{e}_{\mathbf{t}}}{\mathbf{c}}\right)+1} = H\cdot\mathbf{e}_r$$

from the original ″naïve″ formula Hubble **V**=**H**·**r**,

where $\mathbf{e_r}$ is the distance to the galaxy in light years, numerically equal to the time of arrival of light from this galaxy, and practically determined by the luminosity of supernovae, although it can be approximate, until a better method has been found, and $2\mathbf{e_t}$ is the time of gravity on the galaxy in light years. It makes no sense to measure this distance with the help of all sorts of tricks, there are now several principles for measuring distances in modern cosmology, which is influenced by the whirlwinds of the hypothetical BB theories.

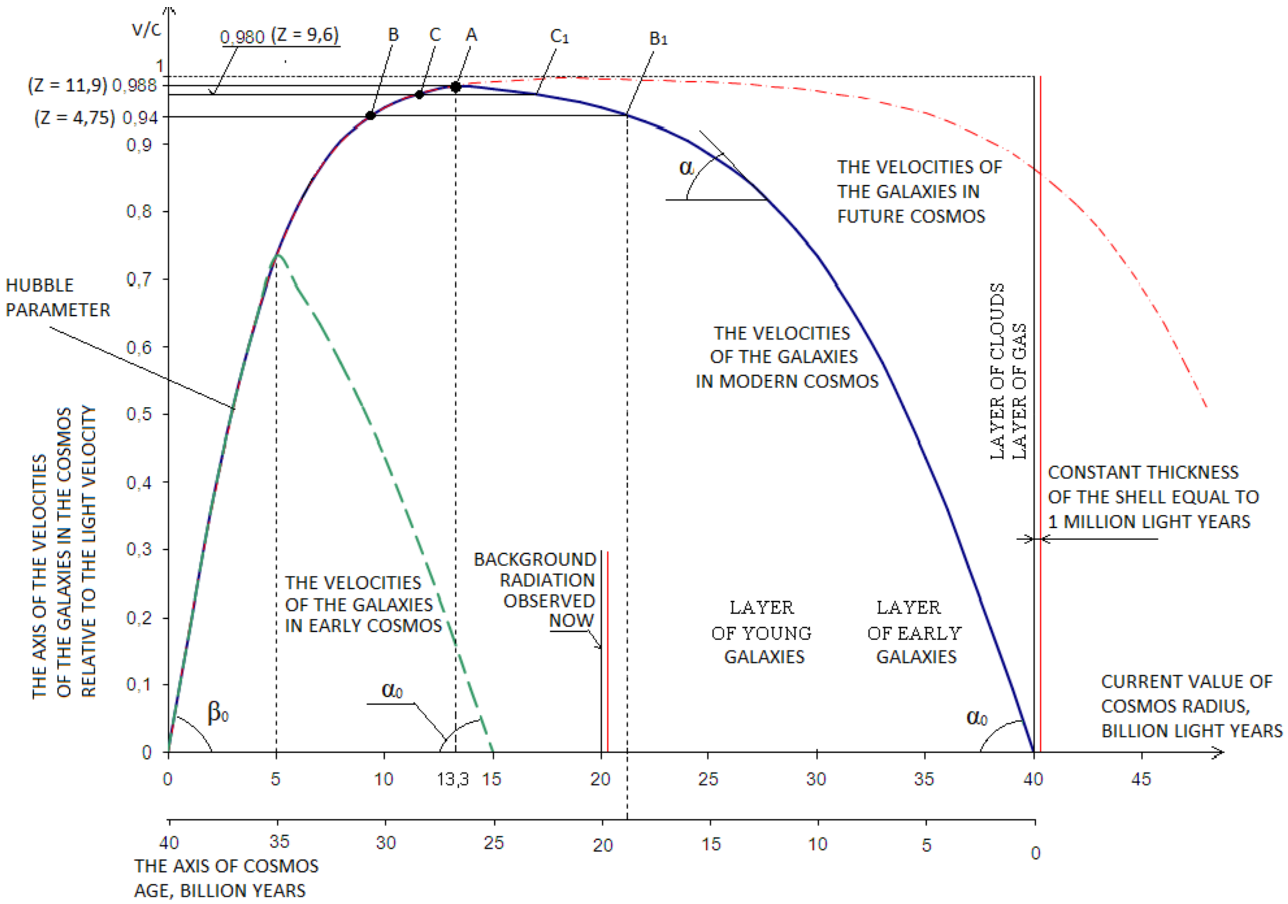

Figure 3 – The distribution of the velocities of the galaxies in the cosmos (momentary state along any direction from the center).

On the right side of the graph, which better correlates with the time coordinate (the time coordinate and the distance coordinate are interconnected), the distribution of the velocities of the galaxies of the modern space from zero time to the vertical point "A" is presented. Zero time[13] corresponds to the beginning of the modern universe (for more details, see sections 2 and 6). On this part of the curve, the speeds of galaxies are fixed from zero speed to almost light speed. At point "A" the galaxy stops accelerating (here the derivative is almost horizontal) and moves already at a constant speed in accordance with the variable Hubble parameter. Similar distributions of galactic velocities are shown in the graphs of the early and future universes. For the early universe, zero time on the graph was located at its radius of 15 billion light years on the distance scale.

[13] Zero time always moves with the speed of light to the right along the distance scale.

The tangent to the left side of the modern space curve (slope **β**) is an expression of the variable value of the Hubble parameter. The Hubble parameter repeats itself at all ages of our universe. The tangent (derivative) to the right side of the curve (the tangent of the angle **α**) is an expression of the current value of the acceleration with which the galaxies are accelerating. The acceleration is variable due to the relativistic effects of the increasing energy of galaxies. The initial slope of the curve (the tangent of the angle $\boldsymbol{\alpha_0}$) is the same for any age of the universe. It may well be that this is some parameter of the universe. The curvature of the right curve of the early universe is identical to the same part of the curve of the modern universe. In this case, the initial slope of the right side is always 2 times less than the initial slope of the left side (the Hubble parameter): $tg\boldsymbol{\alpha_0} = 0.5tg\boldsymbol{\beta_0}$. This is due to the fact that ideally (without taking into account the distance of movement of the galaxy) for a universe of any age, the distance from the center of space to point "A" is half the distance from point "A" to the beginning of this universe. This is especially evident for the early periods of our universe.

The parameter **z** of any galaxy is only an indicator of its radial velocity, nothing more than what is twisted in the theories of the Big Bang, i.e. **z** is equal to the ratio of the increase in the wavelength of light from the galaxy (spectral shift) to the wavelength of laboratory light waves. (The gravitational change in **z** is, firstly, small, and secondly, it is compensated when approaching the Milky Way). With this interpretation of the value of **z**, the velocity of the galaxy is determined by the well-known formula

$$\mathbf{V} = \mathbf{c}\cdot\frac{(z+1)^2-1}{(z+1)^2+1},$$

from the primary formula $\mathbf{V} = \mathbf{c}\cdot\mathbf{z}$.

In Figure 3, it is determined that in modern space, old galaxies are located at a radius of space $\mathbf{r_s}$ up to $15\cdot10^9$ light years, the radial velocity of these galaxies ranges from almost zero (**z**=0) to almost light velocity (**z**=11.9). In general, when noting the presence of old galaxies, one has to note the presence of others in terms of age, for example, mature and young ones. They can also be distinguished by the agility of star formation, because it is obvious that after the birth of a galaxy, its star formation first somehow increases, then reaches a maximum, then somehow decreases. Obviously, star formation is minimal in old galaxies. It is also obvious that in mature galaxies star formation gradually decreases to a minimum. Star formation (own, without the "help" of other galaxies) in old and mature galaxies differs in spectral terms - in old galaxies, the presence of heavy elements is noticeably greater.

An interesting point in Figure 3 is the mark $\sim20\cdot10^9$ years (it is also at the space radius $\mathbf{r_s}$ ~20 billion light years). At this radius of modern space, the hot shell of the earlier universe (at its age equal to 20 billion years) was previously located, and the hot shell itself moved to the right in 20 billion years according to the scheme to the beginning of time of the modern universe (**t** = 0). After the same 20 billion years, its image, and this currently observed background radiation (originating from the gas layer and the recombination layer, for more details, see Section 7) moved along the figure to the left and reached the center of space, i.e. our location, and we are now observing it as the background microwave radiation in all its glory. But this observation comes with some parallax, because the Milky Way, from which we are observing, is located not quite in the center of space. This is noticeable if we consider the background radiation as a whole, abstracting from its details. The background radiation is very weak, but it is not a point object, but an areal one, and even its fluctuations have a large angular size. Accordingly, now we cannot see what is located behind the former hot shell (at the mark of more than 20 billion years), i.e. we do not see the young galaxies of the modern universe - their radiation has not yet reached us. Young galaxies in the modern universe are located to the right of the birth of the observed background radiation at a distance (conditionally) up to 10 billion light years from it (early - up to 18). The transition from gas to gas clouds always takes about 2 billion years from the instantaneous location of the hot shell (for more details, see Section 2). For the modern universe, this occurs at a distance of just under 40 billion light years.

Radiation from mature galaxies located further than 15 billion light years from us, comes to us, and in principle we could observe them, but the intensity is very small for our capabilities. For example, we can observe the galaxy ALESS 073.1 (point B in the figure) with its **z**=4.75 and, accordingly, the expansion velocity equal to 0.94**c** as an old galaxy, but with the same **z**, we cannot observe the galaxy at point B_1 - this too far. Apparently, all this also applies to the SPT 0418-47 galaxy with its **z**=9.6 and radial velocity of 0.980**c** (point C in the figure) and to the galaxy with the same **z** = 9.6, but not yet reached the final speed (point C_1 in the figure). At point C_1, the acceleration is several orders of magnitude smaller than the initial (″microscopic″, for more details, Sec. 3) acceleration $\boldsymbol{a}_o$, corresponding to the angle $\boldsymbol{\alpha_0}$ in Figure 3. If, by long-term observation of the parameter **z**, it is possible to fix the acceleration at point C_1 or at a point somewhat closer, then this will be a direct proof of the hypothesis considered in the work.

The galaxy UDFj-39546284, with its **z**=11.9 and radial velocity of 0.988**c**, is approximately the boundary between the two curves, since it is distinguished as the most distant one (point A in Figure 3). In accordance with the Big Bang theory, it was even called a protogalaxy, they say, it has not yet formed, although it is an ordinary old galaxy, the same as those above. If it were a protogalaxy, then its spectrum would be mostly helium and hydrogen. It has been around for about 25 billion years (if it hasn't merged with other galaxies) and formed from a cloud of helium and hydrogen in the early universe when the universe was only 15 billion years old. It is clear from Figure 3 that it is impossible to observe mature galaxies with the existing means, especially to observe young galaxies. Except, perhaps, dwarf galaxies, in which development is slow due to the smallness of the initial cloud of hydrogen and helium, like small stars that live longer. And what we observe is all old galaxies, and there is absolutely no point in bothering with the tricks of the Big Bang theory **[10]**, **[11]** about young, early and proto-galaxies.

The recently commissioned JWST telescope has significantly increased the distances to extremely visible galaxies. And now it is possible to observe galaxies of type C or B with their analogs C_1 or B_1 (Fig. 3). Their peculiarity lies in the fact that when the spectral shifts **z** are equal (the velocities are equal) for the C and C_1 galaxies (as well as for the B and B_1 galaxies), the distances to them are significantly different. Line A in Fig. 3 is a sharp boundary between galaxies with uniform motion and galaxies with accelerated motion (which is especially noticeable for the early universe). In shape, this boundary is a spherical surface around the center of space. But this boundary is mobile, the speed of its movement outward is 10^5 kilometers per second. This happens because the radius of this sphere is equal to one third of the current value of the radius of cosmos (without taking into account the displacement of galaxies). Accurate knowledge of this boundary allows us to reasonably estimate the size of the cosmos (universe). And it would not be surprising that if we discovered a galaxy with redshift drift, but near vertical A and to the right from her that after some years she found herself without redshift drift, i.e. to the left of line A. And when NASA astronomers provide the data necessary for the analysis, this will be the confirmation of the simplified hypothesis. But for this, the data on **z** and on distances must comply with the principles discussed above (z is a pristine shift and the distances are determined by the luminosity of Ia type supernovae). The same confirmation of the hypothesis is a redshift drift of the most distant galaxies. If the redshift of the spectrum increases, then this will indicate the presence of positive acceleration of this galaxy - the A-B_1 zone in Figure 3. Logically, this follows from the fact that if **z** determines the speed of the galaxy, then the change in **z** determines its acceleration, and the further to the right of point A the galaxy is located on the distance scale (the farther it is from the observer), the greater its acceleration that is the greater redshift drift but the smaller its redshift (its speed). And this cannot be explained by any expansion of the universe (space) **[12]**, **[13]**. If only because, in particular, a similar redshift drift like violet drift in the opposite direction (decreasing **z**), should be observed for galaxies to the left of point A. Such a drift expresses the slow-down acceleration of a galaxy (attraction to the center of cosmos) moving “by inertia” (Section 5). And to observe such a drift, naturally, it would take a longer time. After the results of such observations, talk about the compression of the universe (space) in the vicinity of these galaxies will be inappropriate. We will wait for further observations at JWST.

In modern space, any galaxy, when accelerating to its maximum value, travels along the radius of space a significant distance from its birthplace. Correspondingly, the time of onset of the impact of negative acceleration from the opposite part of the shell (see Section 3 and Figure 2) increases, which leads to some change in the size of the space region occupied by accelerating galaxies in relation to the region of galaxies obeying the Hubble parameter. In an earlier period of our universe, for example, at the age of 15 billion years (green dashed line in Figure 3), the distribution of galactic velocities had an almost triangular shape (the younger the universe, the closer to the triangle), and with a sharp peak of maximum speed. With our capabilities in that early universe, almost all but the youngest galaxies could be observed. In a future universe, for example, at the age of the center of space more than 60 billion years, (the distribution of galactic velocities is partially shown by the red dashed line), we would be able to distinguish only the oldest galaxies.

5. The gravity of the cosmos. When the hot shell moves from position **e** (Fig. 2), new regions of space are formed relative to the considered point **m** (from **e** to 3**e**). That is, the space inside the hot shell is gradually filled with new galaxies in the form of a spherical layer of galaxies with a thickness, for example, 2**e** - by the time of the 3rd position of the hot shell. This layer is motionless and continuously gravitating.

In general terms, the attraction of the test body **m** to the sum of all cosmic galaxies at any moment (for any value of n·**e**) is shown in Figure 2. On it, solid circles indicate the positions of the hot shell, for example, at times **e**, 2**e** and 3**e** (respectively, these are the dimensions of the cosmos with its center at point O). Line **e** (plane **e**) divides space into positive and negative effects of cosmic gravity. Dashed lines - ellipsoids - denote the boundaries of the location of galaxies interacting with the test body **m** to the time points **e**, 2**e**, and 3**e** selected in the figure. The foci of the ellipsoids are the points **m** and O, while the radius vector of the focus O of the ellipsoid denotes the time of formation of the boundary galaxy (and its own radius-eccentricity), and the radius vector of the focus **m** denotes the time of arrival of gravity from this formed galaxy to point **m**. Their sum, respectively, is equal to **e**, 2**e** and 3**e** light years. Beyond these ellipsoids, galaxies do not gravitate with the test body **m** (at these time)[14]. At time **e**, the region of galaxies gravitating with the test body **m** is a very elongated ellipsoid, theoretically a straight line between its foci.

At the birth of a galaxy, with the appearance of its positive acceleration, its constant deceleration $\boldsymbol{a_t}$ appears. For a newly born galaxy, the deceleration acceleration is determined by the presence of galaxies between the center of space and the new galaxy (the prolate ellipsoid **t** ~ **e** in Figure 2). The existence of decelerating acceleration $\boldsymbol{a_t}$ from the sum of cosmic galaxies at other times can be revealed by analyzing Figure 2, if from the total sum of galaxies gravitating with the body **m** by the time, for example, 3**e**, subtract their positive part, "overturning" the positive part (dotted ellipse **t** = 3f) to the negative part around the line **e**. It is this region of galaxies remaining below that will determine the negative acceleration $\boldsymbol{a_t}$ as a continuous and relatively small deceleration of galaxies. In other words, the force of attraction of a galaxy to the center of cosmos can be compared with the linear force of gravity inside a planet along its radius, if we imagine the planet as a volume more or less uniformly filled with atoms of its substance. As the age of the universe increases, its radius also increases, and, therefore, the slow-down force of new galaxies also increases. Someday there may come a time when the acceleration of slow-down of galaxies will be equal to the acceleration of attraction of galaxies to the shell, and as a result, galaxies will stop accelerating.

Thus, the magnitude of the deceleration of galaxies depends on the radius of their birth, and the acceleration of the attraction of galaxies to the shell is first constant in time, and then abruptly becomes zero.

I don't know how exactly these two types of gravity can be correlated with the existing LCDM model, but it is absolutely clear that the acceleration from the shell completely replaces the intuitive dark energy.

[14] This highlights Neumann-Selinger gravitational paradox **[14]** in a new way since it is formulated for an infinite universe.

6. The hot shell. Appendix. The thickness of the layers of the hot shell from layer to layer as a result of their cooling (and the corresponding decrease in density) increases significantly in the direction of the center. Relative to the previous phase state, the "swelling" of the layers occurs due to the fact that already at the initial nucleation of the hot shell, the outer boundary of any layer "leaves" at the speed of light, but in the layer itself, the temperature over this incomplete layer gradually, according to the well-known empirical dependence $\mathbf{T} = 10^{10} / \mathbf{t}^{0,5}$ K (**t** is in seconds) decreases until the jump creates conditions for the formation of a new layer with a new phase state of matter. And only after the start of a new process, the inner boundary of the layer under consideration will also move away from the center at the speed of light. When the temperature at the inner boundary of the layer is below the threshold value of the phase state of this layer (closer to the center - longer in time - lower temperature and density), conditions for a new phase state will be created, i.e. to form a new, more inner layer. And since the laws of temperature and density fall are hyperbolic in nature, the thickness of the layers in the direction of the center relative to the thickness of their previous layer also increases. For example, the layer of primary nucleosynthesis takes 3 minutes, and the next layer of recombination of light nuclei and electrons takes 700 thousand years. And in the future, after the complete formation of the hot shell, this entire procedure in the layered hot shell remains unchanged when it moves from the center.

In the BB situation, the explosion of the singularity is the expansion of the space of this singularity, that is, there is a decrease in density, at first almost instantaneously, and then more slowly. The rapid expansion that occurs approximately between 10^{-35} and 10^{-32} seconds is known as inflation[15]. In the situation of a layered (considered by us) hot shell, with a decrease in temperature in its innermost layers, the space itself also expands. *Presumably*, the expansion of the space of the early layers of the hot shell occurs due to the reduction of the initially "folded" n-dimensional space of the Planck epoch towards the subsequent reduction in dimension to three-dimensional.

Phase transitions of matter (boundaries between layers) due to a decrease in temperature and density within the hot shell are an expression of a decrease in the scale of energy: at temperature of 10^{28} K the so-called Grand Unification of Interactions broke up, at a temperature of 10^{15} K the decay of the electroweak interaction occurred, at a temperature 10^{12} K quarks began to coalesce into hadrons. The reverse procedure is described by P. Davis **[15]**: «At first this is Weinberg-Salam threshold equivalent to almost 90 proton masses behind which electromagnetic and weak interaction are unified into the electroweak one. The second scale corresponding to 10^{14} proton masses is peculiar for the Grand unification and the new physics based on this. At last the ultimate scale is the Planck mass equivalent to 10^{19} proton masses corresponds to full unification of all interactions resulting in surprising simplification of the world». The second half of the procedures requires an incredibly large amount of energy, which makes it difficult to experimentally determine hotter phase transitions. While, on the contrary, in a layered hot shell, the processes energetically go in the opposite direction. They occur through a natural transition from an extremely high energy density to its ever lower levels, which leads to an increase in the stability of subsequent phase states.

Almost a million years after the birth of the universe, its central region was filled with low-frequency photons and hydrogen and helium atoms. Clouds of a mixture of hydrogen and helium began to form from these atoms. These clouds at the radius of the universe $5 \cdot 10^8$ light years (at the age of the universe $5 \cdot 10^8$ years) served as the basis for the first galaxies, that is, they reached a certain size at which the Jeans mass formula is observed[16]. Due to internal gravity, the clouds began to thicken towards their centers, forming galaxies and, accordingly, the initial intergalactic voids. The stars of each cloud formed their own galaxy, and with the growth of their number, the phase of the cold universe began - space. A cosmos of variable, but for each moment of finite radius was formed[17].

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[15] This was necessary to explain the flat space of the cosmos although it is flat without these constructions.

[16] The theory of James Jeans seemed to be unclaimed by the BB theory. But Jeans theory is the best one for the recession model presented here.

[17] This highlights Cheseaux-Olbers photometric paradox **[16]** from new point of view.

Naturally, near the outskirts of space, galaxies, due to the randomness of the process, are located unevenly in radial directions - some are a little closer to the hot shell, others are a little further. Due to the gravitational interaction between the clouds, the clouds first of all rush to those clouds that have condensed immediately behind the more protruding clumps - the previous galaxies in radius (or almost in radius, perhaps somewhat sideways). Thus, gravitational branches of the cosmos (future galactic filaments) are constantly being formed. And side clouds will rush towards them, forming galactic voids (future voids). This determines the spongy structure of the cosmos. The formation of gravitational branches occurs like the growth of dendrites, up to a lateral direction (almost tangentially to the sphere of space). Near the ends of such "branches", hydrogen and helium atoms that have just undergone recombination will accumulate (condense).

The large-scale homogeneity of the cosmos and its isotropy are determined by the same procedure for the formation of hydrogen-helium clouds and their transformation into galactic systems.

As already noted, a layered hot shell on its periphery constantly "acquires" a new mass at the boundary with the original matter, i.e. there is a transition of a part of the high-energy plasma into the energy contained in the mass (simplified $\mathbf{E=mc^2}$). In turn, space on its periphery is constantly replenished with stellar mass from the innermost and coldest layer of the hot envelope. Taking into account the hyperbolic laws of temperature and density changes throughout the universe, the boundary between space and the hot shell is conditional, i.e. in principle, it can be designated anywhere, especially since the cosmos is also layered. The layer of hydrogen-helium clouds belongs to space because of its density, which is correlated with the density of space. And in it, for the first time, differentiation of matter into clots and voids occurs.

Since at the beginning of its formation the cosmos is, as it were, an inner layer of a hot shell, to the extent that it, as the radius of the hot shell increases, also increases its radius on average with the speed of light. Naturally, primary stars and other clumps of matter always consist mainly of hydrogen and helium. Tens of billions of years after the "creation" of the universe, the hot shell in relation to the cosmos is a thin spherical film around the cosmos, but this does not diminish its significance in the fate of the cosmos. All layers of the hot shell surrounding the cosmos do not move in space, i.e. there is no simple transfer. But since the front of the outer layer of the hot shell moves, according to the assumption, at the speed of light (phase velocity), then the entire layer of the hot shell, as it were, moves in space at the speed of light, but the masses of the hot shell do not move (in the first approximation). And since any local speed of sound is, by definition, much less than the speed of light, this explains how the enormous pressure (barometric) in the outer layers is not transferred to the inner layers, and how the layers do not mix.

At the transition from the n-dimensional space of the original matter to the three-dimensional space of the cosmos, the density drops not only due to cooling, but also, presumably, due to a decrease in the dimension of space. In addition, most of the energy was converted into matter. In general, it *can be assumed* that the energy compact of the initial matter (conditionally in the form $\mathbf{h\nu}$ in each layer-epoch of the hot shell transforms into energy in the form of mass $\mathbf{mc^2}$ with a corresponding decrease in the radiation energy $\mathbf{h\nu}$ (in a simplified form $\mathbf{h\nu=E=mc^2}$). In the multistage transformation of energy quanta into matter, this energy is, as it were, conserved.

Until a little less than a second, particles of matter and antimatter were born in pairs and mutually annihilated and were born again, and in general were in a state of thermal equilibrium. After almost one second, the annihilation became universal.

In the situation of the existence of a hot shell around cold space, in its layer, at one second from zero time, annihilation of antimatter and matter with a small remainder occurs - this is inevitable in this layer. Not one-time, but constantly in this layer, which moves with phase velocity. Within the limits of an elementary solid angle directed from any point inside space, this procedure can be assumed. Two billion parts of antimatter and matter carry away the photons of this annihilation in the form of one billion gamma particles of very high energies. But since the hot shell moves in a phase manner, these gamma particles penetrate the inner and colder layers of the hot shell, where the one billionth part of the former matter remaining from the annihilation is located. These photons are absorbed and re-emitted by matter particles and are repeatedly scattered by free electrons (Compton effect), losing their energy. The early layers of the hot shell have a very high density of matter, so the annihilation photons have a short free path and, accordingly, a high frequency of encounters with matter. Over time (from approximately 1 second - the time of annihilation, to 700 thousand years - the time of recombination), the density of the shell decreases by trillions of trillions of times (according to the well-known empirical formula), while the energy of hot electrons is gradually distributed in the medium of matter in a similarly increased volume, and their total energy per unit space decreases accordingly. Thus, hot annihilation photons survive (after almost a million years of constant decrease in their energy) to the optically opaque layer of recombination of light nuclei and electrons, and already in the form of microwave radiation (background) pass through it and uniformly irradiate space from all sides at the rate of one billion photons of radiation per baryon of matter.

The gravitational charge of particles of matter with a rest mass is mainly concentrated in the earliest layer, 300,000 km thick (in time, this is a little less than a second from zero time). Its density is comparable to that of the nucleus of an atom[18]. This is just a monstrous gravitational charge, if it were motionless in space. But since the layers of the hot shell move at the speed of light, their gravitational effect is significantly reduced **[9]**. But in the form of a kind of compensation, the gravity of these layers acts for billions of years. And as a result, each galaxy has its own speed.

7. Background radiation. For the BB theory, the existence of microwave background radiation as a long-standing and one-time phenomenon in the history of the universe is natural.

If the universe consists of space and a radially moving hot shell around it, then it should be considered natural that the microwave background radiation comes out continuously[19]. Most likely, the background microwave radiation is formed in the last layer of the shell - the layer of recombination of light nuclei and electrons from hard gamma quanta, formed earlier in the annihilation layer of hadrons and anti-hadrons. Gamma quanta survive to the recombination layer. Already in this less dense, but much thicker layer, gamma annihilation quanta finally scatter on free electrons, generating microwave radiation. In the recombination layer, under the action of hard gamma quanta, light atoms are destroyed, followed by their repeated recombination, but simultaneously with the weakening of gamma quanta. For microwave radiation, the recombination layer is already transparent.

This microwave radiation is mixed with radiation that is close in frequency, but radiation of other physical processes. This radiation is characterized by angular anisotropy (fluctuations), considered in the framework of the BB theory. It is possible that the anisotropy is affected by the terminations of the cosmic gravitational branches (see Section 6), which affect the distribution of the density of light nuclei of the recombination layer, since these are neighboring layers. Near the ends of the gravitational branches of the outermost regions of space, the nuclei (or already atoms) of hydrogen and helium undergoing recombination will accumulate (condense), and the denser these bunches, the brighter the background radiation. Approximately the same sizes of spots of fluctuations of the background radiation, located diametrically opposite, lead to the inevitability of assuming that the Milky Way is located near the center of space. If we were located closer to the outskirts of space, then the angular dimensions of the fluctuations would be asymmetric. It is possible that the emission of ultrahigh-energy cosmic particles comes from gamma-ray particles of annihilation of matter and antimatter, when they occasionally break through the hydrogen-helium plasma of the shell. This radiation is too uniform in direction.

The presence and nature of the observed microwave background radiation is consistent with the existence of a layered hot shell, and thus, in turn, confirms its existence.

And the very act of the birth of mass is, rather, a permanent process, and not a one-time phenomenon in the history of the universe. If this is a long-standing, one-time phenomenon, then it is necessary to consider the mass of the universe as constant. And here difficulties arise with the finiteness of the mass of the infinite universe, with its four-dimensional space, and similar

[18] As if this layer was densely packed with white dwarfs without voids

[19] According to Ray Fleming's theory, the quantum field always exists, and protons, electrons, neutrons, hydrogen, helium, and also microwave background radiation are continuously formed from the quantum field.

constructions, despite the fact that the observed space is flat three-dimensional. Still, the singularity and the resulting one-time (one-time) birth of the universe introduces many difficulties into the reconstruction of the universe.

8. Some general conclusions.

Gravity is the sole cause of the acceleration and expansion of galaxies[20]. The Hubble parameter is not a constant; its constancy is appropriate only at small radii of space. Cosmos grows from the hot shell in the newly formed flat (excluding local curvatures) three-dimensional space. Space itself is not expanding. The more time passes from the beginning of the universe (the older the universe), in other words, the greater the current radius of the universe, the more gravitating matter in the universe. Quantitatively, the mass of the cosmos at any moment is finite and proportional to the cube of the age of the universe at that moment. The presence of a hot shell in the cosmos, which accelerates all galaxies, excludes its collapse, and this determines the gravitational stability of the cosmos. Local gravitational instability leads to chaotic ("Brownian") motion of galaxies and their clusters which is especially noticeable in the central part of cosmos. The accelerated motion of galaxies always occurs in the last two-thirds of the current space radius value. The initial acceleration from the hot shell is unchanged and, apparently, is a parameter of the universe. Basically, the velocities of the recession of galaxies are peculiar. In terms of its gravitational effect, the hot shell *completely replaces* artificial dark energy, which was primitively introduced into the BB theory out of necessity, when an assumption about the acceleration of galaxies appeared. The hot shell growing from outside and the cosmos formed from it constitute a self-sufficient open universe. Galaxies are not born in the inner regions of cosmos, galaxies are born exclusively on the periphery of space near the hot shell. Despite its expansion, cosmos will never fly apart, because the dimensions of the cosmos grow on average at the speed of light, i.e. faster than its expansion.

Thus, the very presence of the Hubble parameter (regardless of its numerical value) is a necessary result of the recession of galaxies according to the proposed model, which is its priority feature.

A cluster of galaxies, formed for the first time in the history of the universe, has, by definition, zero peculiar velocity, since their eccentricity is zero and they did not experience acceleration from the shell. The Milky Way galaxy is located near the center of space.

Microwave background radiation is a continuously generated radiation.

9. Extrapolation.

For the cosmos there is something common, penetrating all its layers, - this is the acceleration of the deceleration of galaxies (Section 5 for more details). But under the influence of braking, galaxies as such are not destined to find themselves in the center of space. First, galaxies will cool down to the state of heat death for a very long time within the Great Time[21], starting from the central regions of space, and later turn into, for example, a rarefied quark-gluon plasma. And after the completion of this cycle, the time will come when this matter, rushing to the center of the cosmos, will begin to thicken, gradually condensing and turning into that hot initial matter with which our universe began.

From the analysis of Figure 3, we can conclude that the galaxies of the early space (green dashed line) had a not very large spread in the velocities of galaxies. But the galaxies of the future universe (red dash-dotted line) in any direction from the center (or along any elementary solid angle) in a significant amount have about the speed of light. The intensity of the gravitational field of these galaxies shifts significantly in the direction of their velocity vector **[9]**, and the greater their speed, the greater this shift. For any galaxy, the greater the speed it has reached, the greater the slow-down acceleration for it. And someday there will come a moment when the slow-down acceleration will equal the positive acceleration of the galaxy. This is in line

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[20] The author's task did not include physical and mathematical formalization of the considered model. The author negatively perceives the unnatural BB constructions, and he was only interested in studying the possibility of gravitational recession of galaxies.

[21] The time of the entire cycle of the universe from the birth of the universe to the birth of a new universe instead of it.

with what Eric Lerner said in a private letter (and in more detail in chapter 7 of his book The Big Bang Never Happened): "We have ample evidence that any given process tends to run out of conditions for it to expand." That is, every separately taken established process from the very beginning carries the grain of its completion.

On the other hand, the lower the speed received by the galaxy (in the central regions of space), the lower its deceleration acceleration and the earlier it will go into a state of heat death.

It is possible to consider the universe as a whole without dividing it into cold and hot, i.e. consider the cosmos as the last in time and, naturally, the thickest layer of the universe, because being layered is a necessity for the existence of the universe. If we trace the phase change of matter in the universe in the time range from 10^{-42} seconds (at its birth) to tens of billions of years, then a certain direction of the change in the quality of matter itself is revealed, as if the vector of matter evolution. Namely, as a result of cooling and expansion, matter passes from the state in the form of Planck-era matter to the relatively cold state of stellar systems. Extrapolating the vector of evolution of matter in this direction over the Big Time further, we can expect further cooling of matter. In the central region of space, as its oldest part, gas and dust clouds of galaxies will contain less and less helium and hydrogen, which will lead to the absence of the formation of new stars in galaxies. Planets, stars and degenerate stars will burn out their fuel. Gradually all the stars will go out, and the remnants of the stars will cease to radiate, a little later the centers of the galaxies will go out. After some time, the heat death of galaxies in the central part of space will come, and the area of heat death, on average, will expand from the center to the periphery at the speed of light.

But the evolution of matter will not stop there. It is doubtful that our universe was a one-time, as it were, divine phenomenon. More likely to be cyclical.

Hypothetically, as the substance of the central region of space passes to the temperature of absolute zero (for example, as 10^{-40} K), regions of an increase in the probability of proton decay can be created. As a result, for example, a rarefied quark-gluon plasma is formed. Depending on the proximity to the temperature of absolute zero, several phase transitions of states of matter are formed, in some inverse analogy to phase transitions in a hot shell.

But it will not yet be matter, similar to the original matter at the birth of our universe, since the density of matter in the cosmos has significantly decreased as a result of the expansion of galaxies. And here negative acceleration will say its last but important word. Indeed, in contrast to the positive, but temporary acceleration of the expansion of galaxies, the deceleration acceleration is continuous. That is, galaxies in a state of rarefied matter are colder than their thermal death, shrinking towards their centers themselves, they will tend to the center of space, the density and, accordingly, the temperature of matter will continuously increase. The dimension of space evolves from three-dimensional to, for example, ten-dimensional. All four main interactions are collapsed and merged into one overall interaction. And in this state, this region of the universe can exist for a very long time, increasing in size at the speed of light. But, as with the birth of our universe, everything will begin with some small area of this matter, not connected in any way with the current center of the universe, and then phase transitions of the matter of the new universe will continue. Thus, the infinity of the initial matter, which we initially accepted, is removed. And this is the most amazing thing: matter "as if" stands still, and the universes replace each other. Such a scenario of the universe is consistent with the postulate of the infinity and eternity of matter, where any universe is just another transition of uncreated and indestructible matter from one state to another.

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