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PREFACE

The twentieth century was marked by a large number of scientific discoveries. In our case, it is first of all important to note the discovery of galaxies in the Universe. Then, in 1929, Hubble discovered the redshift in the spectrum of galactic radiation and interpreted it as a phenomenon of galaxies receding from each other. Subsequently, this interpretation was confirmed, and many theories that tried to explain known experimental facts had been appeared. The most famous was the theory of the Universe birth due to the Big Bang from the initial singularity of small dimensions, high temperature and density of matter (Gamow's Standard Model). Large scientific forces were looking forward the development of such a mechanism of the Universe birth. It seems that in nowadays all details about the first moments of the Universe birth after the beginning of the Big Bang and in subsequent periods of the matter evolution in the Universe had been already described. However, there are many important details in the process of the birth and evolution of the Universe that have been ignored so far. These details contradict the basic laws of physics, and therefore were excluded by physicists from consideration.

The list of these details refers, first of all, to the fact that when a substance is exploded from a singularity, it must immediately be inside a black hole, since the initial radius of the Universe was much smaller than the value of the gravitational radius. As a consequence, the newborn Universe must immediately collapse to the point. Observations, however, show that the Universe has a very large radius, the magnitude of which is much greater than its gravitational radius, and, in addition, Universe expands.

Secondly, the entropy of matter in the newborn Universe from the initial singularity is very large, which should prevent the creation of massive objects: galaxies, stars, planets, etc., since the creation of such objects requires a decrease in entropy, which contradicts the laws of thermodynamics. At the same time, for the existence of a thermodynamic arrow of time, entropy must increase.

Attempts to reconcile certain moments and inaccuracies of the Standard Model with the help of the theory of space inflation face new contradictions, in particular

regarding the law of the triunity of space-time-matter discovered by A. Einstein. According to this law, all space must be filled with matter and time must flow throughout the space. If we accept the theory of inflation, then we must agree that space can exist without matter.

Despite the great achievements of cosmological science, it is still not clear whether our Universe has a limitation in space. At the same time, it is known that infinite Universe filled with stars should cause an infinitely greater brightness of the night sky. Attempts to explain this fact by galaxies receding from each other do not bring satisfaction, since distant galaxies are observed in the visible region of the spectrum.

The list of contradictions can be continued, which causes discontent with the Standard Model of the Universe.

In this situation, the author of this book made the goal to create a model of the Universe birth, which would not contradict the known laws of physics.

In the basis of the model, the author put the Law of Unity and the Law of Similarity, as the highest laws in the Universe. This was enough to make the model free of its contradictions with the known laws of physics.

Using this approach of solving the problem, the author realized that our Universe is part of the Super-Universe, represented by a fiber space, in which between the individual spaces there is only an information link through one delocalized point.

As a consequence, the author succeeded in proposing and describing the model of the birth of our Universe, in which matter is born at a constant rate, and the initial temperature was zero. Such a model made it possible to describe weak and strong interactions, the mechanism of creation of planetary systems and galaxies, and also to reveal still unknown possibilities: the possibility of instantaneous transmission of information within the whole Universe and the possibility to bring energy from the Scalar Field, which had one of the main roles in the process of birth and evolution of matter in the Universe.

The book contains 7 chapters published in specialized journals:

1. Petro O. Kondratenko. The Birth and Evolution of the Universe with minimum initial Entropy. // International Journal of Physics and Astronomy. December 2015, Vol. 3, No. 2, pp. 1-21. Published by American Research Institute for Policy Development DOI: 10.15640/ijpa.v3n2a1 URL: http://dx.doi.org/10.15640/ijpa.v3n2a1

2. Petro O. Kondratenko. Quarks and Leptons in the Model of the Universe with minimum initial Entropy // International Journal of Physics and Astronomy. December 2015, Vol. 3, No. 2, pp. 51-69. Published by American Research Institute for Policy Development DOI: 10.15640/ijpa.v3n2a4 URL: http://dx.doi.org/10.15640/ijpa.v3n2a4

3. Petro O. Kondratenko. Mechanisms of Origin of Matter in the Model of the Universe with minimum initial Entropy // International Journal of Advanced Research in Physical Science. Volume-4, Issue-8. – 2017. pp. 26-35.

4. Petro O. Kondratenko. Structure of the atomic Nuclei in the Model of the Universe with minimum initial Entropy. // Physical Science International Journal, ISSN: 2348-0130, 2016. Vol.: 12, Issue. 3. P. 1-12. DOI: 10.9734/PSIJ/2016/28694

5. Petro O. Kondratenko. The origin of a planetary system in the Model of the Universe with minimum initial Entropy // International Journal of Advanced Research in Physical Science. – Volume - 4, Issue - 8. – 2017. pp. 4 – 13.

6. Petro O. Kondratenko. Scalar Field in Model of the Universe with minimum initial Entropy // International Journal of Advanced Research in Physical Science. – Volume - 4, Issue - 4. – 2017. pp. 23-31.

7. Petro O. Kondratenko. Strong Interactions in the Model of the Universe with minimum initial Entropy // International Journal of Advanced Research in Physical Science. - Volume - 4, Issue - 5. – 2017. pp. 49-59.

CHAPTER **1. Birth and Evolution of the Universe with minimal initial Entropy**

The models of the Universe, likely to any others, are based on the theoretical concepts that exist currently in cosmology. Modern cosmology arose after the appearance of the general theory of relativity, and that is why, in contrast to the former classic one, it was called relativistic. A new stage of its development has been linked with investigations of A. A. Friedman, who was the first to prove the theory about the Universe which was filled with gravitating substance and namely so could not be stationary. This fundamentally new result has found confirmation after a discovery of redshift by Hubble in 1929, which was interpreted as a phenomenon of galaxies "receding" from each other. Because of this the main focus are on the study of Universe expansion and determination of its age via duration of this expansion. The third period of the development of cosmology is connected with the works of G.A. Gamow. These works are about physical processes taking place in the various stages of the Universe expansion.

All scientists proceed from the assumption that the Universe was first in conditions which were characterized by high temperature and pressure in the singularity, where all matter was focused. Then it was cooled gradually as the Universe expanded. Model of hot Universe was first proposed by G.A. Gamow and later was called Standard.

Gamow's Model required answering some important questions. In particular, if all matter was concentrated in a singularity, then why a black hole did not appear there? What determines the arrow of time? Does the Universe have any boundary in space? Are the laws of thermodynamics true in the process of evolution of the Universe? If the Universe is infinite, why night is dark? Can a space exist without matter? And many others questions, that are not less important and fundamental.

Unfortunately, the numerous models of the birth and evolution of the Universe bypass some of these important questions and therefore can not be acceptable, because clearly are in the contrary with laws of physics. There are attempts have been

done to solve some of the contradictions of the standard model. For example, it was developed the inflationary model of the Universe. However, in this case, some contradictions are simply replaced by others. Therefore, the problem of birth and evolution of the Universe is extremely urgent.

In this situation, the author decided to offer its own model that would not contradict the named physical principles and uniquely would be able to answer these questions [1]. The Laws of Similarity and Unity everywhere in the Universe is the base of model proposed by the author.

It is known that the Universe has the hierarchical structure, which leads to the implementation of the Law of Similarity [2]. Moreover, in [2] the principle of hierarchical similarity was considered as a new fundamental law of physics. In addition, the Law of Similarity is uniquely described by means of the Tree of Life that allowed the author of the monograph [2] to create a theory of hierarchical systems and create various schemes of free electron lasers. We shall use this information at modeling the processes of birth and evolution of the Universe.

1.1. Prenatal development of the child

According to the theory of hierarchical systems and a doctrine of the Tree of Life all the processes in the Universe are taking place on the same scenario, although at different levels and at different scales. On this basis, to solve the problem, we will compare the stages of prenatal development of the child and the stages of the birth and evolution of the Universe.

First of all, for the beginning of intrauterine development of the child a fertilization of the female egg by sperm must be performed. Next follows a relaxation time up to creation of a full-fledged cell ready to reproduce. To start the process of cell division it is required the income of information about the beginning of cell division. The cell has written information about what kind of the human body should be developed in utero. Consequently, there should be two types of information.

It is logical to assume that the information about the beginning of cell division must come from outside. This is suggested by the fact that among the animal world

there are cases represented when fertilization takes place immediately after the birth of females, while the beginning of cell division occurs after puberty of animal. Similarly, in the already formed body after its birth the cell division occurs only when necessary and the information about the need are is coming from the body.

Go back to the first cell of the future body. It was stated above that the entire program of a living body creation has been laid into the first cell. The energy necessary for the cell multiplication and development of the organism has received by the first cell. The building of body is going in accordance with the hierarchical law, i.e., the fibers are forming first (one-dimensional objects), then the tissues (two-dimensional objects) and three-dimensional objects are forming. Since the three-dimensional objects are functional, then, before they have been created, the information must be received about the creation of these objects and their future activities. Thus, three-dimensional objects immediately begin the functional activity, depending on the organ authority. In accordance with the hierarchy of the body's, the creation of three-dimensional objects is going as follows: the creation of monofunctional organ (slices), and then the slices are combined into a multifunctional organ (liver, kidney, etc.). In turn, the multifunctional organs are combined into systems (nutrition, metabolic, blood circulatory, nervous, protective, and immune, etc.). All systems of the body are formed. So during in utero development of child its organs completely perform their functions.

At a birth of child additional information must be introduced to provide a transition to the autonomous functioning of the body. The child is separated from the power of the parent organism (by cut of the umbilical cord), begins to breathe (lungs are switch on), consume food and so on. The period of intrauterine life ended.

1.2. Model creation and evolution of the Universe

Like the beginning of intrauterine development of child the energy and information is introduced to the certain point (World-1). This point has no spatial dimension. We characterize it as a World of Field-time. Thus a program immediately has been created for the future structure of Super-Universe as a multi-fiber bundle.

The *first* starting point of the proposed mechanism of birth and evolution of the World is the claim that the beginning and the continuation of the future evolution of the Super-Universe is concluded in the its expanding with the **speed of light**, and all its components immediately have got the expansion: a one-dimensional space (World-2), a two-dimensional space (the World-3) and three-dimensional space (World-4). In order not to disrupt traditional name, the World-4 is denoted as the Universe while the multi-fiber bundle consisting of zero-dimensional space, one-dimensional space, the two-dimensional space and the three-dimensional space is called as Super-Universe. At the same time, World of Field-time is a state of pure becoming, status of the **Primary Vortex, Vortex Motion the Beginning** and the **Main Driving Force**. It follows that the vortex structure of the Universe is set by Field, which generates one-, two- and three-dimensional Universe, where everything is revolving. From a birth up to the end Universe is fractal, and all its fractals are revolving.

Thus, the Field produces multi-fiber space and time inside of it. With respect to the Field, it can be only a **scalar**. The Feld brings the energy which fills all the named area of space, likely to the connected vessels filled with liquid. The size of the spaces ("receptacles") increases with time. The rate of filling of the first two "vessels" by "liquid" exceeds the rate of increase in volumes of "vessels," so that "liquid" flows into the next "vessel". So, in turn, the one-dimensional space filled with energy, then the two-dimensional space and, finally, energy comes in three-dimensional space. Thus, the three-dimensional space begins to fill up with energy only after a certain period of time ΔT. If the beginning of the Super-Universe birth is considered since the beginning of the filling power into the World-2 and at the same time the expansion of Super-Universe space begins, then time of filling for World -2 will be very small (perhaps 10^{-30} s). While the filling of energy into the World-2 is going, the World-3 will have time to expand significantly, and therefore the time of its filling will be a bit more (perhaps 10^{-6} s). At such case after a time interval $\Delta T_0 \sim 10^{-6} s$ the filling of energy into World-4 will begin. Note that in the Super-Universe information

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communication between layers of multi-fiber space exists only via a delocalized point [3].

The **second** starting point for us will be the next Property of the Field: its ability to create directly the particles of matter in all spaces of the stratified Super-Universe according to the formula $E = mc^2$. That is difference in comparison with the electromagnetic vector field[1], which may create a particle-antiparticle pair at certain circumstances. As the World-1 has no charges the created matter must be electrically neutral. It means that in the World-4 only clusters of neutrons will be created, which are characterized by the zero values of charge, spin, and so on.

By that way, World-4 wills initially expanding without substance inside of it accepted filled vacuum state. Therefore, in this World any singularity will not be. Substance (at once a complete set of fermions and bosons) will appear only then when the initial density of matter will not exceed the density of nuclear matter. This is the **third** starting point.

"Overflow" of Field's energy into the World-2 (space-time) is accompanied by the production of heavy charged particles - preons (conventionally, quark-2), which charge value is equal to the magnitude of charge $q_1 = \pm q_2/2 = \pm e/6$ (q_2 is a quark charge of three-dimensional space- time, e is the electron charge). Here we introduce the assumption (the **fourth** starting point), according to which the minimum charge in a particular layer Super-space is defined by its dimension. Therefore, quarks-3 have a charge $q_2 = \pm e/3$, diones has $q_1 = = \pm q_2/2$.

Two-dimensional World is electrically neutral. Simultaneously with the appearance of preons there are conditions appear for the existence of two-dimensional bosons, which will provide an interaction between preons. Since this interaction will generate a three-dimensional World of the particle (quarks-3), it should be considered that these bosons simultaneously belong to both World-2 and World-3. For the World-3 the two-dimensional World is a Hidden World, and the three-dimensional World (the world of quarks) is the Displayed World. It is clear that

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[1] Physicists are familiar with the waves of electromagnetic nature, in particular, the de Broglie wavelength, but in all cosmological theories take into account only the electromagnetic waves that accompany the birth and annihilation of elementary particles.

belonging of boson to both Worlds is realized through the transfer of information and spatial metamorphosis [3]. Consequently, we have the *fifth* starting point of our model.

Taking into account the **Law of unity as the Supreme Law of the Universe**, we need to accept as the basis that that the Field feels controls and directs all processes at the creation of the World. That is, we take as a postulate (*sixth* starting point), that the Field has enough energy, information and Program for the material world creation and the World of the Living that is our Universe. Thus, in order to existence of the electromagnetic Field (EMF) in three-dimensional space was possible, it is needed that in the one-dimensional space, where there is no pre-conditions for the existence of EMF, to be produced with necessity one-dimensional particles which carry both electrical and magnetic charges. Hence, the particles in the one-dimensional space must necessarily be **diones**, i.e. simultaneously be carriers of the electric and magnetic charges. The birth process of these particles in one-dimensional space will continue as long as the mass of the substance will rise in the space of the highest dimension.

Creation of the first spatial coordinate it is a Big Bang for the two-dimensional World. In one-dimensional space all interactions should be too deterministic. Therefore, the evolution of the two-dimensional World would be short-living. During this time, the size of the two-dimensional World would be not so great, and that will determine the time of transition to the next, three-dimensional World. Over time, the size of the two-dimensional World will increase, allowing the evolution of the Worlds of higher dimensions.

Since the two-dimensional World should only one spatial coordinates, there are no pre-conditions for the creation of vortex electric and magnetic fields.

In this case, it becomes clear why, starting with the World-3, we do not find magnetic monopoles, but notice that all quarks of three-dimensional World and elementary particles (or the vast majority) of four-dimensional World have a spin. This is because diones united so that magnetic charges do not go to the Worlds of higher dimensions and generate a spin.

The rapid saturation of the two-dimensional World by diones and the conversion of two-dimensional space-time three-dimensional brane space-time cause the emergence of a strong information exchange between World-2 and World-3. This creation of diones continues in account of Field of one-dimensional World.

It is worth to note that the initial Field is so powerful that it will supply the energy for the creation and evolution of all the other spaces. That is, we have the dark energy, which are looking for and can not be found any theoreticians or astronomers.

Saturation brane by diones in two-dimensional space promotes a phase transition, namely the creation of particles in three-dimensional space-time, which is characterized by equal contributions of spatial coordinates x and y. So there was a Big Bang for the three-dimensional World. There particles have been created in the three-dimensional space-time with charges $\pm q_2$ and $\pm 2q_2$, where $q_2 = e/3$, e is an elementary charge in four-dimensional space-time[2]. Saturation of the three-dimensional World by particles will lead to its transformation into a brane of four-dimensional World. In parallel, the bosons of three-dimensional World are created; they are responsible for the strong interaction between quarks and for weak interaction. Saturation of the three-dimensional space by "fluid" is completed after $\Delta T_0 \sim 10^{-6} s$ (it still has the very small dimensions).

Again, due to the strong interaction between quarks particles generates four-dimensional World (conditionally: quarks-4[3]), you should assume that these bosons belong to both the World-3 and World-4. Thus for World-4 the World-3 will be Hidden World, while our Universe is the Displayed World. As before, the bosons belonging to both Worlds are realized through the transfer of information, and through the spatial metamorphosis [3].

In the three-dimensional World is still not a sufficient condition for the existence of the vortex magnetic field, which requires three spatial coordinates. Instead for the electric and magnetic fields a new feature appears: in addition to the longitudinal

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[2] Information about the localization of the quarks in the Hidden World (2 + 1) first appears in the monograph [2].
[3] It seems that for particles of four-dimensional world the best name will not quarks-4 bat hyhelith, from the hydrogen, helium, lithium.

waves the transversal electric and spin waves can arise and spread. Then the waves have a helical configuration (longitudinal-transverse wave).

Before proceeding to the next phase transition, pay attention to the dimensions of the particles in the World-2 and World-3. It is axiomatic that the particles have finite dimensions in the manifested axes: accordingly, in one and two coordinate axes. It might seem that in other dimensions the particles have a size zero that would create difficulties for the description of such particles. However, we know that along with the manifested, there are additional dimensions rolled-up measures exist [4, 5]. And besides the length of the folded dimension only 1-2 orders of magnitude larger elementary length. The presence of these measurements suggests that diones have not less than three-dimensional structure, but can move only in one dimension. Other measures are provided for the emergence of certain properties of particles, and not for motion. Thus, the mechanical motion of a particle is possible only along the manifested dimension.

Similarly, we can describe the structure of the particles of the World-3, where two measurements are displayed and at least one dimension is closed. This situation contributes to the presence of motion in only two manifested dimensions.

It is worth to mention that the described conditionally three-dimensional space World-2 and World-3 do not intersect and do not have a common measurement between themselves and the World-4. Thus, we arrive to the necessity at least $(3+3+7)^4$ measurements of the existing Super-Universe. Including information measurement, we have 14 dimensions. Most likely, these measurements are enough for a complete description of all the properties of Super-Universe as a whole, and each World in particular. The number of displayed dimensions for Universe is equal to 4, and the number of hidden dimensions is equal to 3, common number is 7.

After the completion of inflation of the three-dimensional World (through $\Delta T_0 \sim 10^{-6} s$) a phase transition occurs, that is the Big Bang for the four-dimensional space-time (3 + 1). The particles of four-dimensional space-time (quarks-4, *hyhelith*)

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[4] A World of 3 + 1 dimensions is much richer by the particles and fields, and therefore requires a minimum of 7 measurements (3 of them are closed).

have been produced: electrons, protons, deuterons, two kinds of helium nuclei and two types of lithium nuclei. Thus, at the increase of charge of positively charged particles their number decreases essentially.

In the four-dimensional World the so familiar for us light quanta are created, which can have linear or circular polarization and move at the speed of light. They, being virtually, are responsible for electromagnetic interactions between the particles.

The energy of the electrostatic interaction with the distance will be reduced to zero. This character of interaction should lead to the fact that at the transition of four-dimensional World to the brane of five-dimensional World the particles of four-dimensional World will be able to coexist with particles of brane of a five-dimensional World (no confinement). This situation can have significant consequences. In particular, the absence of confinement for particles of a four-dimensional World and for particles of brane of five-dimensional World would be an obstacle to the creation of the five-dimensional World. Consequently, brane of the five-dimensional World is the ***final stage*** of evolution of the Universe (Super-Universe which unites a one-dimensional latent space, a two-dimensional latent space and the displayed three-dimensional space)[5]. This statement supports the Law of similarity intrauterine development of the child.

The emergence of neutrons in the four-dimensional World is accompanied by a $W(Z^o)$ - bosons responsible for weak interaction [6]. Since this interaction is accompanied by changes both neutrons and quarks, bosons are located simultaneously in the three-dimensional and four-dimensional World.

Saturation brane two-dimensional space diones promotes phase transition - the creation of particles in three-dimensional space-time, which is characterized by equal contributions spatial coordinates x and y. So there was a Big Bang for the three-dimensional World. This creates a three-dimensional particles of space-time with charges $\pm q_2$ i $\pm 2q_2$, where $q_2 = e/3$, e - elementary charge in four-dimensional space-time. Saturation of the three-dimensional World particles will lead to its

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[5] This conclusion follows from a comparison of pre-natal development of the child and the development of Super-Universe.

transformation into a World of four-dimensional brane. In parallel, three-dimensional World are bosons, which are responsible for the strong interaction between quarks and weak interaction. Saturation of the three-dimensional space "fluid" is completed after (it is still a very small size).

Birth and stabilization of electrons and nuclei $_1^1H$, $_1^2D$, $_2^3He$, $_2^4He$, $_3^6Li$, $_3^7Li$ the formation of the four-dimensional World has been completed (through $\Delta t \sim 10^2$ s). Its transformation into a brane of five-dimensional World is accompanied by the birth of heavy (Z> 3) nuclei for which the particles of four-dimensional World[6] will be components.

Inflating the four-dimensional World as a brane of five-dimensional World takes a very long time due to a significant increase in the size of the Universe. Therefore, time of inflation may exceed $\Delta t \sim 10^{18}$ s. When the brane is inflated, a density of five-dimensional World decreases, what is an additional evidence in favor the fact that the brane of five-dimensional World is the final phase of the Super-Universe evolution (at the creation of the four-dimensional World a density of matter in the brane of three-dimensional World grew that gave growth to the Big Bang).

And, although the evolution of the Super-Universe will finished before the formation of a five-dimensional World, the ability to create it will set the algorithm for the existence of the main types of charges in four-dimensional World [1].

Pay attention to the similarity of prenatal development of the child and the evolution of Super-Universe. The fertilized egg will correspond to the creation of embryo for the Super-Universe designated as "Field + time" or a one-dimensional World of Field-time. Then the creation of fibers will mean the creation of a one-dimensional space, and the path to the creation of tissue will be the way to the formation of brane of two-dimensional World.

Creation of two-dimensional space will correspond to the formation of tissues, and the evolution of two-dimensional space to the brane of three-dimensional space is the way to the formation of three-dimensional functional organs.

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[6] As the molecule is composed of atoms, so according to the law of similarity nuclei of heavy atoms should consist of light nuclei, i.e., nuclei of heavy atoms have a molecular structure.

Now let us make a small pause. It should be noted that the one-dimensional and two-dimensional space does not provide conditions for the development of intelligent life. Therefore, it does not appear there. A three-dimensional space *is created just for* that to give a life to gain all possible forms (the anthropic principle in the Universe [7]). So, before a four-dimensional space-time will be created, it is necessary to ensure the transition by the presence of intelligence information about upcoming intelligent life.

Only now there are all reasons to create the four-dimensional space-time. Then our World will be converted to the brane of the five-dimensional space-time.

Just as a child at the birth receives additional information, for the creation of higher level of life in the Universe additional information must enter.

Taking into account the **Law of unity, as the Supreme Law of the Universe**, we must accept the fact that the information about the life is acting at all hierarchical levels of the World-4, that is, we are dealing with a sensible Universe. Otherwise, no life could exist on the Earth!

It is interesting in this context to draw attention to the theory of the noosphere, which was developed by Vernadsky [8] and that includes not only the biosphere of the Earth but the Universe as well.

Unexpected confirmation of the conclusion about the creation of reasonable Universe was the information about calculation of two geneticists, Richard Gordon of Gulf Specimen Marine Laboratory and Alexei Sharov of the National Institute on Aging, who used a biological analogue of Moore's Law to determine the age of DNA and found that the DNA came 10^{10} years ago, that is, life is 2 times older than our planet (on the geological data Earth created $4.5 \cdot 10^9$ years ago) [9]. Consequently, the program of intelligent life appeared immediately upon creation of the World-4 and was implemented on Earth when the relevant environmental conditions were achieved needed for the existence of life.

If the Universe began its evolution from a singular point, then it would have been inside the black hole. Estimates for the gravitational radius are following:

$$r_G = \frac{GM}{c^2} \sim \frac{6{,}67259 \cdot 10^{-11} \cdot 10^{53}}{9 \cdot 10^{16}} = 7{,}4 \cdot 10^{25}\, m = \frac{7{,}4 \cdot 10^{25}\, i}{9{,}46 \cdot 10^{15} i\ /\,\tilde{n}\hat{a}.\eth.} = 7{,}84 \cdot 10^{9}\ light\text{-}years.$$

For this calculation a raised mass of the Metagalaxy has been used (instead of the real average density of matter in the Metagalaxy it was used its critical value, i.e. $\rho_{cr} = 10^{-29}$ g/cm^3).

To avoid an inaccuracies of the standard model, let use the proposed above mechanism and assume that at all stages of evolution of the Universe its gravitational radius is significantly smaller than the radius of the Universe, i.e., $r_G = \eta R_U$, $\eta \ll 1$. Since the born space increases its radius with the speed of light, $R_U = cT_U$. There T_U is a lifetime of Metagalaxy.

To simplify the task we perform calculations for four-dimensional World, not for the brane of five-dimensional World.

At given $r_G = \dfrac{GM_U}{c^2} = \eta R_U = \eta c T_U$, us find: $M_U = \dfrac{\eta c^3 T_U}{G}$.

Consequently, the formation of matter in our world is carried out continuously at the same speed[7]

$$\upsilon_m = \frac{dM_U}{dT_U} = \frac{\eta c^3}{G} = \frac{\eta \cdot 27 \cdot 10^{24}}{6{,}67 \cdot 10^{-11}}\ kg/s = \eta \cdot 4{,}05 \cdot 10^{35}\ kg/s.$$

For the average density of matter in the Universe is

$$\rho = \frac{3M_U}{4\pi R_U^3} = \frac{3\eta c^3 T_U}{4\pi G c^3 T_U^3} = \frac{3\eta}{4\pi G T_U^2} = \frac{3\eta}{4 \cdot 3{,}14 \cdot 6{,}67 \cdot 10^{-11} T_U^2} = \frac{3{,}58 \cdot 10^9 \eta}{T_U^2} \quad (1.1)$$

To carry out the calculation of the quantities M_U, υ_m and ρ, we must select the initial conditions. The value of T_U can be found using the value of the Hubble constant $H = 73.8$ km/(s·Mpc) $= 0.755 \cdot 10^{-10}$ years^{-1} $= 2.392 \cdot 10^{-18}$ s^{-1} [10]. In this case, we assume that the redshift is stipulated by the expansion of space, rather than the recession of galaxies. Hence **$T_U = 13.25 \cdot 10^9$ years** $= 4.18 \cdot 10^{17}$ s, $R_U = 1.25 \cdot 10^{26}$

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[7] The scientists are getting used that a law of conservation exists for the baryon number, because it corresponds to the experimental facts in all interactions and transformations of baryons. However, they forget that in the process of the Universe creation following the standard model the baryons had been absent in a singular point. The baryons appeared in the evolution of the Universe. Hence, at the Universe birth a law of baryon number conservation was not working. In the author's model the process of the Universe birth is going continuously. In this case, the conservation of baryon number is not possible. At the same time a baryon number is preserved in the process of a strong or weak interaction.

m. The space is completely filled with the substance. From (1) we find the parameter η, taking the density of $\rho = 0.05 \cdot \rho_{\text{кр}} = 5 \cdot 10^{-28}$ kg/m^3: $\eta = 0.0244$. The rate of formation of matter will be $\upsilon_m = 1 \cdot 10^{34}$ kg/s, i.e., about 5000 solar masses per second. Modern mass of the Universe ($4.18 \cdot 10^{51}$ kg) was an order of magnitude less than expected. Consequently, the effective number of stars with a mass equal to the mass of the Sun, ($M_s = 1.99 \cdot 10^{30}$ kg), equal to $2.1 \cdot 10^{21}$.

To estimate the time T_{Uo} of start for substance filling in the World-4 take as a basis that the density of matter at this point should be $\rho_o \approx 10^{17}$ kg/m^3. In this case, the calculation gives $T_{Uo} = 3 \cdot 10^{-5}$ s. At this point, the radius of the Universe was equal to 9 km. From this moment, the filling of volume by matter begins to go at a constant speed. In this case, the formula (1) for the first second of the Universe's expansion will look like

$$\rho = \frac{3\upsilon_m T_U}{4\pi R_U^3} = \frac{3\eta T_U}{4\pi G \left(T_U + T_{Uo} \right)^3} , \qquad (1.2)$$

In this formula, the time T_U is measured from the Big Bang in the World-4. Within 1 second after the Big Bang the formula (1.1) and (1.2) will be no different. According to (1.2) the density of matter initially increases reaching a maximum at $T_U = T_{Uo}/2$. However, only ~15% of the volume is occupied by the substance. Consequently, some embryos will be formed for the future stars and galaxies. After 1 second the average density value fell to $8.74 \cdot 10^7$ kg/m^3.

If we assume that on average every star has to equal the mass income, then the Sun gets $4.76 \cdot 10^{12}$ kg/s. In this case, the mass of the Sun for the year will increase by $1.5 \cdot 10^{20}$ kg, and for $1.325 \cdot 10^{10}$ years up to $1.99 \cdot 10^{30}$ kg, that is, the entire mass of the Sun.

Establishment of galaxies and stars requires that during the substance creation in the World-4 it must be immediately structured that can be provided only by the **fractal structure** of the embryo of the Universe, and each element of fractal should have a rotational torque. In addition, the Big Bang in the World-4 should make the lowest possible entropy, i.e. the born substance must be **cold**. On further admission of substance into the existing mass its heating will occur. In [1] it was shown that in this

model the entropy of the Universe must increase with time, what corresponds to the laws of thermodynamics and determines the thermodynamic arrow of time.

Knowing the average density of matter in the Universe, we can estimate the average value of the effective density of quark matter in the World-3 and dione substances in the World-2. For the assessment we assume that the mass of the substance in each layer is the same. We use formulae

$$\rho_3 = \frac{M_U}{V_U} = \frac{3M_U}{4\pi R_U^3}; \quad \rho_2 = \frac{M_U}{S} = \frac{M_U}{\pi R_U^2} = \frac{4}{3}\rho_3 R_U; \quad \rho_1 = \frac{M_U}{2R_U} = \frac{2}{3}\rho_3 \pi R_U^2.$$

Hence we find that quark matter has an effective value of the density $\rho_2 = 8.33 \cdot 10^{-2}$ kg/m^2. At the same time we get to the diones substance $\rho_1 = 1.64 \cdot 10^{25}$ kg/m. Consequently, the substance in the World-3 still is rarefied, and in the World-2 it is strongly compressed from the point of view of the World-4.

An interesting comparison: if nuclear matter will be arranged in a chain, we shall get a linear density of $\rho_1 = 1.267 \cdot 10^{12}$ kg/m, and if will be created a flat structure then $\rho_2 = 1.11 \cdot 10^3$ kg/m^2. Thus, the effective density of quark matter is on 4 orders of magnitude lower than nuclear density, while diones matter is greater by 13 orders of magnitude. However, it is possible that the actual mass of diones and quark matter differs significantly from this estimate, since these substances are situated in other layers of the Universe, where there are no preconditions for the emergence of mass usual for us.

Another important comparison of found linear density with Planck's parameters. We know that the Planck's mass is $M_p = 2.176761 \cdot 10^{-8}$ kg and the Planck's length is $l_p = 1.616 \cdot 10^{-35}$ m. If the particles with the Planck's mass are arranged in a linear chain, we obtain a linear density of $\rho_1 = 1.347 \cdot 10^{27}$ kg/m. As you can see, the parameters obtained for the Planck's linear density by 2 orders exceed our estimates for a density of diones matter. Taking into account the dilution parameter $\eta = 0,0244$ and apply it to the calculation of the Planck's density of matter, then get $\eta\rho_1 = 3.29 \cdot 10^{25}$ kg/m, which is only 2 times more than we have found an effective value of the density of matter diones. Such proximity of obtained parameters value shows that

Planck's parameters (mass, length, time) **are realized namely in one-dimensional space of World-2.**

1.3. Increasing of the Universe entropy

Extremely important characteristic of the Universe is an increasing of its entropy, presumably indicating the direction of the time flow - the arrow of time [11].

In the models of birth of the hot Universe during the Big Bang it is declared complete chaos and insanely large entropy that is to become certainly an obstacle to the creation of an ordered Universe, as well as to a dominance of the fundamental laws that govern the life of the Universe and the origin of life [7, 8].

Consequently, only a powerful organizer and performer could direct the action so powerful forces that wonderful organization and laws arose. And so we come to the conclusion that the created Universe was not hot in each layer. Rather, the Big Bang generated for each layer the zero entropy and absolute ordering.

We use a new model of the Universe to calculate the change in entropy.

We will consider only the rapid processes. It should be remembered that the slow processes in inanimate nature can take place only in the direction of increasing entropy. Therefore, the formation of inhomogeneities, their concentration, and the transformation into galaxies, star clusters and star system are going with an increase in entropy of the system, that is, these processes are unlikely.

Quick processes those are most responsible for the growth of entropy is stipulated by the birth of matter at a constant rate:

$$\upsilon_m = \frac{dM_U}{dT_U} = \frac{\eta c^3}{\gamma} = 1,0 \cdot 10^{34} \ kg/s.$$

If we divide the resulting value by the molar mass of the neutron ($M = 10^{-3}$ kg/mol), we obtain:

$$\frac{d\nu}{dt} = \frac{\upsilon_m}{M} = 1,0 \cdot 10^{37} \ mol/s.$$

As for the process of evolution of the Universe

$$dS = d(vS_M) = \frac{vR}{V}dV + \frac{vC_V dT}{T} + S_M dv,$$

assuming that the temperature of the incoming material is constant ($dT = 0$), we find

$$\frac{dS}{dt} = v\frac{dS_M}{dt} + S_M \cdot \frac{dv}{dt} = \frac{3vR}{R_U}\frac{dR_U}{dt} + \frac{dv}{dt} \cdot (R \cdot \ln V_M + C_V \ln T + S_0) =$$

$$= \frac{3vR}{T_U} + \frac{1}{M} \cdot \frac{\eta c^3}{G} \cdot (R \cdot \ln V_M + C_V \ln T + S_0).$$

Analyzing the resulting expression, we note that both terms on the right side is greater than zero. Consequently, the entropy of the Universe increases with time. The first term on the right side decreases with time, but the second term increases with time, as

$$V_M = \frac{M}{\rho} = \frac{4\pi GMT_U^2}{3\eta},$$

i.e. the second term in the expression for the increase of entropy increases with time proportional to the logarithm of the lifetime of the Universe.

Thus, *a*) the entropy of the Universe actually increases with time, and *b*) the rate of growth of entropy in the process of matter creation decreases with time. It should be noted that the star formation, giving a significant contribution to the entropy of the Universe in time may somewhat stabilize the speed of entropy increase.

The increase in entropy with time this is one of the definitions of the so-called arrow of time, i.e. possibility to distinguish the past from the future, to determine the direction of time.

There are three different arrows of time. First, the thermodynamic arrow indicating the direction of time in which the entropy increases. Second, the psychological arrow. This is the direction in which we feel the passage of time, the direction in which we remember the past but not the future. And third, the cosmological arrow. This is the direction of time in which the Universe is expanding [11, 12].

We have considered the change in entropy along with the Universe expands and increases of its mass, which shows that the time in the Universe are clearly identified

both its expansion and growth of entropy. The direction of the psychological arrow of time into the future is an axiom.

1.4. Conclusion

In this chapter on the basis of the similarity Law and the Law of unity in the Universe, a model of creation and evolution of the Universe is proposed in which the laws of physics are true. To create the model information about the prenatal development of child has been involved, as well as the concept of the Tree of Life, what allowed describing the structure of the Universe and all the stages of creation and evolution of the Universe.

1. Our Universe is part of the Super-Universe, is a separate layer in the multi-fiber bundle. Information communication between the individual layers is carried out through a single delocalized point.

2. In the process of creation a Super-Universe a one-dimensional World of Fields-time was filled. This World has not the particles, but has a powerful field and information about the next steps of Super-Universe creation.

3. Energy of the Fields is overflowing into the adjacent two-dimensional (1 + 1) World in which the pairs of Planck's particles have got a birth with opposite electric and magnetic charges; their movement is limited to one spatial coordinate.

4. End of filling a two-dimensional World leads to an "overflow" of energy into a nearby three-dimensional World - a World of known quarks with fractional electric charges, color charges and spins. The next step is an "overflow" of energy into the four-dimensional (3 + 1) World and particle creation of this World. The evolution of the World completes by the creation of brane of the five-dimensional World. This evolution is accompanied by the birth of a whole set of stable and unstable heavy nuclei and atoms. Filling of each new layer in multi-fiber bundle does not introduce entropy into this space (the start of evolution is cold and completely deterministic).

5. To create a life in our Universe and, in particular, a man on the way from three-dimensional to four-dimensional World the relevant information was introduced.

6. The proposed model does not lead to the possibility of the collapse of the Universe into a black hole. Furthermore, it provides a steady increase in entropy and hence the constant direction of thermodynamic arrows of time. The model supports the anthropic principle in the Universe.

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CHAPTER **2. Quarks and leptons in the new model of the Universe**

In Chapter **1** the author proposed a new model of the birth of our Universe with minimum initial entropy on the basis of the Law of Similarity and Unity [1]. At the same time our Universe is part of the Super-Universe, where the Super-Universe presented by fiber space.

Such a structure of the Super-Universe causes appearance of hadrons in the Universe (World-4) due to interaction of quarks in the World-3 and transfer of information about such and interaction to the World-4. So, one particle of the World-4 could be represented by a group of quarks of the World-3, which approximately contains 2 or 3 quarks (see Table 2.1).

Table 2.1. Classification of hadrons.

The group	Particle name	Symbol particles	Symbol antiparticle	Weight (electron mass)	Electric charge		Quark structure
Mesons	Pions	π^0		264.1	0		$\pi^0 = u\bar{u} - d\bar{d}$
		π^+	π^-	273.1	1	−1	$\pi^+ = u\bar{d}$, $\pi^- = \bar{u}d$
	K-mesons	K^+	K^-	966.4	1	−1	$u\bar{s}$
		K^0		974.1	0		$d\bar{s}$
	η°-meson	η^0		1074	0		$\eta^0 = c_1\left(u\bar{u} + d\bar{d}\right) + c_2\left(s\bar{s}\right)$
Baryons	Proton	p	$\hat{p}^-$	1836.1	1	−1	uud
	Neutron	n	$\hat{n}$	1838.6	0		udd
	Λ-hyperon	Λ^0	$\hat{\Lambda}^0$	2183.1	0		uds
	Σ-hyperons	Σ^+	$\hat{\Sigma}^-$	2327.6	1	−1	uus
		Σ^0	$\hat{\Sigma}^0$	2333.6	0		uds
		Σ^-	$\hat{\Sigma}^+$	2343.1	−1	1	dds
	Ξ-hyperons	Ξ^0	$\hat{\Xi}^0$	2572.8	0		uss
		Ξ^-	$\hat{\Xi}^-$	2585.6	−1	1	dss
	Ω^- - hyperon	Ω^-	$\hat{\Omega}^+$	3273	−1	1	sss

Such a structure of the Super-Universe produces of hadrons in the Universe (in the World-4) in result of the interaction between quarks in the World-3 and transmission of information about this interaction in the World-4. Thus, a single particle of World-4 can be assigned to a group of quarks World-3, which has in the zero approximation two or three quarks (Table 2.1)

The table 2.1 contains data on the particles, which are present in the structure of the first three quarks (light quarks). It is clear that there is a large series of particles, which are composed of more heavy quarks.

Since the particles have internal quark structure, they can be in an excited singlet or triplet state in the case of two-quark structures, or doublet and quartet states for three-quark structures.

The lifetime of π^+- and π^--mesons is $2.6 \cdot 10^{-8}$ s, and π^0-meson – $0.8 \cdot 10^{-16}$ s.

Strong interaction in the World-4 appears as one nucleon emits a π-meson, and the second absorbs it for 10^{-23} seconds. Such particles are called by virtual ones. To make these particles are real, they must be free from interaction with nucleons. To do this, you need to provide pion energy to overcome the work function and providing kinetic energy (the analogue of the photoelectric effect).

Perhaps to clarify the calculations of the hadron's characteristics and the relevant interactions one should take into account a few such groups of quarks. Confirmation of this assumption is a creation of considerable number of elementary particles in inelastic collisions with high energy particles. It is not surprising according to Ref. [2] that a hadron is corresponded about 6000 particles in a hidden world. So, to describe the properties of proton in the zero approximation it is necessary to take into account three quarks, and with increased accuracy their number should be significantly increased (up to 6000). In a definite sense this is analogous to a solution of the polar molecule in water, when the solvation shell of a few water molecules is formed. There is also a far zone of molecules, whose influence can be taken into account by using the averaged macroscopic parameters of a solvent.

Thus, a nucleon can be associated with 6000 quarks and quarks that can be associated with 2000 nucleons. It is obvious that there is a certain correspondence

between quarks and hadrons. However, it is not found so far the information link between the quarks and leptons. This Chapter is devoted to clarification of the last issue.

2.1. Weak interaction

The emergence of neutrons in the four-dimensional world is accompanied by a $W(Z^o)$- bosons responsible for weak interactions [3]. Since this interaction is accompanied by changes both neutrons and quarks, such bosons must be in three-dimensional and four-dimensional World.

If $W(Z^o)$- boson was emitted by a single particle, and was absorbed by another, there would be a super-strong interaction (heavy boson) between them. In reality, the radius of the weak interaction is R$\approx 2 \cdot 10^{-18}$ m [4], that is substantially smaller than the radius of the neutron. So over a lifetime these bosons do not go beyond the nucleon that makes it impossible for the emergence of super-strong interaction between the particles.
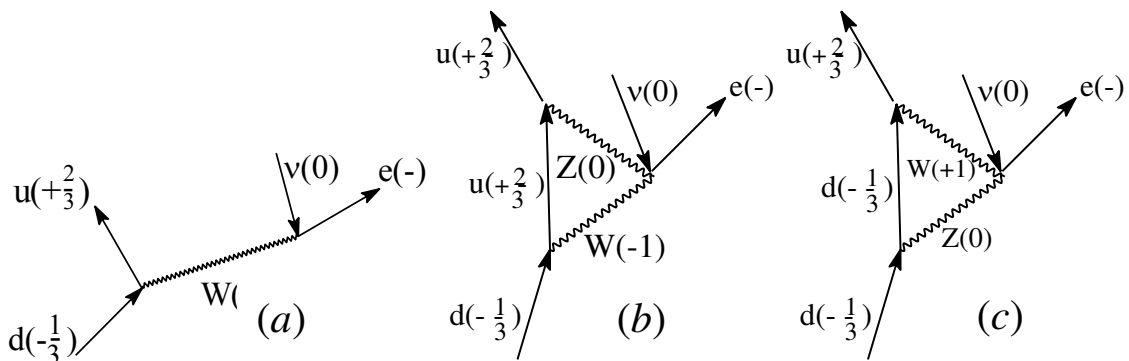

Fig. 2.1. The known Feynman diagram of the weak interaction (a) [3] and proposed in this Chapter diagrams (b) and (c) as a first step to the knowledge of the physics of weak interactions.

Currently, it is accepted a scheme of the weak interactions, according to which the d-quark emits W- boson, turning into u-quark (Figure 2.1a). In turn, the virtual W⁻- boson decays into a pair of real leptons: electron and antineutrino. So, here one has the first contradiction in the accepted scheme of weak interactions. In addition, it is not clear why nature needs Z^o- boson.

This approach to the problem should be considered erroneous. To solve the problem, let us consider a few steps of successive approximations, which allow describing the mechanism of the weak interaction.

In the case of the weak interaction a virtual boson must return to the particle, which emits it. Otherwise, this boson is responsible for the superstrong interaction.

As the World-3 is electrically neutral, the number of d-quarks must be twice more than the number of u-quarks. In the accepted scheme of weak interaction d-quark turns into a u-quark, which violates the electrical neutrality of the World-3.

Furthermore, the particle (real or virtual) can not disappear in the same space to appear in another. **In each space something must be remained.**

Therefore it is necessary to change a scheme of weak interactions in a way that one particle emits and absorbs these bosons. ***The first step*** to changing this scheme is the understanding that during a life time a virtual particle has an ability to turn into another virtual particle with the creation of quarks or leptons (W- bosons and the Z^o-boson belong to the World-3 and the transmission of information via the World-4). Thus as a result of the weak interaction with other charged particles W^--boson must turn into Z^o-boson or vice versa (Figure 2.1, b and c):

The fact that free Z^o- boson (91.2 GeV) is more massive than the $W^{\pm}$- boson (80.4 GeV), does not prevent running such processes, since both are virtual bosons (associated with quarks). Moreover, the energy released during this conversion (the energy level of a massive virtual particle must lie much deeper) should allow the free lepton pair production, in particular the electron and electron antineutrino. Such a process will not affect the energy distribution between leptons formed, whereby an electron can obtain an arbitrary amount of kinetic energy from zero to the maximum possible value.

Thus, the proposed scheme shows why we need Z^o- boson.

Since the instability manifests itself only in the neutron, one must assume that *d*-quark can emit bosons of the weak interaction only in the presence of a pair of quarks (*ud*). The structure of the proton also includes a pair of quarks (*ud*), but it is not able to activate an emission of *u*-quark. Yet β^+- active nuclei is known, which implies that

u-quark could be activated by an additional interaction with the surrounding protons (β^+- activity exists only when there is an excess of protons).

The presence of activation of the weak interaction by neighboring nucleons can be seen in β^-- nuclear activity. While the characteristic decay time of the free neutron is $\tau \approx 840$ s, it is reduced to 0.797 s for ^6_2He, to 0.176 s for ^9_3Li, and to 0.0186 s for $^{13}_5B$ etc. [5]. Consequently, with increasing number of neutrons in the nucleus with excessed neutrons β^-- activity increases. We have the similar result for β^+- activity: the characteristic time of decay of the proton in the $^{10}_6C$ nucleus is 20.34 min, and ^9_6C - 19.48 s, in $^{13}_7N$ - 9.96 min, and $^{12}_7N$ - 0.01095 s. We have the similar result in a case of the heavy nuclei.

The second step. Since the law of conservation of electric charge must be performed in both worlds, a conversion process of the W- boson into Z^o must be accompanied by a creation of the pair of quarks, which have a total electric charge of -1 and the total spin s = 0. This is the same pair of quarks, which forms π - meson.

The experiment shows that the decay of the neutron produces a proton, an electron and an electron antineutrino (Figure 2.2). It may be, if a conversion reaction of the W⁻- boson into Z^o is accompanied in the World-3 by formation of $d + \bar{u}$ pair in the associated (virtual) form with Z^o- boson. Since the quark matter density in the World-3 is quite large [1], it calls for interaction between a virtual particle $\bar{u}$ and real *u*. Under annihilation of this pair the energy is released to make free the d-quark. As a real particle, being fermion, can not become a virtual one, an interaction of the *u* quark with $\bar{u}$ can be only contacted with the simultaneous conversion of the d-quark in the virtual pair into free d-quark.

It is necessary to remember that the mass of the d-quark (~ 7 MeV/c^2) exceeds the mass of the u-quark (~ 5 MeV/c^2), that could interfere with the reaction of the weak interaction. However, the conversion W⁻ $\rightarrow Z^o$ with releasing quite big energy will promote this reaction. In this case, the decay of a neutron into a proton and leptons are not accompanied by the release of γ-rays. Thus, a revised scheme of

conversion of a neutron into a proton with the releasing leptons can be represented as follows (see Figure 2.2; *second step*):
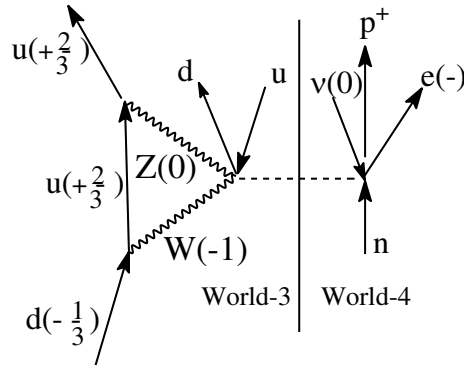

Fig.2.2. The second step to the treating physics of the weak interactions.

In this scheme, the appearance of a pair of quarks is accompanied by a pair of leptons.

Similarly the scheme in Figure 2.1c can be transformed in such way that a creation of virtual boson Z^o- with conversion into the W^+-boson will be primary. However, in this case, it wills likely not enough energy for the leptons pair production. Consequently, this scheme can not be realized.

In fact, the whole process of the weak interaction in the World-3 can be described as gross formula:

$$u + (udd) \rightarrow (uud) + d.$$

The process of replacing members of the bound quarks trio at the information level is replacement of a neutron by a proton with releasing an electron and an antineutrino.

Now let us consider *the third step* to treating the weak interaction. For a more detailed explanation of the weak interaction processes let us draw an attention to the fact that the bosons in World-3 must comply with the bosons in the World-4 (spatial metamorphosis by Gerlovin [2]). Therefore we call the bosons in the World-3 as $W_3^{\pm}$ and Z_3^0. As for bosons in the World-4, then we keep them old notation.

The processes in the World-3 and World-4 should be run in the synchronized[8] way because of the information interaction and spatial metamorphosis. The final diagram of the weak-interaction processes will be as follows:
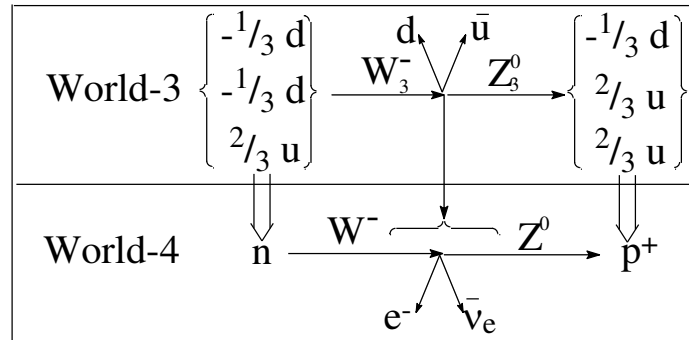
It is clear that annihilation $u + \bar{u}$ with releasing free d-quark should take into account in this scheme. Simultaneously this scheme explains why there are parallels between the quark structure of matter in the World-3 and leptons in the World-4 (Table 2.2).

So there is a parallel between the quarks and leptons, which indicates the relationship between them. Indeed, the lepton pairs (electron plus antineutrino) are formed from W- bosons in the single act with conversion of quarks in the weak interaction reactions. There are three pairs of quarks and leptons, three pairs. Interestingly, there are three pairs of hyhelithes. However, this parallel need the further studying.

Table 2.2. The parallels between the quark structure of matter in the World-3 and leptons and hyhelithes in the World-4.

Quarks	d, u	s, c	b, t
Leptons	e, v_e	μ, v_μ	τ, v_τ
Hyhelithes[9]	^1_1H , ^2_1D	^3_2He , ^4_2He	^6_3Li , ^7_3Li

The attention is drawn to the fact that a sum of the color charges formed during the weak interaction of quarks is zero, as well as a sum of the lepton numbers of created leptons. The total electric charge of the particles in the World-3 and World-4

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[8] In fact bosons of the weak interaction in the World-3 and World-4 are single particles, united at the information level as a result of the spatial metamorphosis.

[9] Hyhelith – the common name of group of the nuclei: hydrogen, helium and lithium

is the same. In both worlds there are formed a particle and an antiparticle. Thus, the spatial metamorphosis of the created quarks pair is a pair of the formed leptons.

It seems that a pair of the quarks and a pair of the leptons are the splitted states of a single particle (boson) in the World-3 and single particle in the World-4, interconnected by a spatial metamorphosis. However, the spatial metamorphosis can combine several particles of the Hidden world with a single particle (or several particles) of the Manifested World, as seen by the example of hadrons. It is not surprising that the two particles of World-3 match just two particles of the World-4. Still cited particles can be found. Really, let us consider the scheme:

$$W^- \rightarrow \left(Z^0 + e^- + \overline{\nu}_e \right) \rightarrow Z^0 + e^- + \overline{\nu}_e .$$

The first process is isoenergetic to form an intermediate complex boson, which decays in a short time ($< 10^{-25}$ s) with forming a virtual boson Z^o and a free pair of leptons.

The analogous reaction occurs in the World-3. Thus, the particles related by a spatial metamorphosis in the World-3 and World-4 are the bosons $\left(Z^0_3 + d + \overline{u} \right)$ and $\left(Z^0 + e^- + \overline{\nu}_e \right)$ with a very short lifetime. If the boson Z^0_3 and free pair of quarks $d + \overline{u}$ created as a result of the $\left(Z^0_3 + d + \overline{u} \right)$ boson separation, then the further interaction would lead to emission of the γ-quanta. If the virtual pair $d + \overline{u}$ firstly interacts with a free u- quark, then an emission of the γ-quanta will be absent.

Further it follows from structure of the final weak interaction process scheme that there is appeared a pair of quarks ($d, \overline{u}$), which is part of the pion π⁻. It is not surprising that the charged pions decay to produce leptons. From the other hand, pions are sufficiently massive particles (264.1 and 273.1 electron mass), and the total mass of the appeared leptons (an electron and an electron antineutrino) in the decay of the neutron does not exceed the difference between the masses of the neutron and the proton (2.5309 electron mass). In the case of the nuclear β-activity energy of the formed leptons can increase by an order due to energy of the active nucleus. This is not surprising, since the initial state in the weak interaction processes corresponds to

the virtual particles with need of energy for his releasing, which is responsible for reduction of the created leptons energy. To confirm the described mechanism, let us remind that π-mesons can decay in several ways: with and without emission of γ-quanta:

$$\pi^{\pm} \rightarrow \begin{cases} \mu^{\pm} + \nu_{\mu}\left(\tilde{\nu}_{\mu}\right) \\ e^{\pm} + \nu_{e}\left(\tilde{\nu}_{e}\right) \\ \mu^{\pm} + \nu_{\mu}\left(\tilde{\nu}_{\mu}\right) + \gamma \\ e^{\pm} + \nu_{e}\left(\tilde{\nu}_{e}\right) + \gamma \end{cases}$$

We draw attention to the fact that a decay of the charged pions into leptons occurs at the level of conservation of energy and an electric charge in both Worlds. In the World-3 π- meson interacts with a free u-quark: $\left(d\bar{u}\right) + u \rightarrow \left(\left(u\bar{u}\right) + d\right) \rightarrow \left(u\bar{u}\right)* + d + \gamma$ [10]. This reaction uses the strong interaction, which leads to a small lifetime for π-meson.

In this case, a free d-quark is appeared and a γ-quantum is emitted; the excess energy in the World-4 is spent on the creation of a pair of leptons, which accompany an appearance of quarks $d + \bar{u}$. Since a real pair of quarks $d, \bar{u}$ corresponds to the π-meson, i.e. energy is not wasted to release this pair from a virtual state, and then energy of the created pair of leptons will be significantly higher than an energy released in the neutron decay because of the weak interaction mechanism. We have already indicated that only a transfer of information exists between the exfoliated spaces.

In the case of the weak interaction **it is carried information about a necessity of creation of the leptons pair by means of using energy, which is available in the World-4**.

Emission and absorption of the $W_3(\pm 1)$, or Z_3^0-bosons without the leptons pair production will look as follows:

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[10] Here $\left(u\bar{u}\right)*$ is a vacuum particle.
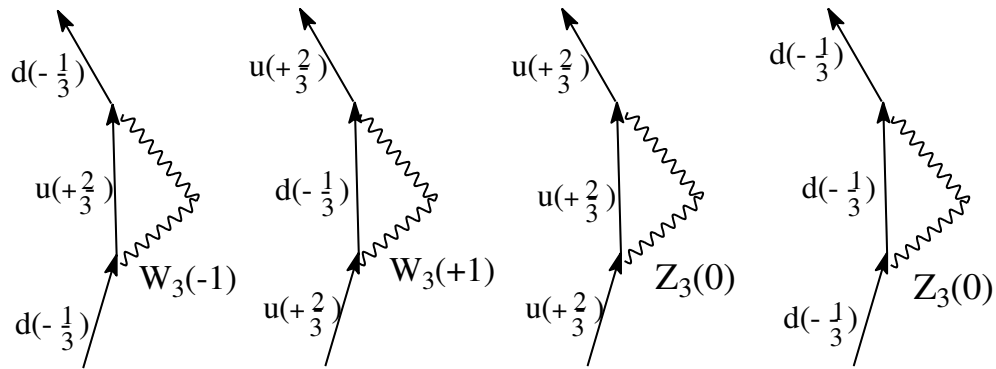
But the scattering during interaction between quarks with Z_3^0 - boson (all the processes run in the World-3) will be looked so:
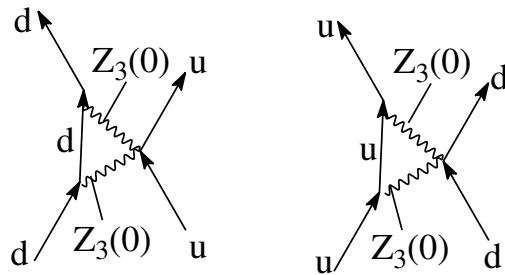

Consequently, in this scheme of interaction W_3 and Z_3^0 - bosons remain virtual in the World-3. As a scattering is carried out on Z_3^0 – bosons, which are not sensitive to a kind of quarks, the scattering processes can occur in arbitrary pair of quarks, one of which emits a virtual Z_3^0 -boson, and second one is scattered on it. The conditions for the Z_3^0 – boson emission are discussed above. Similarly the processes of scattering of electron and neutrino on the Z^o- bosons will occur in the World-4. Naturally, Z^o-boson is emitted and absorbed by neutron (neutrons group) or by a group of protons. Scattering of neutrino on electron with participating the Z^o- boson does not exist because leptons do not emit the weak interaction bosons. Consequently, we can register only electron or neutrino scattering on a neutron involving virtual bosons in the weak interaction reactions.
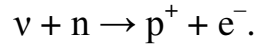
2.2. Well-known reactions involving neutrinos

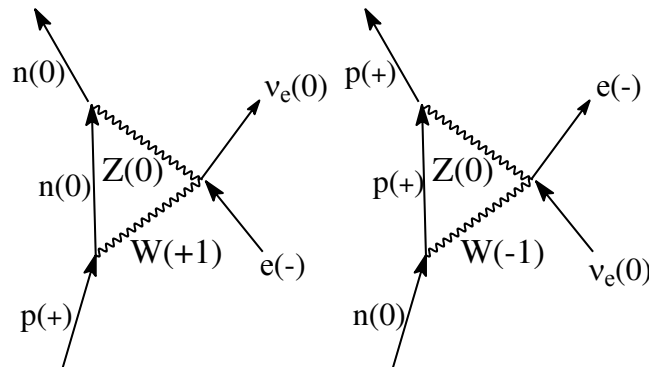Now let us consider the well-known reactions involving neutrinos.

1. Reactions that were observed by Raines and Cohen:

$$p^+ + e^- \rightarrow v + n$$

35
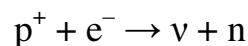
and its inverse reaction

$$\nu + n \rightarrow p^+ + e^-.$$

These reactions can be described by the diagrams:

The first of these schemes allows to detect neutrino at a sufficiently high energy of the electron ($m_e c^2 > 1,3$ МэВ), which was done. In addition, the similar reaction can be realized by means of the electron K-capture by atomic nucleus. The neutrino is released and a charge of the atomic nucleus decreases by one. The second reaction can occur at any energy neutrino. At the same time neutrino disappears and the electron appears.

Both reactions are possible, as under transformation $W^{\pm} \rightarrow Z^o$ the necessary energy (≥ 1.3 МэВ) for the reaction is released.

2. It is easy to see that it will be permitted a reaction of interaction between antineutrino and a proton, which can radiate the W^+- bosons in a nucleus with an excess of protons:

$$\overline{V}_e + p^+ \rightarrow n + e^+$$
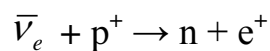
3. Finally, let us consider the reaction of the tau-lepton decay.

It is believed that this reaction runs in the framework of the weak interaction, which is contrary to the short lifetime of the tau-lepton ($2.9 \cdot 10^{-13}$ s).

Since the decay of the tau lepton is not observed in the absolute vacuum, one could assume that it interacts with the atomic nuclei. The weak interactions manifest in a case if the tau-lepton interacts with the W^+- boson according to scheme of conversion of an electron into an electron neutrino. So, we will have a reaction:
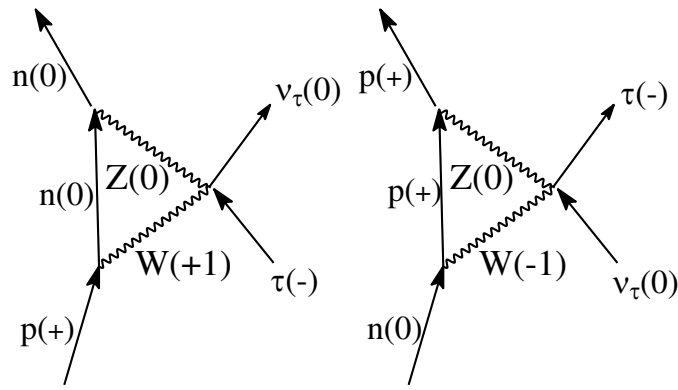
These reactions will run at arbitrary energies of the tau-lepton ($m_\tau c^2 = 1784{,}36$ MeV) and sufficient energy of the tau neutrino ($E_{v\tau} > 1783{,}06$ MeV). It is important that the pions are not created, but only a change of a nuclear charge occurs.

The first of these reactions is possible in a case of availability of the nuclei with an excess of protons, while the second reaction can take place on nuclei with excess of the neutrons. However, the reaction of converting the tau-lepton within the weak interaction scheme is unlikely, and therefore slow in comparison with instability of the free neutron. It follows that such a reaction can not be described by the experimental data on the transformation of the tau-lepton. Rather, one should look for the reasons of instability of the tau-lepton in the framework of the strong interaction.

Tau-lepton, with a mass greater than the nucleon mass, can easily penetrate into the atomic nucleus and cause a deep inelastic collision. As a result of the collision it will be knocked out another particle - π^-, which will take on an electrical charge of the tau-lepton. Thus, instead of the tau-lepton the tau-lepton neutrino emitted from a nucleus. Consequently, the reaction will be as follows:

$$\tau^- + {}^Z\!X \to {}^Z\!X + \pi^- + v_\tau.$$
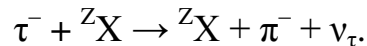
Here a nucleus (${}^Z\!X$) acts as a catalyst.

Another reaction could be knocking from a nucleus of a neutral pion with the transformation of a proton into a neutron:

$$\tau^- + {}^Z\!X \to {}^{(Z-1)}\!Y + \pi^0 + v_\tau.$$
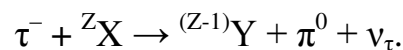
In addition, there is a possibility of spontaneous decay of the tau-lepton to form the light leptons:

$$\tau^- + \rightarrow \mu^- + \bar{V}_\mu + \nu_\tau.$$

$$\tau^- + \rightarrow e^- + \bar{V}_e + \nu_\tau.$$

All of the considered reactions of the tau lepton should proceed with high efficiency, which corresponds to the results of experimental studies.

The reaction of decay of the tau-lepton within the weak interaction scheme will be accompanied by the reaction in the World-3:

or
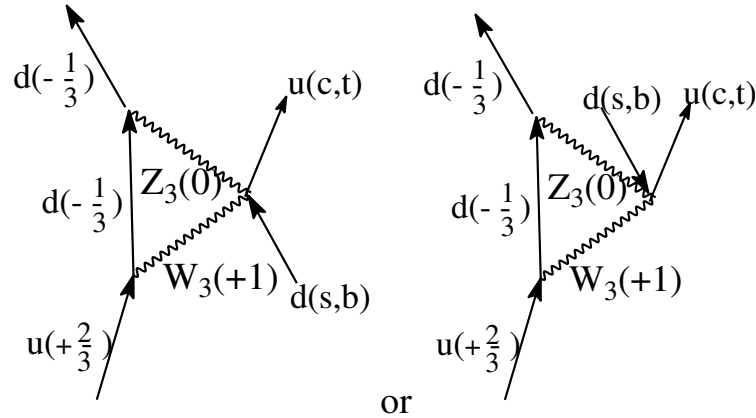
2.3. Conclusion

In this Chapter we have considered the weak interactions mechanisms in the World-3 and World-4 on the basis of earlier proposed author's model of the birth of our Universe with a minimal initial entropy. This analysis allowed us to treat the weak interaction processes in an adequate agreement with the known experimental results. In particular, it has been found:

1. Since the interaction between quarks in the World-3 leads to the appearance of hadrons in the World-4, the bosons $W^\pm$ and Z^o, responsible for the weak interaction, must exist due to the a spatial metamorphosis of one part in the World-3, and the other part in the World-4. There is an interaction between these parts at the information level, which synchronizes all processes taking place with the participation of these bosons.

2. In a process of the weak interaction in the World-3 a virtual boson is emitted and absorbed by the same quark. It may happen that during the existence emitted $W^\pm$-boson become a Z^o- boson, forming a quark-antiquark pair with opposite color

charges and integer total electric charge. Synchronously with this process in the World-4 it is created a pair of leptons with zero total lepton charge and electric charge to be equal to the total electric charge in the World-3. Thus, the interaction between quarks in the World-3 leads to an appearance of the hadrons in the World-4, and an emergence of the quark-antiquark pair in the weak interaction process leads to an appearance of the lepton-antilepton pair (for example, an electron – an electron antineutrino) in the World-4.

3. Leptons can not emit virtual bosons $W^{\pm}$ and Z^{o}. The scattering and conversion of leptons is possible only on bosons $W^{\pm}$ and Z^{o}, emitted by nuclei. Similarly, in the World-3 it is possible running reactions of scattering and transformation of quarks.

4. The instability of the tau-lepton is only marginally described by the reaction of the weak interaction. Instead, the tau-lepton can decay within a scheme of the strong interaction, because it can easily penetrate into an atomic nucleus, causing inelastic collision with a creation of pions $\pi^{\pm}$ or π^{o} and tau-lepton neutrino. In addition, the reaction of spontaneous decay of the heavy leptons in the lungs effectively occurs.

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URL: http://dx.doi.org/10.15640/ijpa.v3n2a1

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CHAPTER **3. Mechanisms of origin of matter in new model of the Universe**

In this Chapter we will use a model of the birth of our Universe with the minimum initial entropy [1], described in Chapter 1, to describe mechanisms of mater origin at the all layers of fiber space of the Super-Universe.

Formation of the fiber space takes place simultaneously in all layers with the appearance of energy of Field-time in the zero-dimensional space (World-1). The Field produces the substance stepwise filling the one-dimensional World (World-2), the two-dimensional World (World-3) and our World-4. After the birth of the Super-Universe the characteristic size (radius) of each space increases with the speed of light. Filling our space is starting from the time $T_{Uo} = 3 \cdot 10^{-5}$ s. Since that the creation of matter in the World-4 takes place with the constant speed. Before this moment only vacuum states were filled in our space [3].

Energy of scalar field unlike electromagnetic field has an ability to directly produce particles of appropriate space. At the same time produced particles should not have charge and spins. In our space such particles are represented by neutrons complexes (bineutrons and bineutrons complexes). Initial matter looked like a combination of small cold neutron stars. In the World-3 such particles are represented by bineutrons – complexes of 6 quarks (which do not have colorful or electrical charge and also spin). In the World-2 it is a complex of dions with cumulative electrical and magnetic charges equal to zero.

In this Chapter the same laws will be applied to reveal the mechanisms of particles and atomic nuclei production in our four-dimensional (3 + 1) Universe (World-4).

In modern cosmological theories the production of heavy chemical elements referred to explosion of supernovas. If it is so in their depths a synthesis of heavy atomic nuclei has to take place due to thermonuclear reactions and in the result of a supernova explosion should cause an emission of heavy chemical elements into space. Further, on default it is considered that these heavy atoms group around the

stars, and then they form small and large planets. But most of cosmogony theories state last stage of thermonuclear synthesis as Fe nucleus production. It is considered that endothermic reactions of heavy nuclei (Z > 50) production could take place only if temperature of star central area is higher than 10^9 K. If such a possibility exists, heavy nuclei should be localized in the middle of star. And in the case of large star bang on its place neutron star is created, all heavy nuclei should stay inside it, don't throw out into space. At the same time we explored huge quantities of Pl, Hg and U etc. in the Earth. And such theories of heavy nuclei birth inside thermonuclear stars don't give answer on where such huge quantities of heavy elements in the Earth are from?

It should be noted that the supernova explosions are quite rare (only 4 times during last thousand years [4]) phenomenon within our galaxy and that is why they are studied on all observable galaxies complexes. In addition, during the stars formation process the fusion of heavy nuclei (Z> 50) is energetically unfavorable. So such explosions could not provide a sufficient amount of heavy chemical elements, to create even a cloud of cosmic dust, not to mention the extremely low probability of capturing such clouds by stars with the subsequent formation of planets. On the other hand, binary stars are quite common in the Universe. This suggests that both double stars and stars with planets have some common mechanism of the origin.

Thus it is necessary to look for other mechanisms that would allow the production of heavy chemical elements, as well as small and large planets in the gravitational field of the stars.

On the other hand, there is a general question about the origin of matter in the Universe emerges. Let us cite famous mathematician and astrophysicist S. Hawking [5]:

"Inflating Universe could explain why there are so many substances. The observable part of the Universe contains about 10^{80} particles. Where did they? The answer lies in the fact that in quantum theory particles can be created out of energy in the form of particle-antiparticle pairs. But then the question immediately rises: Where does the energy come from? There is the answer. The total energy of the Universe is

exactly zero. In the Universe the substance is formed of positive energy. But the substance itself is attracted by gravity. Two closely spaced pieces of material have a lower energy than the same two pieces that are far from each other as to the diversity of the sides need to expend energy to overcome the gravitational force that seeks to connect them. Thus, the energy of the gravitational field is in some sense negative. It can be shown that in the case of the Universe, about the homogeneous space, this negative gravitational energy exactly cancels the positive energy associated with the substance. Therefore, the total energy of the Universe is zero."

In this regard, we can say the following.

In this statement S. Hawking [5] after S.W. Carey [6] considers that the potential energy totally ccompensates the positive one (kinetic energy plus the rest energy of the substance), and the resulting energy is equal to zero. If it is true, there would be no reason for the formation of black holes, supernova explosions etc. By a strange thoughtlessness theoretical physicists forget about the existence of the virial theorem (for stationary or equilibrium state), which claims that for the central fields such as gravitational ones the kinetic energy equal to the half of the potential energy. If we compare this energy with the energy of the substance for instance in the solar system the value of Mc^2 for the Sun and planets exceeds the potential energy in 9 orders of magnitude.

Similar calculation of gravitational interaction energy of arbitrary particle with mass of the Universe shows, that correlation between relativistic rest energy of particle and gravitational interaction energy is determined by correlation of the Universe radius R_u to its gravitational radius r_g[11]. Using R_u and r_g from [1] it could be shown that rest energy is 27 times bigger than gravitational energy. In other words, the contribution of the energy of motion and gravitational interactions can be neglected in comparison to the full energy of matter in the Universe, which is a large positive value and in any case is not equal to zero. So, it is impossible to get zero energy for the Universe.

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[11] $E_G = - \int_0^{R_U} \gamma m \rho \cdot 4\pi r dr = \frac{3}{2} m \frac{\gamma M_U}{R_U} = \frac{3}{2} m \frac{\gamma M_U}{r_G} \cdot \frac{r_G}{R_U} = \frac{3}{2} m c^2 \cdot \frac{r_G}{R_U}$

.At the same time the collapse does not significantly change the value of Mc^2. The collapse of stars leads to a dramatic reduction in their radius, a release of large amount of energy, which is equal to the half of the difference of the potential energies of a star in the original and the collapsed state. This will for sure lead to an explosion of the star, and it can be really observed in the Universe. So the collapse is a rapid (adiabatic) process. If the process of compressing of the star would be slow, then the excess of energy would come out in the form of emission of photons and particles without causing the explosion of the star (an open system, the process is non-adiabatic).

Since the Universe is assumed to be closed [7], its expansion is possible 1) due to the initial excess of the kinetic energy (the entire Universe was born in the Big Bang, the mass is constant), or 2) by constant infusion of energy and matter (weight increases).

In the first model the final stage of evolution of the Universe depends on the total energy (kinetic and potential), which can be both positive and zero or negative. And only negative energy makes the Universe closed, the expansion of which sometime will be replaced by the compression.

In the second model, the final stage of evolution of the Universe is totally depended on the program of the scalar Field.

3.1. "Birth" of substance

To explain the origin of a matter from the Fields energy, we are assuming that the **scalar Field can directly produce the matter**. However, the field is not bearer of charges. As a result our Universe is electrically neutral, i.e. the number of protons equals the number of electrons. Thus **only neutrons can be produced**. It can be single neutrons[12], or clusters which can contain many neutrons coupled by the strong interaction involving neutral pions. It is clear that the neutrons in such clusters will decay due to the weak interaction.

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[12] Neutron is a bearer of spin and the baryon number, and therefore it is unlikely that a field will create single neutrons. Rather, pairs or clusters of neutrons with fully compensated charges and spins will be produced.

Thus, a pair of $p^+ + e^-$ and an electron antineutrino is formed from the neutron.

A cluster of two neutrons will produce a deuteron, an electron and an antineutrino. A cluster of three neutrons will give tritium, an electron and an antineutrino, with further decay into $_2^3 He$. and so on.

From our estimations [1], first the four-dimensional world (World-4) substance was very dense (~ 10^{17} kg/m^3), but as a result of the expansion of the Universe, its density dropped, that led to the formation of clusters of different sizes, which in particular according to the laws of physics were evolved in a complete set of nuclei, survived to the present days. The unstable nuclei decayed in the early stages of evolution.

It should be noted that the characteristic decay time of a free neutron is $\tau \approx 840$ s, for tritium it is $3{,}87 \cdot 10^8$ s, for $_2^6 He$ is 0.797 s, for $_3^9 Li$ is 0.176 s, for $_5^{13}B$ is 0.0186 s, etc. [6].

It is clear that fast enough processes of protons and electrons formation will take place in newly formed neutron matter. At the same time energy will be released and the matter will be heated. While the density of the substance will be high a reverse process of the integration of electrons and protons into a neutron will take place (the analogue of K-capture in heavy atoms). During this process neutrino will be produced.

It was shown in [7][13] that there is a circulation of energy in the Universe, just like there is a water circulation in the nature. The latter consists of four phases: 1) an evaporation of water from sea surfaces, 2) a condensation of water vapors in clouds and their motion, 3) water return to the ground as precipitates, 4) water transit to the seas by rivers. Analogous circulation of stellar radiation leads to a finite lifetime of

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[13] Circulation of energy in the Universe must be provided by electromagnetic field quanta (photons) because they do not affect on the electrical neutrality of the Universe. On the previous stage, it is the energy flux from the higher hierarchical level, which is transformed in massive objects into neutral particles and electromagnetic waves. Because electromagnetic radiation is 77% of the total solar radiation, the same part the energy is transformed inside the Sun in a circulation process. In this case, the lower limit of the antineutrino flux may be reduced to 23% of the presented value.

light quantum. Ultimately, the star radiation energy returns to the center of the stars to complete the cycle of the energy circulation in the nature.

If the Sun gets $4 \cdot 10^9$ kg of neutrons every second due to the energy circulation process, and $4.25 \cdot 10^{12}$ kg/s during the process of the Universe mass increase [1], and the same number of neutrons decays into protons, electrons and antineutrinos, it is easy to calculate that of about $2.5 \cdot 10^{36} \div 2.5 \cdot 10^{39}$ neutrons/s turn (lower limit corresponds to the process of energy circulation, and the top one corresponds to the matter birth during the process of the Universe, if this matter is born inside some massive bodies – stars and planets). Hence, the same quantity of antineutrinos is formed and emitted into space. As a result $9 \cdot 10^{12} \div 9 \cdot 10^{15}$ antineutrinos per second fall on each square meter of the Earth's surface. If some part of a new substance is born within the Sun, and the rest of it is born in the solar surrounding (within the Oort cloud), the antineutrino flux will come not only from the sun but also neighborhood areas. So the flux of antineutrinos from the sun to the earth is less than $9 \cdot 10^{15}$ per second.

This value can change if the secondary substance conversion processes take place. Neutrinos can also appear.

It should be noted that all these processes can also take place in neutron stars (pulsars). In spite of great pressures keeping a neutron star in a compact form, a lot of electrons and protons should exist in its volume. Since this is a dynamic equilibrium process, a neutron star will emit a large flux of neutrinos and antineutrinos, as well as electromagnetic waves of a wide frequency range. Taking into account that the volume of a neutron star can serve as a resonator for the electrical oscillations generated by an electron gas, the nature of its pulsating electromagnetic oscillations registered by our receivers can be understood. It can not be excluded that neutron decay in a neutron star is stimulated by these oscillations which is analogues to the stimulated emission of atoms in lasers.

The production of neutrons in stars will result in additional energy generation and appearance of hydrogen atoms (or electrons and protons) and antineutrinos. It is

also possible an appearance of neutrinos due to the formation of neutrons from the electrons and protons.

There are two stages of the matter production. Let us consider the first one.

Let matter in the World-4 had a fractal structure and its density was of about 10^{17} kg/m^3. As a result the volume of one of a future stars increased during one second from $1,454 \cdot 10^{-9}$ m^3 = 1,454 mm^3 to $5.38 \cdot 10^4$ m^3. Note that this volume includes the volume of the star itself, and the volume of space between the stars. This space was formed because inside the future star nucleus the strong interaction forces acted first, then the forces of electromagnetic interaction appeared during process of structuring of substance and weak interaction reactions. The further increase of the star's mass and space expansion the gravitational interaction became dominant. These forces had slowed the expansion of the star and, as a consequence, led to the relative increase of the volume of vacuum between stars.

As there were gaps between the fractals in the initial structure of the Universe, nothing was prevented to rotation of some fractals (future stars) around their center of mass, as well as of groups of fractals (future galaxies) around a mutual center of mass.

The second important point, which immediately requires our attention, is the substantial difference between the conditions for the existence of an initial dense mass of the Universe and neutron stars which are currently known. This difference can be characterized by the relative change of size (deformation) of the Universe $\varepsilon = \Delta R_U / R_U = \Delta T_U / T_U$. For $\Delta T_U = 1$ s, the deformation of the Universe at present time is 18 orders of magnitude smaller than during the first seconds of the existence of the World-4. This stretching of matter at the beginning of the evolution of the Universe was so powerful that it was not slowed down by the forces of interaction between fractals. As a result, there are individual galaxies and stars inside them appeared.

Space expansion will lead to volume structuring of stars onto islands of dense matter, which caused an increase of the average distance between stars. However, the mass of the islands *during the early stages of the Universe expansion may be much*

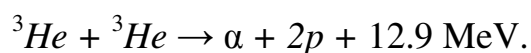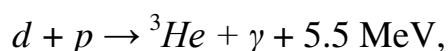*higher than the mass of the heaviest stable atomic nucleus* and, in addition, it will increase rapidly.

Simultaneously with the described structuring processes a matter transmutation will take place: protons and electrons will appear as a result of weak interaction reactions. The islands become superheavy nuclei. In addition, a large excess of neutrons will lead to some neutrons penetration through the surface of the islands. Neutrons can cause a fission reaction for nuclei onto fragments, which quantity will decrease and as a result this leads to the creation of nuclei, having from 1 to ≥92 protons. Due to this a lot of thermal energy will be released, and the substance will be heated up.

As you can see, such mechanism of the Universe evolution, in particular, will lead to the production of heavy atomic nuclei just after the Big Bang. Therefore, we should expect that the **bowels of the Sun and stars consist of heavy nuclei, the increase of their mass and fusion will provide the energy release and the temperature regime in stars**.

3.2. "Birth" of light nuclei and atoms

In the second part, let us consider the birth of light nuclei in the process of the evolution of the Universe. As a result of fission of heavy nuclei, the number of light nuclei will exceed the number of heavy nuclei; such course of the evolution will prevail.

We shall assume that the creation of matter is fulfilled by pairs of neutrons, which do not carry charge and spin. This creation takes place continuously and does not require temperature for nuclear reactions (cold fusion). In its turn, the thermonuclear fusion reactions can take place only at high temperatures which allow overcoming the Coulomb barrier. Such temperatures exist only in thermonuclear stars providing the reactions:

$p + p \rightarrow d + e^{+} + v + 0.5$ MeV,

$d + p \rightarrow {}^{3}He + \gamma + 5.5$ MeV,

${}^{3}He + {}^{3}He \rightarrow \alpha + 2p + 12.9$ MeV.
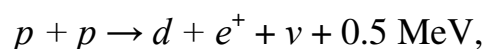
This cycle allows four protons turn into α- particle with the energy release of about 19 MeV.

This simple mechanism of nucleosynthesis stops after the creation of α- particles because nuclei with mass number 5 can not exist. In the literature, the problem was solved assuming α- particles triple fusion reactions at $T \sim 10^8$ K [8]:

$3\alpha \rightarrow {}^{12}C + 7,7$ MeV.
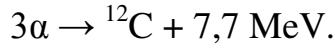
Triple fusion of the helium nuclei is possible due to the resonance between three α-particles and excited ${}_{6}^{12}C *$ nucleus. Indeed it was shown in the experiment that ${}^{12}C$ nucleus has appropriate excited state, for triple fusion of α- particles[14]. If this nucleus will have time to emit γ- quantum its breaking onto 3 α- particles, which is unlikely, ${}_{6}^{12}C$ nucleus will be created.

However, the fusion nucleosynthesis becomes ineffective if nucleus mass approaches to 50.

In our case (cold nucleosynthesis) the substances creation takes place in nucleus and in the nucleus field, where free or bounded bineutrons (*Bn*) are produced with certain probability.

If *Bn* are free particles, then the possible reactions are:

$Bn \rightarrow 2\,{}_{0}^{1}n \rightarrow 2\,{}_{1}^{1}p + 2e^- + 2\tilde{\nu}$

$Bn \rightarrow {}_{1}^{2}d + e^- + \tilde{\nu}$
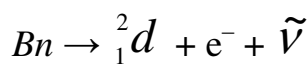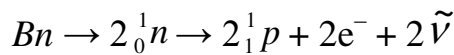
Now let us consider nucleus processes during *Bn* production.

$ {}_{1}^{1}p + Bn \rightarrow {}_{1}^{3}T \rightarrow {}_{2}^{3}He + e^- + \tilde{\nu}$

$ {}_{1}^{1}p + Bn \rightarrow {}_{1}^{2}d + {}_{0}^{1}n \rightarrow {}_{1}^{2}d + {}_{1}^{1}p + e^- + \tilde{\nu}$

$ {}_{1}^{2}d + Bn \rightarrow {}_{1}^{4}H \rightarrow {}_{2}^{4}He + e^- + \tilde{\nu}$

$ {}_{1}^{2}d + Bn \rightarrow {}_{1}^{4}H \rightarrow {}_{1}^{3}T + {}_{0}^{1}n \rightarrow {}_{1}^{3}T + {}_{1}^{1}p + e^- + \tilde{\nu} \rightarrow {}_{2}^{3}He + {}_{1}^{1}p + 2e^- + 2\tilde{\nu}$

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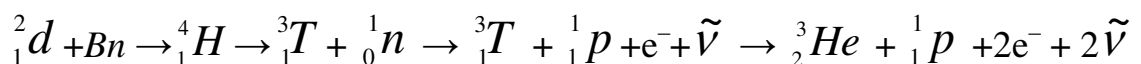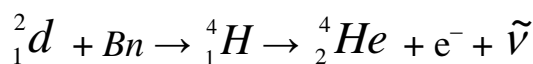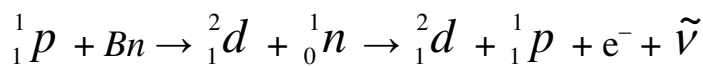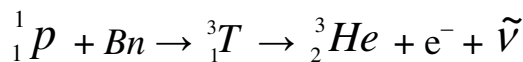
[14] In such reactions, the Coulomb repulsion between α-particles, which creates a barrier for the reaction, is not taken into account. Therefore, the reaction is possible only if the density of matter is comparable with the nuclear one, when other charges surrounding eliminates Coulomb repulsion.

$$_1^3T + Bn \rightarrow {}_1^5H^* \rightarrow {}_2^4He + {}_0^1n + e^- + \tilde{\nu} \rightarrow {}_2^4He + {}_1^1p + 2e^- + 2\tilde{\nu}$$

$$_2^3He + Bn \rightarrow {}_2^5He^* \rightarrow {}_2^4He + {}_0^1n \rightarrow {}_2^4He + {}_1^1p + e^- + \tilde{\nu}$$

$$_2^4He + Bn \rightarrow {}_2^6He \rightarrow {}_2^4He + 2{}_0^1n \rightarrow {}_2^4He + 2{}_1^1p + 2e^- + 2\tilde{\nu}$$

$$_2^4He + Bn \rightarrow {}_2^6He \rightarrow {}_3^6Li + e^- + \tilde{\nu}$$
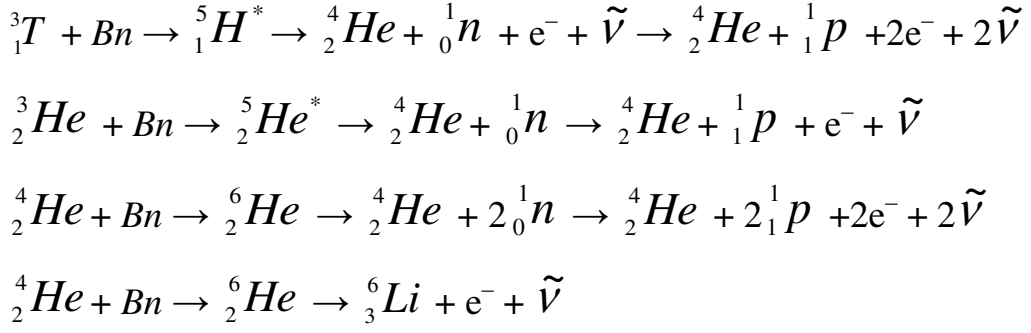
Since the nuclei $_2^5He$ and $_3^5Li$ don't exist, the ejection of a neutron from the nucleus $_2^6He$ cannot be expected. During the initial stage of the Universe expansion the following reactions are possible:

$$_2^6He + Bn \rightarrow {}_2^8He \rightarrow {}_3^8Li + e^- + \tilde{\nu} \rightarrow {}_4^8Be + 2e^- + 2\tilde{\nu} \rightarrow 2{}_2^4He + 2e^- + 2\tilde{\nu}$$

$$_2^6He + Bn \rightarrow {}_2^8He \rightarrow {}_3^8Li + e^- + \tilde{\nu} \rightarrow {}_4^7Be + {}_0^1n + 2e^- + 2\tilde{\nu} \rightarrow {}_4^7Be + {}_1^1p + 3e^- + 3\tilde{\nu}$$

$$_2^6He + Bn \rightarrow {}_2^8He \rightarrow {}_3^8Li + e^- + \tilde{\nu} \rightarrow {}_3^7Li + {}_0^1n + e^- + \tilde{\nu} \rightarrow {}_3^7Li + {}_1^1p + 2e^- + 2\tilde{\nu}$$
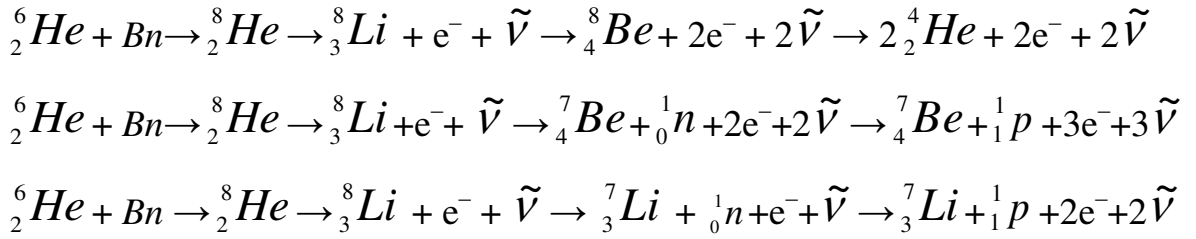
In this case, there is no $_4^8Be$ nucleus which is just the sum of unbounded α-particles. Therefore, hopping that $_3^8Li$ will be enough active, it was prescribed for it to throw neutron and an electron or a neutron only. The reaction of $_4^7Be$ formation is hypothetical in this case. Given reactions are actually quite rare (the ratio of a probability of bineutrons creation to probability of the birth of a matter is $2\cdot10^{-18}$, which is equal to the ratio of the Universe mass increase rate to the mass of the Universe [1]). Thus, the probability of appearance of bineutrons in nucleus is 10^{-18} per second per nucleon, and therefore it is hard to assume that unstable nuclei will be involved in such reactions. So, below we shall consider only stable nuclei (or more precisely, quasi-stable ones), whose the half-life is years. Next

$$_3^6Li + Bn \rightarrow {}_3^8Li$$
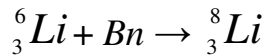
This reaction is similar to the previous one, however, it is going on with a stable particle $_3^6Li$. In this case, we can not exclude the appearance of activated nucleus $_3^8Li$ which can emit a neutron, a proton or an electron. In the first case $_3^7Li$ will be

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formed, in the second one a non-existent isotope $_2^7He$ will be produced which will immediately loose a neutron. If the electron will be emitted, non-existent particle $_4^8Be$ will be formed which will immediately decay into two α- particles.

At the first stage of hyhelith formation, when there are a lot of neutrons, it is probable that a neutron capture reaction by the bottom row of hyhelith[15] will be effective. Then $_3^6Li$ and $_2^3He$ will "erode". Many deuterons will be also born.

$$_1^1p + _0^1n \rightarrow _1^2d$$
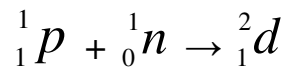
But eventually the continuous channel of the protons formation will overpower their transformation into deuterons.

$$_2^3He + _0^1n \rightarrow _2^4He$$

$$_3^6Li + _0^1n \rightarrow _3^7Li$$

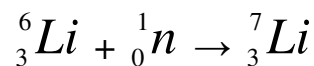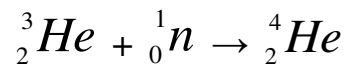It should be noted that the inelastic collisions of nuclei with neutrons are possible in the presence of resonance and fast channel for the excitation relaxation of new nucleus. Resonance can be provided by an appropriate kinetic energy of interacting particles in daughter nucleus coordinate system. In other words, the probability to capture a neutron by nucleus for most nuclei may be negligible. Than

$$_3^7Li + Bn \rightarrow _3^9Li \rightarrow _4^9Be + e^- + \tilde{v}$$

$$_4^7Be + e^- \rightarrow _3^7Li \quad \text{K-capture of an electron in an atom}$$

$$_4^9Be + Bn \rightarrow _4^{11}Be \rightarrow _5^{11}B + e^- + \tilde{v} \text{ - known } \beta^- \text{- activity of } _4^{11}Be.$$

$$_4^9Be + _0^1n \rightarrow _4^{10}Be$$

$$_4^{10}Be + Bn \rightarrow _4^{12}Be \rightarrow _4^{11}Be + _0^1n \rightarrow _5^{11}B + _1^1p + 2e^- + 2\tilde{v}$$

$$_5^{10}B + Bn \rightarrow _5^{12}B \rightarrow _6^{12}C + e^- + \tilde{v} \quad (100\%)$$

$$_5^{10}B + Bn \rightarrow _5^{12}B \rightarrow _6^{12}C^* + e^- + \tilde{v} \rightarrow 3\alpha + e^- + \tilde{v} \ (1,5\%)$$

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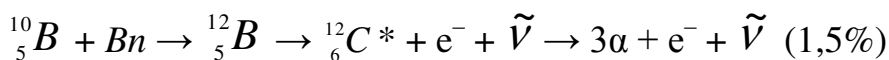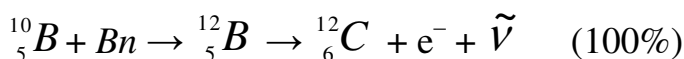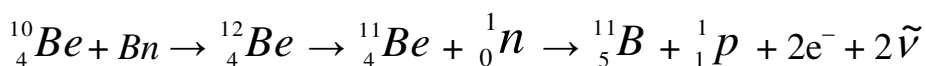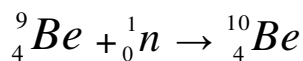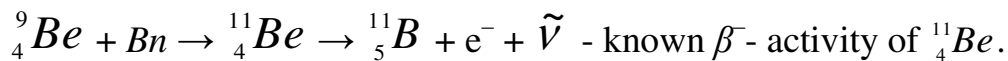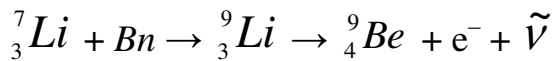
[15] Here the author has introduced the term "hyhelith" (hydrogen, helium, lithium) to denote six stable isotopes: $_1^1H$, $_1^2D$, $_2^3He$, $_2^4He$, $_3^6Li$, $_3^7Li$.

$$^{10}_{5}B + Bn \rightarrow {}^{13}_{5}B \rightarrow {}^{13}_{6}C + e^- + \tilde{\nu}$$

$$^{12}_{6}C + Bn \rightarrow {}^{14}_{6}C \rightarrow {}^{14}_{7}N + e^- + \tilde{\nu}$$

$$^{13}_{6}C + Bn \rightarrow {}^{15}_{6}C \rightarrow {}^{15}_{7}N + e^- + \tilde{\nu}$$

$$^{14}_{6}C + Bn \rightarrow {}^{16}_{6}C \rightarrow {}^{16}_{7}N + e^- + \tilde{\nu} \rightarrow {}^{16}_{8}O + 2e^- + 2\tilde{\nu}$$

$$^{14}_{7}N + Bn \rightarrow {}^{16}_{7}N \rightarrow {}^{16}_{8}O + e^- + \tilde{\nu}$$

$$^{15}_{7}N + Bn \rightarrow {}^{17}_{7}N \rightarrow {}^{17}_{8}O + e^- + \tilde{\nu}$$

$$^{15}_{7}N + Bn \rightarrow {}^{17}_{7}N \rightarrow {}^{16}_{8}O + {}^{1}_{0}n + e^- + \tilde{\nu} \rightarrow {}^{16}_{8}O + {}^{1}_{1}p + 2e^- + 2\tilde{\nu}$$

$$^{16}_{8}O + Bn \rightarrow {}^{18}_{8}O$$

$$^{17}_{8}O + Bn \rightarrow {}^{19}_{8}O \rightarrow {}^{19}_{9}F + e^- + \tilde{\nu}$$

$$^{18}_{8}O + Bn \rightarrow {}^{20}_{8}O \rightarrow {}^{20}_{9}F + e^- + \tilde{\nu} \rightarrow {}^{20}_{10}Ne + 2e^- + 2\tilde{\nu}$$

$$^{19}_{9}F + Bn \rightarrow {}^{21}_{9}F \rightarrow {}^{21}_{10}Ne + e^- + \tilde{\nu}$$

$$^{20}_{10}Ne + Bn \rightarrow {}^{22}_{10}Ne \quad \text{stable atomic nucleus.}$$

$$^{21}_{10}Ne + Bn \rightarrow {}^{23}_{10}Ne \rightarrow {}^{23}_{11}Na + e^- + \tilde{\nu}$$

$$^{22}_{10}Ne + Bn \rightarrow {}^{24}_{10}Ne \rightarrow {}^{24}_{11}Na \rightarrow {}^{24}_{12}Mg + e^- + \tilde{\nu}$$

$$^{23}_{11}Na + Bn \rightarrow {}^{25}_{11}Na \rightarrow {}^{25}_{12}Mg + e^- + \tilde{\nu}$$

$$^{24}_{12}Mg + Bn \rightarrow {}^{26}_{12}Mg \quad \text{stable atomic nucleus.}$$

$$^{25}_{12}Mg + Bn \rightarrow {}^{27}_{12}Mg \rightarrow {}^{27}_{13}Al + e^- + \tilde{\nu}$$

$$^{26}_{12}Mg + Bn \rightarrow {}^{28}_{12}Mg \rightarrow {}^{28}_{13}Al + e^- + \tilde{\nu} \rightarrow {}^{28}_{14}Si + 2e^- + 2\tilde{\nu}$$

$$^{27}_{13}Al + Bn \rightarrow {}^{29}_{13}Al \rightarrow {}^{29}_{14}Si + e^- + \tilde{\nu}$$

$$^{28}_{14}Si + Bn \rightarrow {}^{30}_{14}Si \quad \text{stable atomic nucleus.}$$

$$^{29}_{14}Si + Bn \rightarrow {}^{31}_{14}Si \rightarrow {}^{31}_{15}P + e^- + \tilde{\nu}$$

$$^{30}_{14}Si + Bn \rightarrow {}^{32}_{14}Si \rightarrow {}^{32}_{15}P + e^- + \tilde{\nu} \rightarrow {}^{32}_{16}S + 2e^- + 2\tilde{\nu}$$

$$^{31}_{15}P + Bn \rightarrow {}^{33}_{15}P \rightarrow {}^{33}_{16}S + e^- + \tilde{\nu}$$

$$^{32}_{16}S + Bn \rightarrow {}^{34}_{16}S \quad \text{stable atomic nucleus.}$$

$$^{33}_{16}S + Bn \rightarrow {}^{35}_{16}S \rightarrow {}^{35}_{17}Cl + e^- + \tilde{\nu}$$

$$_{16}^{34}S + Bn \rightarrow _{16}^{36}S \quad \text{stable atomic nucleus.}$$

$$_{16}^{36}S + Bn \rightarrow _{16}^{38}S \rightarrow _{17}^{38}Cl + e^- + \tilde{\nu} \rightarrow _{18}^{38}Ar + 2e^- + 2\tilde{\nu}$$

$$_{17}^{35}Cl + Bn \rightarrow _{17}^{37}Cl \quad \text{stable atomic nucleus.}$$

$$_{17}^{37}Cl + Bn \rightarrow _{17}^{39}Cl \rightarrow _{18}^{39}Ar + e^- + \tilde{\nu} \rightarrow _{19}^{39}K \text{ - stable atomic nucleus.}$$

$$_{17}^{36}Cl + Bn \rightarrow _{17}^{38}Cl \rightarrow _{18}^{38}Ar + e^- + \tilde{\nu}$$

$$_{18}^{38}Ar + Bn \rightarrow _{18}^{40}Ar \text{ - stable atomic nucleus.}$$

To form a stable nucleus $_{18}^{36}Ar$ is necessary to assume stable in the normal situation isotope $_{16}^{36}S$ at meeting $_{16}^{34}S$ with bineutrons will be activated with the reaction

$$_{16}^{36}S \rightarrow _{17}^{36}Cl + e^- + \tilde{\nu} \rightarrow _{18}^{36}Ar + 2e^- + 2\tilde{\nu} \quad \text{stable atomic nucleus.}$$
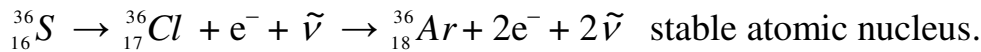
As a result the concentration $_{16}S^{36}$ in nature is 0.014% only.

This assumption can be considered as justified, because in a similar situation for $_{5}^{12}B$ the activated nucleus $_{6}^{12}C$ is formed with probability 1.5%, instantly into 3 α-particles.

Continue to write down nuclei formation reactions, can reach the heaviest stable nuclei, which composition is near the islands of atomic nuclei stability. Therefore, if there is a deposit of uranium-238, we should expect the formation of plutonium in it. And this is really the case: in uranium ores ^{239}Pu with a half life 24100 years and ^{244}Pu with a half life of 80 million years was found. It was found that ^{239}Pu is formed in accordance with the following nuclear reaction:

$$_{92}^{238}U + _{0}^{1}n \rightarrow _{92}^{239}U \xrightarrow{\beta^-} _{93}^{239}Np \xrightarrow{\beta^-} _{94}^{239}Pu$$
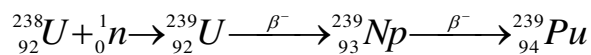
Intermediate products have a short lifetime: 23.5 min for ^{239}U and 2.3565 days for ^{239}Np.

Surprise scientists did not find a reaction that could lead to the formation of ^{244}Pu. It was decided that it was formed before the creation of the solar system (4.5 billion years ago), and as a result its concentration now is approximately $6.5 \cdot 10^{-18}$ from the initial one.

Please note that this plutonium isotope is the most stable, and it is necessary to add two protons and four neutrons to $_{92}^{238}U$ nucleus to create it (this ratio is typical for heavy nuclei[16]).

Concentration of ^{244}Pu atoms could be defined using value of life cycle of these atoms, birth velocity of clusters formed from bineutrons and concentration of $_{92}^{238}U$ atoms.

$$\left[_{92}^{238}U\right] \cdot \frac{d\left[\left(_0^1 n\right)_6\right]}{\left[_{92}^{238}U\right] \cdot dt} \cdot \tau = \left[_{94}^{244}Pu\right]$$

or $\quad \cdot \dfrac{d\left[\left(_0^1 n\right)_6\right]}{\left[_{92}^{238}U\right] \cdot dt} = \dfrac{\left[_{94}^{244}Pu\right]}{\left[_{92}^{238}U\right] \cdot \tau} = \dfrac{6.5 \cdot 10^{-18}}{2.5 \cdot 10^{15}} = 2.6 \cdot 10^{-33} \ s^{-1}.$

Resulted value is 15 orders lower than current relative birth velocity of bineutrons in the Universe [1]. Seems, it should be so.

We should also pay attention to the value $6.5 \cdot 10^{-18}$, which corresponds to a relative increase of the Universe mass at present moment [1]. Thus, we can conclude that ^{244}Pu in uranium ores is formed due to reaction:

$$_{92}^{238}U + \left(_0^1 n\right)_6 \rightarrow _{92}^{244}U \xrightarrow{\ \beta^-\ } _{93}^{244}Np \xrightarrow{\ \beta^-\ } _{94}^{244}Pu.$$
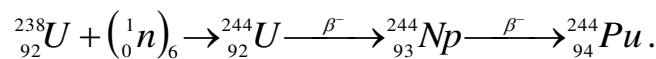
So, near heavy nuclei Field form clusters of three bineutrons. A large excess of neutrons in the $_{92}^{244}U$ nucleus will lead to the increase of β^--activity, so we can not observe intermediate nuclei.

Now let us consider what would happen if the Universe was filled with a substance through the creation of individual neutrons?

Unlike bineutrons that carry only baryon charge (as there is no interaction between the baryon charge, they renamed to the baryon number), neutrons also have a spin which is the real characteristic of the particles, leading to the appearance of the magnetic moment of the particle and the some kinds of interactions.

Therefore, if neutrons were born in the nucleus or in the nucleus field only, all known and unknown isotopes should be born during the first minute after the Big Bang because the rate of the nuclei creation should exceed their decay rate. But later nucleus living less than a second could be excluded from the process of creation. In

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[16] For example, in the nucleus $_{92}^{238}U$ the number of neutrons increased by 20 in comparison with $_{82}^{208}Pb$, and the number of protons – by10.

3.5 days all nuclei that live less than 10^3 s would be excluded. If we take a look on the table of isotopes we note that there are very few unstable nuclei that are still able to take part in the creation of new nuclei. Today only stable isotopes, as well as $^{238}_{92}U$ the half-life of which is $4.5 \cdot 10^9$ years = $1.42 \cdot 10^{17}$ s are involved in this process.

Now let us take a look on the table of isotopes and let us establish what isotopes cannot exist today which amount was so small that they can be ignored in the isotopic composition of the Universe.

If the creation of isotopes was due to the production of neutrons in nuclei or in the field of nuclei[17], it would be impossible to get ^6_3Li nucleus from ^4_2He, we could not get ^9_4Be from ^7_4Be, and all other nuclei could not be created after it. Moreover the creation of isotopes through the generation of neutrons in nucleus does not allow describing the difference in concentrations of stable isotopes of the same chemical element. A large amount of ^4_2He could be explained due to the decay of unstable $^{12}_5B$ nucleus. Nuclei ^8_5B, $^{12}_7N$, $^{20}_{11}Na$, which should also decay with the ^4_2He release are absent in nature. It is looking surprising the ratio of the neon nuclei abundance [$^{20}_{10}Ne$] :[$^{21}_{10}Ne$]:[$^{22}_{10}Ne$] = 90.92: 0.257: 8.82. The same situation is for the nuclei of magnesium, silicon and others. This excludes the possibility of single neutron production in the nucleus and supports the idea of bineutrons creation.

So, we can definitely say that the creation of isotopes is exclusively due to the creation of bineutrons and their clusters in nuclei.

3.3. Conclusions

The analysis of the birth and the evolution of the Universe with minimum initial entropy have allowed proposing the mechanisms of substance (light and heavy nuclei) creation, namely:

1. Most likely, the birth of matter in the Universe created with a minimum of initial entropy takes place in nuclei or in the nuclei fields in the form of bineutrons or

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[17] In such situation there is the effect of a heavy atom for the spin-orbit interaction, the value of which does not depend on ether a heavy atom is in its own nucleus, or in the nearby one. Therefore, the processes of bineutrons creation can be assumed equally probable in the nucleus and in the nuclear field.

clusters of three bineutrons due to the energy of Field. This mechanism supposes that in the first moments after the birth of the Universe mainly heavy nuclei are produced, their mass exceeds the mass of known atomic nuclei.

2. The chain reactions of nuclear fission cause heating of substance and leads to emission of stars and high temperature in the cores of planets up to the present time.

3. In the process of the Universe evolution, when the number of protons (hydrogen atoms) significantly exceed the number of heavy nuclei the mechanism of light nuclei formation will dominate, which is typical for stars in our time. Moreover, in the ground the light atoms formation processes should also take place, resulting in appearance of the Earth's atmosphere and water on the Earth surface.

4. The probability of a birth of bineutrons now is 10^{-18} bineutrons per nucleon per second. Since the rate of production of the substance is constant in time, and the Universe mass grows, the probability of particles birth in the nucleus decreases and is inversely proportional to the Universe lifetime.

5. At the moment of the Big Bang the probability of bineutrons creation in the World-4 per nucleon was more than 10^5 s^{-1}. At the end of the first second the probability of a birth of bineutrons per nucleon becomes less than the unit.

6. The Universe birth through the creation of single neutrons in the nucleus seems to be impossible.

7. The proposed mechanism explains the large abundance of hydrogen and helium in the Universe and reveals the stars radiation source.

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CHAPTER 4. **Structure of the atomic nuclei in the new model of the Universe**

4.1. Introduction

New model of the Universe birth [1], described in Chapter 1 is based on the Laws of Similarity [2] and Unity. It states that our Universe is the part of the Super-Universe, represented by fiber space [3]. Information interaction between layers of such fiber space is done via single delocalized point. 0-dimension space of Filed-space has ability of interaction with other spaces and of establishing the program of the Universe evolution.

Such a structure of the Super-Universe should essentially influence on the structure of atomic nuclei and the processes inside it.

In this Chapter, the mechanisms of particles and atomic nuclei creation in our four-dimensional (3 + 1) Universe will be described using the same Laws.

A lot of models of atomic nucleus structure have been discussed in the literature. One of these models included in all textbooks on nuclear physics, presents the nucleus as the set of protons and neutrons with the configuration which provides the minimum energy of nucleus. It is assumed that, despite of the α-activity of heavy nuclei, α-particles are absent in the nuclear structure as defined clusters. Among these models there is also cluster (molecular) model [2-4].

Cluster model (or the model of nucleon associations) treats the structure of some nuclei as a kind of molecule consisting of α-particles, deuterium (D), tritium (T), and others. For example, $^{12}C=3\alpha$, $^{16}O=4\alpha$, $^{6}Li=\alpha+D$, $^{7}Li=\alpha+T$ and so on.

Model of nucleon associations is a model of atomic nucleus based on nucleus representation as a system of clusters, or nucleon associations of a certain type, usually, α-clusters. The simplest version of this model (α-cluster model) was formulated in 1937 by J. A. Wheeler. This model has arisen from the fact that the stability of nuclei is increased if the core has an even number of protons and neutrons, like in α-particle. Therefore such nuclei were described as clusters of α-particles. Among these nuclei there are ^{8}Be, ^{12}C, ^{16}O, ^{20}Ne and similar nuclei (at $n =$

2, 3, 4, 5). For these nuclei an enormous amount of energy E_n is needed to remove a neutron. For nearest nucleus with odd number of neutrons this energy decreases by 10-15 MeV. Meanwhile the energy which is needed to remove an α-particle (E_α) is rather small. ^{8}Be nucleus is unstable as for the decay into two α-particles ($E_\alpha < 0$), and as a result this nucleus does not exist. For other nuclei of this row the binding energy of the α-particles increases (in a nucleus of ^{12}C the energy $E_\alpha = 7$ MeV, in ^{16}O $E_\alpha = 16$ MeV).

There was experimentally established the following law: nuclei consisting of α-particles can easily emit them in nuclear reactions. Moreover, it has been shown that these nuclei have excited states with abnormally large width of α-transitions. This means that α-particles **exist** on nucleus surface as separate clusters.

For such nuclei, the nucleus wave function can be written as a product of the antisymmetrized wave functions ψ_α, describing the internal motion of the nucleons in the individual α-cluster, and the wave function χ, describing the motion of the clusters with respect to each other.

$$\psi\left(^8Be\right) = \widehat{A}\,\psi_{\alpha 1}\left(r_1\right)\psi_{\alpha 2}\left(r_2\right)\chi_L\left(R_1 - R_2\right),$$

where $R_i = \sum_{i=1}^{4} r_i / 4$ is the radius-vector of the center of mass of the α-cluster, L is total the orbital angular momentum of the nucleus, $\widehat{A}$ is the antisymmetrization operator on the nucleons belonging to different clusters.

However, it has been found that such wave function can satisfactorily describe the behavior of ^8Be and ^{12}C, but it can not describe ^{16}O, ^{20}Ne, etc.

The cluster model is used to describe the nuclear reactions. The most common approach here is the so-called resonating group method which is similar to the method of valence bonds for the description of the molecules [8].

The cluster model of heavy clusters is frequently used to describe nuclei. For example, ^{24}Mg nucleus is described as a "molecule", consisting of two ^{12}C nucleus

separated in space. In this case, wave functions $\psi_{^{12}C}$ instead of ψ_α are written for nucleus.

It is interesting, that a quark model of nucleons is analogues to the cluster model of nucleus (nucleon is considered as a 3-quark cluster and it is also assumed the existence of multiquark configurations: 6- and 9-quark clusters).

The cluster model proved to be useful for the description of a nucleon fragmentation processes in the nuclear reactions taking place under an action of high-energy heavy ions.

Thus, we have a confirmation of the molecular structure of nuclei. The only difference between cluster models used in experimental and theoretical studies from our model is that they are empirical, unproved. Our presentation naturally arises from the new methodological basis of the World cognition.

4.2. Particles of four-dimensional Universe

According to the statements of Victor Kulish [2] our Manifested World has 4 dimensions and Hidden World has only 3 ones. Together we have 7 dimensions: 3 dimensions for the quarks and four dimensions for the nucleons, electrons, atoms, matter, fields.

Four-dimensional World of particles is produced by the three-dimensional World by quarks gluing by gluon into particles. These quarks are in the Hidden World, while corresponding particles are in the Manifest World. [1]

The charges of quarks are $-(\frac{1}{3})e$ and $+(\frac{2}{3})e$ (opposite signs for antiquarks), e is the minimum charge of the particle in four-dimensional space-time.

It follows that quarks charges are formed by the dimension of the World: $\pm(\frac{1}{3})e$ for each coordinate. Thus, all types of quarks are two-dimensional (since the space has two dimensions, all the particles in this space should move only in two directions) which is allowed by the dimensionality of space. So, it can be assumed, that in Hidden space the charges 0, $\pm(\frac{1}{3})e$ and $\pm(\frac{2}{3})e$ can exist.

Comparing these conclusions with the data in Table 4.1 it can be concluded that for the quarks only charge $-(\frac{1}{3})e$ and $+(\frac{2}{3})e$ are realized, and opposite charges are for

antiquarks. This result can be understood taking into account that the birth of the Universe is presented as a vortex (and as a result tightening in gravity [5] and time [6] takes place). At the same time, the 3 projections of charge are realized as stationary states in the World-3, see Figure 4.1.
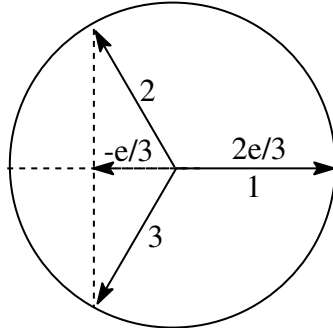

Fig. 4.1. Three projections of charge in the World-3. Two types of charge -(⅓)*e* should be different by additional quantum numbers (helicity). Mirror reflection with respect to the vertical y-axis (or in inversion point) gives the charges of antiparticles.

To determine the charge in the World-4 it is necessary to use a sphere rotation (Fig. 4.2).
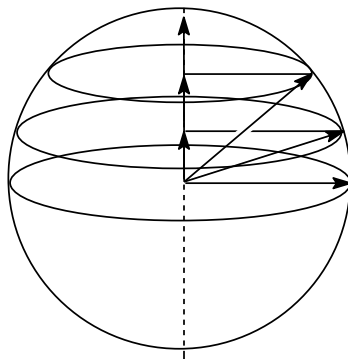
Fig. 4.2. Four projections of a charge in the World 4. Mirror reflection in the plane *xy* (or in reversal point) will give the charges of antiparticles.

It is necessary to note another important detail: all particles of World-4 have been formed due to the transfer of information from a quarks cluster while the heavy nuclei are formed from the particles of World-4 whose quarks do not have a border. This is worth also to remember during the consideration of the fusion reaction of helium nucleus formation from the nuclei of hydrogen and lithium or deuterium, when the quarks of complex core do not border each other. And only due to virtual

pairs participation (a proton-antiproton, etc.) the α-particle of World-4 is formed from a complex helium nucleus.

Table 4.1. Quarks.

Type (flavor) of quark	Electric charge	Spin	Colour	Mass (calculation)
d	-(1/3)e		yellow, blue, red	~7 MeV/c^2
u	+(2/3)e		$-''-$	~5 MeV/c^2
s	–(1/3)e	ħ/2	$-''-$	~150 MeV/c^2
c	+(2/3)e		$-''-$	~1,5 GeV/c^2
b	–(1/3)e		$-''-$	~4,5 GeV/c^2
t	+(2/3)e		$-''-$	~175 GeV/c^2

The dimensionality of the World is changing during the transition from the Hidden World to the Manifested World, and hence the magnitude of a charge. The dimensionality of the Manifested World requires a combination of quark charges to create a charge ± e.

On the other hand, charges 0, ± $Q/4$, ± $2Q/4$, ± $3Q/4$ should exist in the Manifested World. Here, the value of ±Q corresponds to the charge of the next five-dimensional World where our space is generating (and probably hidden).

As a result, $Q = 4q = 4e$ is an elementary charge of the next Manifested World where our particles will be quarks-4.

It is also should be noted, that according to Figure 4.2 stable charges ±e, ±2e, ±3e, and 0 should exist in our space.

Nuclei of hydrogen correspond to the first particle (proton and deuteron), nuclei of helium correspond to the second particle ($_2^3He$ and $_2^4He = _2^4\alpha$), the third particle corresponds to lithium nuclei[18]. Of course, particles and antiparticles corresponding to particles with opposite charges should exist. However, the Manifested World has

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[18] This suggests an interesting parallel: three pairs of quarks and three pairs of particles of World-4. For the second and third pairs of quarks the top quark is more massive, and for the first pair an opposite situation takes place. Similar relationships can be observed for propagation of particles in World-4.

electrons with charge $-e$ to stabilize atoms and to provide the electrical neutrality of the Universe.

Table 4.2. Particles of four-dimensional World (World-4)[19].

Charge	Particles	The total content of isotopes in the Universe
$-e$	e	
0	${}_0^1 n$	
$+e$	${}_1^1 H$, ${}_1^2 D$	0,65 [2,7]
$+2e$	${}_2^3 He$, ${}_2^4 He$	0,24 [2,7]
$+3e$	${}_3^6 Li$, ${}_3^7 Li$	$6{,}5 \cdot 10^{-5}$ [8]

Note: The concentrations of charged particles in the World-4 are following:

$[{}_1^2 D] = 1{,}56 \cdot 10^{-4} \cdot [{}_1^1 H]$, the last one is 65% of the mass of Universe,

$[{}_2^3 He] = 1{,}38 \cdot 10^{-6} \cdot [{}_2^4 He]$, the last one is 24% of the mass of Universe,

$[{}_3^6 Li] = 8{,}1 \cdot 10^{-2} \cdot [{}_3^7 Li]$, the last one is $2 \cdot 10^{-10}$ of the mass of Universe, $6{,}5 \cdot 10^{-5}$ in the Earth.

Since among the particles of the World-4 a rapid process of exchange interaction (p↔p, n↔n, n↔p) takes place, it is necessary to assume that each element of these particles is a result of averaging, i.e. all the elements of particles are identical, and the particles of World-4 are indivisible. In such way they will perform for particles of brane in the World-5.

Since the particles of the World-4 act as indivisible, it is better to present them using a quark structure:

$${}_1^1 H = 2u + d \equiv u^2 d,$$

$${}_1^2 D = 3u + 3d \equiv u^3 d^3,$$

$${}_2^3 He = 5u + 4d \equiv u^5 d^4,$$

$${}_2^4 He = 6u + 6d \equiv u^6 d^6,$$

$${}_3^6 Li = 9u + 9d \equiv u^9 d^9,$$

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[19] Using the presentation of the particles of the World-4, shown in Figure 2, we can find a product of the length of corresponding circle on the height of the segment of a circle, and then can find the ratio of these values. It turns out that it is equal to 1: 0.6285: 0.2484: 0; i.e. corresponds to the concentration of the relevant charges in the Universe.

$$^7_3Li = 10\text{u} + 11\text{d} \equiv u^{10}d^{11}.$$

So, we have a stable structure containing of three quarks, 6 quarks, 9 quarks, 12 quarks, 18 quarks and 21 quarks. There are no structures containing of 15 quarks (^5_2He or ^5_3Li) in the World-4.

Thus, during the transition from the Hidden World-3 into the Manifested World-4 a formation of particles from quarks takes place, i.e. the real Manifested World. That is why quarks are in the Hidden World, and hadrons are in the Manifested World and there is an information interaction between them.

As other nucleus and atoms of our World are formed as a result of a combination of a family of particles of World-4, it should be assumed that with the formation of other nuclei and atoms the Manifest World-4 received the fifth coordinate (it becomes the brane of four-dimensional space), which began to increase in time, leading to the birth of matter, planets, stars, etc., causing the expansion of the Universe.

So, we are living in the swelling brane of the World-5.

Moving in the opposite direction, we shall understand that a generating two-dimensional World should exist for the hidden for us three-dimensional World providing the possibility of ±1/2 charges of a quark-3. For the World-4 these charges are equal to ±e/6. These quarks-2 will generate all possible quarks-3. It was shown in [1] that quarks-2 should be **diones** having both electric and magnetic charges. During the transition to the spaces of higher dimensionality magnetic charges cause the appearance of the spin of elementary particles.

A lot of quantum numbers of quarks are lost at the birth of the World-4, and in particular color. Therefore, we can assume that in the two-dimensional World there are some characteristics which are lost at the transition to the World-3 (including the abovementioned magnetic charges). Thus, two particles of World -2 have a wide set of quantum numbers, which are lost during the transitions to the Worlds of higher dimensionality.

The Fields-time coordinates are common for all spaces, so two spatial dimensions of quarks and one spatial dimension constituent quarks (diones) from the previous World should be added for our four-dimensional World. Totally it will be 7 dimensions. However, 3 of them have various degrees of secrecy (2 for the nearest Hidden World and 1 for the remote one).

There are photons in the World-4. They appear, in particular, during particles-antiparticles annihilations. But there are particles (for example, π^o), which have quark-antiquark type structure. This results in a disintegration of such particles into γ-quants in the World-4, while the quark-antiquark annihilation has to give 2 two-dimensional photons specific for World-3. Types of these photons are discussed in [1].

4.3. Particles of World-5. The hierarchy of bosons.

In our World-5, all other nuclei ($Z \geq 4$) are combinations of "elementary" particles of World-4 and can decay into these "basic" particles. These combinations are:

$_1^3T \rightarrow {}_1^2D + {}_0^1n$, - unstable ($\beta^-$ - active) due to the contribution of the neutron nucleus;

$_3^8Li \rightarrow {}_3^7Li + {}_0^1n$, - the nucleus is β^- - active;

$_4^9Be \rightarrow {}_3^7Li + {}_1^2D$, - the nucleus is stable, but quite rare because there are not enough lithium and deuterium;

$_4^{10}Be \rightarrow {}_3^7Li + {}_1^2D + {}_0^1n \leftrightarrow {}_3^7Li + {}_1^3T$, - the nucleus is β^- - active;

$_5^{10}B \rightarrow {}_2^4\alpha + {}_3^6Li$, - the nucleus is stable; but less than $_5^{11}B$, because $\left[{}_3^6Li\right] < \left[{}_3^7Li\right]$,

$_5^{11}B \rightarrow {}_2^4\alpha + {}_3^7Li$, - the nucleus is stable, but quite rare because there is not enough lithium;

$_5^{12}B \rightarrow {}_2^4\alpha + {}_3^7Li + {}_0^1n$, - nucleus is β^- - active, $_6^{12}C$ is formed in an excited state, which decays into three α-particles.

$_6^{11}C \rightarrow 2\,{}_2^4\alpha + {}_1^2D + {}_1^1H$, or $_6^{11}C \rightarrow 2\,{}_2^4\alpha + {}_2^3He$, the contribution second is small, the first one is β^+ - active (the proton in the field of nuclear forces is unstable),

$^{12}_{6}C \rightarrow 3\,^{4}_{2}\alpha,$ or $^{12}_{6}C \rightarrow 2\,^{6}_{3}Li,$ - the nucleus is stable, but the probability of the reaction of the second type is very small, because of the lack of $^{6}_{3}Li$ in the nature;

$^{13}_{6}C \rightarrow ^{6}_{3}Li + ^{7}_{3}Li,$ - nucleus is stable, but its abundance is very small (1%).

$^{14}_{6}C \rightarrow 2\,^{7}_{3}Li,$ or $^{14}_{6}C \rightarrow ^{7}_{3}Li + ^{4}_{2}\alpha + ^{2}_{1}D + ^{1}_{0}n$, or $^{14}_{6}C \rightarrow 3\,^{4}_{2}\alpha + 2\,^{1}_{0}n$, - unstable nucleus ($\beta$-active) as a result of the contribution of the neutron, due to big amount of $^{4}_{2}\alpha$;

$^{12}_{7}N \rightarrow 2\,^{4}_{2}\alpha + ^{3}_{2}He + ^{1}_{1}H,$ - - the nucleus is β^{+}- active, $^{12}_{6}C$ is formed in an excited state, with following decay into three α-particles..

$^{13}_{7}N \rightarrow 3\,^{4}_{2}\alpha + ^{1}_{1}H,$ - the nucleus is β^{+} - active,

$^{14}_{7}N \rightarrow 3\,^{4}_{2}\alpha + ^{2}_{1}D,$ or $^{14}_{7}N \rightarrow 2\,^{4}_{2}\alpha + ^{6}_{3}Li,$ - the nucleus is stable,

$^{15}_{7}N \rightarrow 2\,^{4}_{2}\alpha + ^{7}_{3}Li,$ - the nucleus is stable, but its abundance is very small (0,365%),

$^{16}_{7}N \rightarrow 2\,^{4}_{2}\alpha + ^{7}_{3}Li + ^{1}_{0}n,$ - the nucleus is β^{-} - active, it transforms into $^{16}_{8}O$ in the excited state, which emits one α-particle,

$^{16}_{8}O \rightarrow 4\,^{4}_{2}\alpha,$ or $^{16}_{8}O \rightarrow 2\,^{6}_{3}Li + ^{4}_{2}\alpha,$ - the nucleus is stable[20]; the second contribution is small, due to the lack of $^{6}_{3}Li$.

$^{17}_{8}O \rightarrow ^{4}_{2}\alpha + ^{7}_{3}Li + ^{6}_{3}Li,$ - the quantity of such nuclei is small, since $N(^{4}_{2}\alpha) \gg N(^{7}_{3}Li) \gg N(^{6}_{3}Li).$

$^{18}_{8}O \rightarrow ^{4}_{2}\alpha + 2\,^{7}_{3}Li,$ - the nucleus is stable; but the quantity of these nuclei is less than of $^{16}_{8}O$, because $N(^{4}_{2}\alpha) \gg N(^{7}_{3}Li)$, but is bigger than of $^{17}_{8}O$ in 6 times.

$^{19}_{8}O \rightarrow ^{4}_{2}\alpha + 2\,^{7}_{3}Li + ^{1}_{0}n,$ - the nucleus is β^{-} - active,

$^{18}_{9}F \rightarrow 4\,^{4}_{2}\alpha + ^{2}_{1}D,$ or $^{18}_{9}F \rightarrow 3\,^{4}_{2}\alpha + ^{6}_{3}Li,$ $^{18}_{9}F \rightarrow 2\,^{4}_{2}\alpha + ^{7}_{3}Li + ^{2}_{1}D + ^{1}_{1}H,$ - only the later combination provides β^{+}- activity, so the reaction is slow (109,7 min),

$^{19}_{9}F \rightarrow 3\,^{4}_{2}\alpha + ^{7}_{3}Li,$ - the nucleus is stable,

$^{20}_{9}F \rightarrow 3\,^{4}_{2}\alpha + ^{7}_{3}Li + ^{1}_{0}n,$ - the nucleus is β^{-} - active (11,56 s),

$^{19}_{10}Ne \rightarrow 4\,^{4}_{2}\alpha + ^{2}_{1}D + ^{1}_{1}H,$ $^{19}_{10}Ne \rightarrow 4\,^{4}_{2}\alpha + ^{3}_{2}He,$ - the nucleus is β^{+} - active, small contribution of the second combination,

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[20] Below much more structures for the core $^{16}_{8}O$ providing its stability in the ground state will be presented.

$^{20}_{10}Ne \rightarrow 5^4_2\alpha$, - the nucleus is stable [21] (90,92%),

$^{21}_{10}Ne \rightarrow 3^4_2\alpha + ^7_3Li + ^2_1D$, - the nucleus is stable, but the amount of these nuclei is small (0,257%)

$^{22}_{10}Ne \rightarrow 2^4_2\alpha + 2^7_3Li$, - the nucleus is stable (8,82%),

$^{23}_{10}Ne \rightarrow 2^4_2\alpha + 2^7_3Li + ^1_0n$, - the nucleus is β^- - active.

$^{22}_{11}Na \rightarrow 5^4_2\alpha + ^2_1D$, $4^4_2\alpha + ^6_3Li$, $3^4_2\alpha + ^7_3Li + ^3_2He$, $^4_2\alpha + 2^7_3Li + ^3_2He + ^1_1H$, $2^7_3Li + ^6_3Li + 2^1_1H$,

the nucleus is β^+ - active tacking into account last configurations,

$^{23}_{11}Na \rightarrow 4^4_2\alpha + ^7_3Li$, the nucleus is stable,

$^{24}_{11}Na \rightarrow 4^4_2\alpha + ^7_3Li + ^1_0n$, the nucleus is β^- - active.

$$* * * * * * * * * *$$

$^{55}_{25}Mn \rightarrow 5^4_2\alpha + 5^7_3Li$,

$^{54}_{26}Fe \rightarrow 10^4_2\alpha + 2^7_3Li$, $7^4_2\alpha + 2^7_3Li + 2^6_3Li$, the nucleus is stable (5,84%), small contribution of the second combination,

$^{55}_{26}Fe \rightarrow 10^4_2\alpha + 2^7_3Li + ^1_0n$, $7^4_2\alpha + 3^7_3Li + ^6_3Li$, $6^4_2\alpha + 4^7_3Li + ^3_2He$, in this case, the experiment shows K-electron capture with a conversion into a stable nucleus $^{55}_{25}Mn$. Thus, it is necessary to assume that the contribution of the last configuration is a main one, while the first is very small. In the field of nucleus ^3_2He there is a reduction of the number of neutrons, which results in K-electron capture with a conversion it into tritium nucleus and its combination with α-particle gives ^7_3Li, nucleus, corresponding to the $^{55}_{25}Mn$ nuclei configuration.

Proceeding in the same manner to the heavy nuclei, we draw an attention to the fact that the protons-neutrons number relation for nuclei with number up to No. 50 can be described by combinations of ^7_3Li, ^4_2He etc. But after this number the contribution of neutrons increases. Moreover, at the transition from $^{208}_{82}Pb$ to $^{238}_{92}U$ 10 protons and 20 neutrons should be added [10]. So, ^3_1T, ^6_2He, ^9_3Li should be included

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[21] In fact, this nucleus has much more structures, how it will be shown below for $^{16}_8O$.

into the consideration. Such nuclei really exist, but, they are β^- - active with the lifetime $3.87 \cdot 10^8$ s = 12.262 years, 0.797 s and 0.176 s respectively.

Neutrons in a free state are also β^- - active, but, all nuclei are containing them. The interaction between nucleons much faster makes a transformation of a neutron into a proton, than it would decay.

So, these three heavy nuclei can stably exist in nuclei, where the number of neutrons is twice higher than the number of protons. The need for such nuclei should be grounded on intranuclear interaction.

The bosons are always responsible for the interaction between particles. The gluons berry strong interaction between quarks; the bosons which are partly in the World-3, and partly in the World-4 are responsible for weak interaction $W(^{\pm})$ и Z^o [11]. $\pi(^{\pm})$ and π^o bosons can not be neglected in the consideration. They are responsible for the transfer of the interaction between nucleons in three groups of particles in the four-dimensional World. Bosons of the World-4 should provide the interaction between the particles of the World-4. α-particle and boson, consisting of two coupled neutron Y(2n) can play this role. For example:

$$_3^7Li + _1^3T \leftrightarrow _1^3T + X\left(_2^4\alpha\right) + _1^3T \leftrightarrow _1^3T + _3^7Li$$

$$_3^9Li + _1^1H \leftrightarrow _3^7Li + Y(2n) + _1^1H \leftrightarrow _3^7Li + _1^3T \text{ (Fig. 4.3).}$$

$$_3^9Li + _2^4He \leftrightarrow _3^7Li + Y(2n) + _2^4He \leftrightarrow _3^7Li + _2^6He$$

$$_2^6He + _1^1H \leftrightarrow _2^4He + Y(2n) + _1^1H \leftrightarrow _2^4He + _1^3T$$
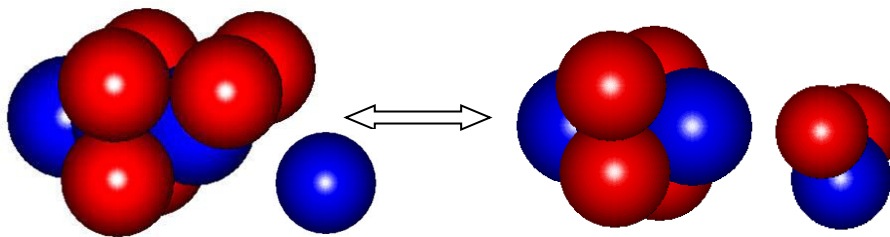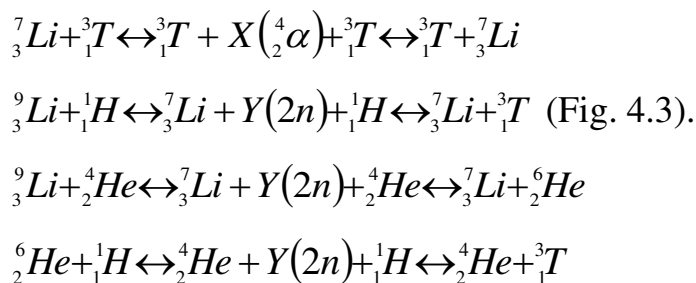

Fig. 4.3. Intranuclear interactions due to Y(2n) boson transfer.

In this case, it is becomes clear a presence of doubled number of neutrons (in comparison with protons) in heavy nuclei.

Since it is considered that boson X(α) is much heavier then boson Y(2n), it should provide a much stronger interaction. However, a reality shows that α-particles

are poorly connected to the rest of the nucleus fragments, because they have a large electrical charge. As a result, α-particle is not able to provide interaction between components of a nucleus. Moreover, if α- particle participate in the formation of nuclei with Z> 50, the protons-neutrons number relation 1:2 can not be satisfied. So the interaction via X(α) bosons has to be excluded from the consideration.

So, it is clear now that $_4^8Be \rightarrow 2_2^4\alpha$ can not exist and should immediately decay into two α-particles. In the present case, it is impossible to arrange the transfer of two neutrons. A resonant exchange by Y(2n)-bosons is only possible. But, in this situation it is necessary to take off two neutrons from α-particles, and then put two other neutrons on their place. If the last reaction seems simple enough, the first one requires a lot of effort and its implementation looks problematic.

In the case of $_6^{12}C \rightarrow 3 \cdot _2^4\alpha$ the nucleus can be imagined only in excited state, which leads to its decay on 3 α-particles. The ground state can be provided by the configuration $_6^{12}C \rightarrow _3^9Li + 3_1^1H \leftrightarrow _3^7Li + 2_1^1H + _1^3T$. The "Molecular" structure is following (Figure 4.4):
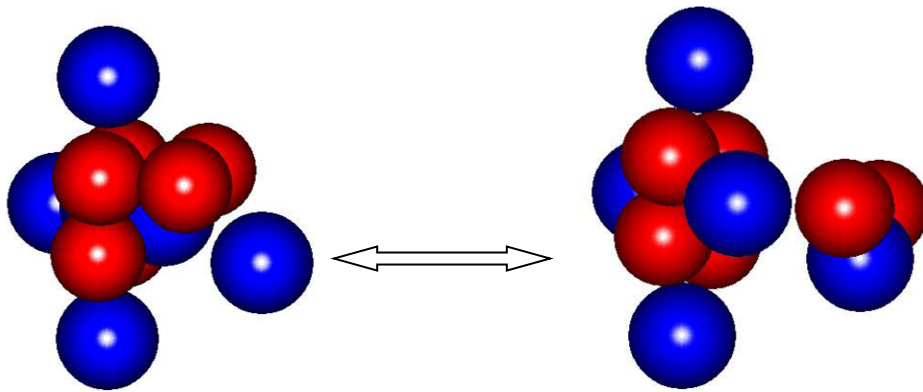
Fig.4.4. The "Molecular structure" of carbon nucleus $_6^{12}C$.

Since the boson barring the interaction is virtual, the particle can emit it and absorb it at once (Figure 4.5). This phenomenon is described in detail in quantum electrodynamics.

So, as a result of the processes of boson radiation-absorbing a spatial orientation or shape of nucleus components can continuously change. This is important in the cases when a nucleus of 5-dimensional World brane contains more than two

particles-4. For example, $^{12}_{6}C$ nucleus contains 4 particles-4 ($^{9}_{3}Li + 3^{1}_{1}H$ or $^{7}_{3}Li + 2^{1}_{1}H + ^{3}_{1}T$). In this case, the transfer of Y(2n)-boson is equally probable for all three nucleus protons. Thus, after transfer Y(2n)-boson, the wave function of the nucleus will contain equal contributions from all three protons.

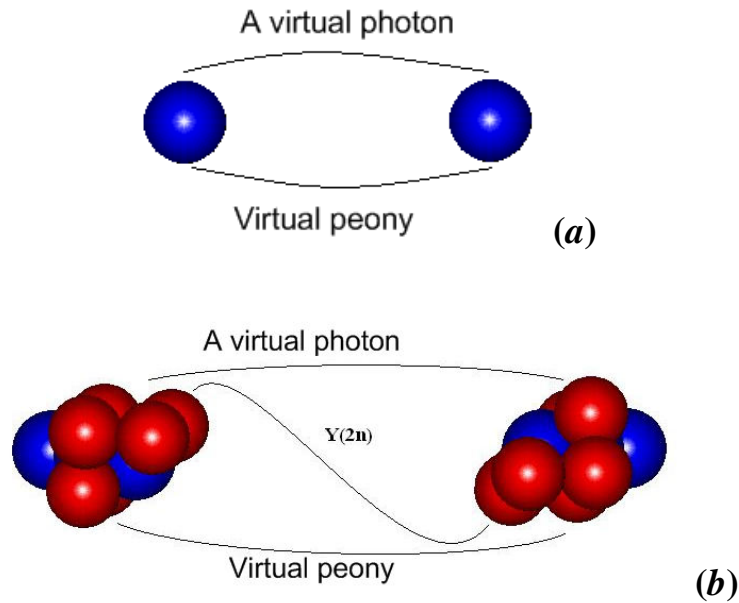A virtual photon

Virtual peony (*a*)

A virtual photon

Y(2n)

Virtual peony (*b*)

Fig. 4.5. A particle surrounded by virtual bosons: *a* - proton, *b* - $^{9}_{3}Li$.

Similarly, for oxygen-16 nucleus: $^{16}_{8}O \rightarrow 4^{4}_{2}\alpha$ - such state is a highly excited. The presence of the four α-particles provides more opportunities for the organization of ground and lower excited states, the lowest excited state emitting only one α-particle, turning into a carbon-12 nucleus.

$$^{16}_{8}O \rightarrow ^{9}_{3}Li + ^{4}_{2}\alpha + 3^{1}_{1}H,$$

$$^{16}_{8}O \rightarrow ^{9}_{3}Li + ^{3}_{1}T + 4^{1}_{1}H,$$

$$^{16}_{8}O \rightarrow ^{7}_{3}Li + 2^{3}_{1}T + 3^{1}_{1}H,$$

$$^{16}_{8}O \rightarrow ^{6}_{2}He + ^{7}_{3}Li + 3^{1}_{1}H,$$

$$^{16}_{8}O \rightarrow ^{6}_{2}He + ^{4}_{2}\alpha + ^{3}_{1}T + 3^{1}_{1}H.$$
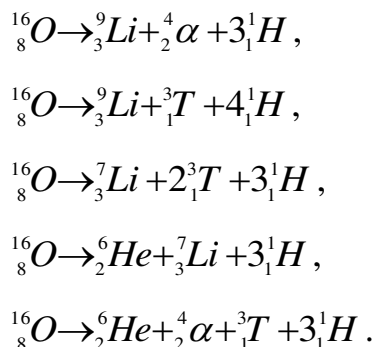
According to the **principle of similarity**, the nucleus has to be built as a set of three pairs of particles of World-4 like molecules are built of atoms. A virtual photon acts as the boson, which determines the interaction between electron and nucleus in

atom. At the same time, a *pair of electrons in singlet state, being surrounded by a coat of virtual photons, plays a role of boson, which defines the interaction of atoms in a molecule*. This pair of electrons is in continuous motion around the interacting atoms.

Similarly, **bineutron** (i.e. two neutrons) **in a coat of neutral pions** acts as a boson, which is responsible for the interaction between particles of the World-4 in nuclei of chemical elements. Therefore it is logical to assume that complex nuclei have a certain geometric structure which is similar to structure of atoms in molecules. In this case, for $^{16}_{8}O \rightarrow ^{9}_{3}Li + ^{4}_{2}\alpha + 3^{1}_{1}H$. $^{9}_{3}Li$ nucleus is surrounded along three sides by protons, and the interaction in this structure is due to Y(2n)-bosons. The interaction of this structure with a boson $^{4}_{2}\alpha$ will be weakened, and as a result α-particle will be emitted out of the nucleus, this is observed at the excitation of $^{16}_{8}O$ nucleus.

The state $^{16}_{8}O \rightarrow ^{6}_{2}He + ^{7}_{3}Li + 3^{1}_{1}H$ will be almost resonant with the previous state, if the both of them have the same geometric structure. However, in this state, $^{6}_{2}He$ is assumed to be an active particle. Consequently, the structure may be different from the previous one and there are more variants of interaction via Y(2n) boson transfer. This can lead to corresponding reduction in the energy and stabilization of the nucleus.

The structure $^{16}_{8}O \rightarrow ^{6}_{2}He + ^{4}_{2}\alpha + ^{3}_{1}T + 3^{1}_{1}H$ where two transfer of Y(2n)-bosons takes place should have much lower energy. A little bit lower is situated the state corresponding to the structures $^{16}_{8}O \rightarrow ^{9}_{3}Li + ^{3}_{1}T + 4^{1}_{1}H$ and its resonant (identity) state $^{16}_{8}O \rightarrow ^{7}_{3}Li + 2^{3}_{1}T + 3^{1}_{1}H$, where two Y(2n)-bosons have transferred together. All these structures are stable states of $^{16}_{8}O$ nucleus.

Let's come back to the virtual photons and gravitons. It is necessary to find a mechanism providing repulsion of two electric charges of the same sign and attraction of opposite sign charges. If the virtual particle is a usual plane-polarized photon, it is impossible to satisfy the specified requirements for the interaction between charges. So a virtual photon must be circularly polarized, (Figure 4.6-*a*).
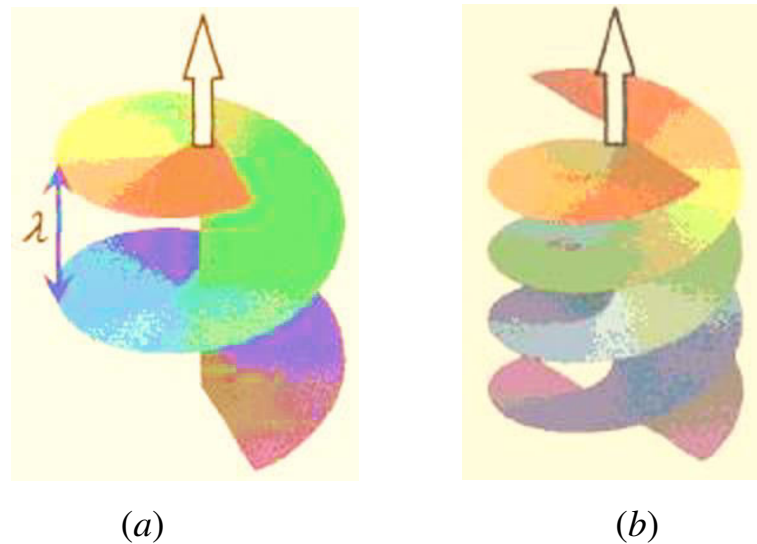
Fig. 4.6. Circular right-hand polarized photon (*a*) and the graviton (*b*).

It should be taken into account that the virtual particle is coupled with emitting particle, i.e. a virtual particle is localized in a potential well.

Because a virtual boson can be presented as the boson coupled with a particle (Figure 4.7), the total energy of a particle with its virtual particles should be slightly higher (otherwise there will not be interaction between the particles) then the energy of the particles themself[22], but much smaller than the sum of the energies of the particles and released boson.

If we consider the electrically charged particles, it has to be considered that positive charges emit a circularly polarized photon of the first type (for instance, right-hand polarized one; but it is necessary to establish this), while negative charges emit photons of the second type. Absorption with the attraction between particles takes place, if the particle gets a virtual photon which is of different type than the particle emits. So the electron does not want to absorb the virtual photon emitted by other electrons. The scattering with repulsion will take place. Similar situation is observed for proton. Its own virtual photon after particles removal is reflected back to a potential well with a change of its direction of circular polarization (odd wave function). Then such photon will be absorbed by particle which was emitted it.

The proposed mechanism exhaustively describes electrostatic interaction experimental data.

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[22] [6] In this case a particle is in a coat of vacuum particles (bosons with zero energy).

Now take a look on gravitons. The main property of the gravitational field: there is an attraction between masses and there is no repulsion. However, according to the law of gravitational interaction, the mass will repel the negative mass (if there is a hypothetical negative mass). This is the first condition. And the second condition is: the graviton must be a boson with the spin s = 2.

These requirements can be met if a graviton is a double helix (Figure 4.6-b), like a DNA double helix. Because the wave function of the virtual graviton is supposed to be even, after a reflection it does not change the direction of circular polarization and can be absorbed by mass which was emitted it. If a graviton radiated by a negative mass, circular polarization changes a direction. Such negative graviton will be absorbed by a negative mass, but will be scattered by a usual mass. Thus, it will provide a repulsion of a usual mass from a negative mass.

Virtual pair of particles generated by the physical vacuum is different from a virtual photon near an electric charge because both particles in the pair (electron-positron or a virtual pair of other particles) are virtual, so they are situated in a deep potential well (Figure 4.7). This virtual pair annihilates without photon emission, because the total energy of a virtual pair is zero up to the uncertainty relation. However, such a virtual pair can interact with a real pair. As a result the wave function of a real particle can be complex leading to a strange behavior of particles.
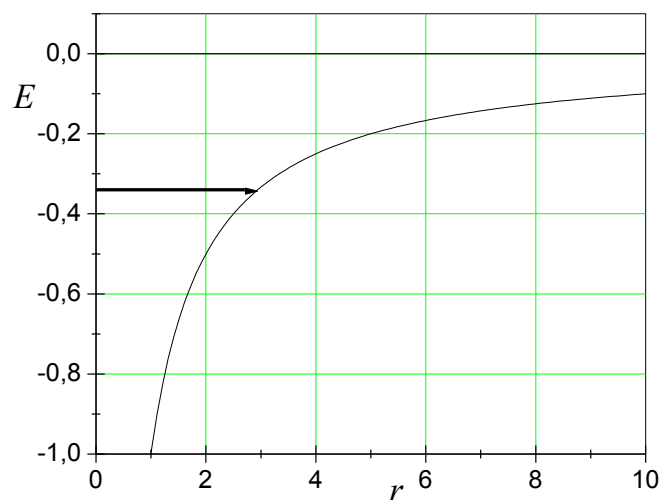
Fig. 4.7. Virtual particles in the vicinity of radiating particles.

4.4. Conclusions

On the base of new ideas about the creation of the Universe and using of the Laws of similarity and unity in the Universe the description of the structure for the heavy ($Z \geq 4$) cores and hierarchies of boson interaction is provide. In particular:

1. The classification of charges of elementary particles in different layers of the fiber space of Super-Universe was introduced. It was shown that diones with an electric charge $\pm e/6$ should exist in the one-dimensional space, charges $\pm e/3$ and $\pm 2e/3$ should exist in the two-dimensional World (World of quarks), charges 0, $\pm e$, $\pm 2e$ and $\pm 3e$ should exist in the three-dimensional space.

2. The model of the molecular structure of nuclei has been proposed and the reasons for instability of nuclei in ground and excited states have been shown.

3. The hierarchy of bosons which are responsible for the interaction between particles in different hierarchical layers of the fiber space of Super-Universe has been analyzed.

4. New bosons have been proposed to explain the interaction between the elements of atomic nuclei. It has been shown that coupled neutron pairs (bineutrons) play the role of these bosons.

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CHAPTER 5. **Origin of a planetary system in the new model of the Universe**

In this Chapter we will describe in detail the process of the origin of galaxies, complexes of stars and planets based on the new model of Universe birth [1], described in the Chapter 1, where the Universe is stated to be the part of fiber space [2] of the Super-Universe.

It is important to note, that filling of the fiber space by energy starts with a World-1. Then the spaces of higher dimensions are filled, each in turn. The initial time of filling of our four-dimensional Universe (World-4) by an energy is $T_{Uo} = 3 \cdot 10^{-5}$ sec after appearance of an energy in the World 1. The energy entered the World-4 has an ability to create bineutrons (charges and magnetic moment are equal to zero) in the vicinity of the atomic nuclei. It is known that the ground state of bineutron is the triplet state with the bond energy of about 0.5 MeV. The bond energy in the singlet state is reduced to a value of $\approx$70 keV [3]. However the bineutron instability is connected with the weak interaction processes. It is known that the half-life of a free neutron is 881 sec [4]. The presence of the additional neutron causes the weak interaction activation and results in a significant reduction of the neutron half-life as in the bineutron composition as in a composition of the β-active nucleus [5,6]. However, the half-life of bineutron is significantly higher than the corresponding time for a pion, which is responsible for the strong interaction.

In contrast to the Standard model of origin of Universe [7-11] from singularity with infinitely large density of matter and infinitely high temperature, and therefore infinitely large entropy, the model proposed of origin of the Universe provides the lowest possible value of entropy, the cold initial state and the limited density of a matter.

In the proposed model a zero-dimensional space of Field-time could interact with other spaces and determine a program of evolution of the Universe. According to this program, at creation of a matter in the World 4 it has a fractal structure and the large torque of each fractal element.

Starting with these ideas, we will consider the origin of a planetary system from a primary fractal to the state, we are observing at the present moment.

5.1. Origin of a planetary system

Let's suppose that the born neutron matter[23] in the World-4 had a fractal structure and density of the order of 10^{17} kg/m^3, i.e. the density of a nuclear matter. After 1 second, the average value of the density dropped to $8.74 \cdot 10^7$ kg/m^3. The volume of a future star during one second increased from $1.454 \cdot 10^{-9}$ m^3 = 1.454 mm^3 to $5.38 \cdot 10^4$ m^3. Note that this volume includes as the volume of the star, and the volume of the space between the stars. This space is formed from the beginning, providing fractal features of a matter in the World-4. A primary nucleus of a future star resembles a microscopic neutron star.

Within the nucleus of a future star the strong interaction forces were initially superior. Then the electromagnetic interaction forces emerged in the process of structuring a matter and running the weak interaction reactions. With further increasing the star's mass and expansion of space the gravitational interaction becomes the dominant one. These forces slowed an expansion of a star and, as an consequence, resulted in the formation of large volumes of space (vacuum) between the stars. There were existed the gaps between the embryos of stars in the initial structure of the Universe that provided a possibility of their rotation around their center of mass, as well as groups of embryos (the future galaxies) around a common centerr of mass[24]. Further one should pay attention at another important point which is in the essential difference between the initial conditions for existence of a dense mass of the Universe and now known neutron stars.

This difference can be characterized by the relative change in size (deformation) of the Universe $\varepsilon = \Delta R_U / R_U = \Delta T_U / T_U$. If you take $\Delta T_U = 1$, then the deformation of the Universe in our time is smaller than in the first seconds of the existence of the World-4 by 18 orders of magnitude. This extension of a matter in the early evolution of the Universe is so powerful that it can not be to slow down by the forces of

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[23] The total electrical neutrality of matter in the World-4 is provided only by this way.
[24] In Ref. [12] the authors make conclusion on an existence of the initial torque at the origin of the Universe, based on the study of the galaxies orientation in a space.

interaction between the fractal elements. As a result, the individual galaxies and the stars within them had appeared.

An extension of a space leads to the structuring of the volume of the star on the islands of dense matter (embryos of atomic nuclei), that increases the average distance between them. However, the mass of the islands in the early expansion of the Universe may be much greater than the mass of the heaviest stable atomic nucleus and, in addition, it quickly increases as a new matter is created in the field of atomic nuclei.

The processes of a matter transformation run simultaneously with the described structuring and, as a result, protons and electrons appear due to the weak interaction reactions. The islets turn into atomic nuclei of the superheavy mass. In addition, a large excess of neutrons leads to the selection of individual neutrons through the surface of the islets. Such neutrons could call for reactions of fission of atomic nuclei into separate fragments, the value of which is reduced till the creation of nuclei containing from 1 to 92 protons, existed on the Earth. As a consequence, a lot of the heat energy releases and the substance are to be warmed up.

As you can see, the mechanism of evolution of the Universe leads to creation of the heavy atomic nuclei in the first moments after the Big Bang.

Now let us take into account that the fractal structure of the Universe included a large torque of each fractal element and each future star. A rotation of a future star leads to its deformation, and, as a result, it will take a disk-like shape. This shape resembles a miniature galaxy. Over time, the mass of the star grows so that gravity seeks to return it to a spherical shape. This will result in reducing a deformation of a space. However, the peripheral part of a disc-shaped star (in the case of the Solar system the Sun's mass is at 750 times greater than the total weight of all his satellites) will get a high torque and remain outside the star, which provides a creation of future planets. It is obvious that the orbits of these planets must lie in the equatorial plane of the star. Moreover, the star and planet in its orbit must rotate in the same direction. At the same time the axis of rotation of the planets can have an arbitrary direction (chaos), and the angular velocities of their rotation should significantly differ because

of the intense processes of the substance islands fission (by the way, it can be observed on the example of planets of the Solar system).

What do we really have? All the planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune) are rotating around the Sun in the same direction (in the direction of axial rotation of the Sun), on nearly circular orbits, whose planes have little inclination to each other (and to the plane of the solar equator).

The planets have the different axial rake angles, that is, their axes are directed at a certain angle to the equatorial plane of the parent star. For this reason, the amount of light received by any planet hemisphere, varies during the year; the northern hemisphere of a planet is illuminated longer than the southern hemisphere, and vice versa. As a consequence, a change of seasons occur on the majority of the planets, i.e. climate changing during a year. As usually, a time, when one of the hemispheres faces the Sun, is called the solstice. During one rotation around the star (one turn of the planet in its orbit) two solstices meet; when one hemisphere is in the summer solstice and day is the longest, while when the other hemisphere is in the winter solstice with its extremely short day. Because of their disposition, the hemispheres receive different amounts of light and heat, which causes the annual changes of weather conditions on the planet.

The axial tilt of the Jupiter is extremely small, and seasonal changes there are minimal, while Uranus, on the other hand, has such a large axial tilt, it orbits around the Sun almost "on the side". During its solstices one of its hemispheres is for a long time under sunlight, and the other one is always dark. Between these two states there is a time (spring and autumn), when the days and nights alternate with each rotation of the planet.

If to designate an initial moment of inertia of a future star as J_o, and the initial radius as R_o, then the moment of inertia will increase in $(R/R_o)^2$ times in the process of increasing the radius of the star. Simultaneously the angular velocity of rotation of the fragment (if the non-relativistic approximation is true) decreases by the same time. The additional mass should be added to the ground one with conserving their

mechanical characteristics. As a result, the angular momentum L of a star at the arbitrary time will be equal to

$$L = L_o \cdot (m/m_o). \tag{5.1}$$

One could calculate the approximate value of L for the Sun (without taking into account a dependence of the density upon a distance from the center of the Sun):

$$L = \frac{2}{5} MR^2 \omega = 2{,}8 \cdot 10^{36} \text{ kg} \cdot \text{m}^2/\text{s}. \tag{5.2}$$

The axial rotation of the Sun is about 2% of the angular momentum of the solar system, although the mass of the Sun is more than 99.8% of the total weight. This distribution of the angular momentum between the Sun and the planets is associated with slow rotation of the Sun and the huge size of the planetary system - its diameter is larger than the diameter of the Sun at several thousand times. The angular momentum of the solar system is $1.4 \cdot 10^{38}$ kg·m^2/s.

One could easily estimate the initial value of the angular momentum of the solar system:

$$L_o = L \cdot (m_o/m) = 1.4 \cdot 10^{38} \cdot (1.454 \cdot 10^8/1.99 \cdot 10^{30}) = 1.02 \cdot 10^{16} \text{ kg} \cdot \text{m}^2/\text{s}.$$

Here the initial mass of a star is determined as the product of the original volume, belonging to a star, on the density of nuclear matter (10^{17} kg/m^3). It is easy to show that such value of the angular momentum is indeed relativistic. Nevertheless, an embryo of a star has a spherical shape as the nuclear forces have a significant value. During expansion of space and increasing the size of a star, when the free spaces between the elements of the stars mass (embryos of atomic nuclei) increase, a shape of the star becomes by disk-like. Over time, the disk-shaped peripheral regions receive independent life as the satellites of a star.

At this stage of creation of the planets it is necessary to find the quantum conditions that provide the known ratio of the radii of orbits of the Solar system planets. Since this is a macroscopic system, it is natural to speak about formation of the resonances between the individual orbits of the planets. This resonance may be of different types. For example, the rotation of the Moon around the Earth and around

its own axis is realized with the same frequency, whereby the surface of the Moon is always directed to one side of the Earth.

This type of resonance is possible between the planets. In this case, under each approaching one of these planets will always be to one side of another planet. This case is realized between the Mercury and Earth. However, this case is rather the exception than the rule.

Indeed the resonance between the orbits is very important for all planets. If neighboring planets at a certain time were on one straight line passing through the Sun, the next same situation in the resonance requires, for example, that the nearest planet made 1.5 turns under half the turnover of the remote planet. One could write the corresponding relation between the periods:

$$0,5 \cdot T_n = 1,5 \cdot T_{n-1}, \tag{5.3}$$

or $T_n = 3 \cdot T_{n-1}$.

This type of response should occur between the neighboring planets. Now one can use the Kepler's third law (a - semi-major axis of the elliptical orbit):

$$\left(\frac{T_n}{T_{n-1}}\right)^2 = \left(\frac{a_n}{a_{n-1}}\right)^3 = 9. \tag{5.4}$$

or

$$\left(\frac{a_n}{a_{n-1}}\right) = \sqrt[3]{9} = 2,080. \tag{5.5}$$

So, if the radius of the orbit (or major semiaxis) of the next planet is greater than the radius of the previous planet in 2.08 times, then the orbits will be in resonance. All matter which is outside of these orbits, will shrink to a resonant orbit. This results in formation of the planets. There is absent a free matter on the orbits of planets. The reason is that even under minor deflections of orbits of a planet embryo and other substance their meeting is inevitable. Consequently, there will be a capture of substance by a planet from orbit around a star.

In order that a planet has its own satellites, it is necessary that such a structure of matter exists under creation of the planets at the moment of separation from the disk of a future star. Other mechanisms of creating the satellites are not so obvious.

What can be said about the real situation for the Solar system? Some important quantitative data are listed in Table 5.1.

Since $T_n = 3 \cdot T_{n-1}. = 3^{(n-1)} \cdot T_1$

$$\ln\left(\frac{T_n}{T_1}\right) = (n-1) \cdot \ln \beta, \qquad (5.6)$$

where the value of $\beta = 3$ in the ideal variant.

Table 5.1. Parameters of planets of the Solar system.

n	Body	Weight, kg	T_n, Earth day	Distance to the Sun, Mln. km.	$a = R_m$
1	Mercury	$3.3022 \cdot 10^{23}$	87.97	46.0012–69.8169	57.909
2	Venus	$4.8685 \cdot 10^{24}$	227.70	107.476259-108.942109	108.209
3	Earth	$5.9737 \cdot 10^{24}$	365.26	147.098290-152.098232	149.598
4	Mars	$6.4185 \cdot 10^{23}$	686.98	206.669-249.2093	227.939
6	Jupiter	$1.8986 \cdot 10^{27}$	11y.314d.	740.52 – 816.62	778.57
7	Saturn	$5.683 \cdot 10^{26}$	29y.167d.	1353.57-1513.33	1433.45
8	Uranus	$8.7 \cdot 10^{25}$	84y.5d.	2748.9-3004.4	2876.75
9	Neptune	$1.0243 \cdot 10^{26}$	164y.288d.	4452.9-4553.9	4503.4
10	Pluto	$1.19 \cdot 10^{22}$	247y.255d.	4436.8-7375.9	5906.35

Similarly,

$$\ln\left(\frac{a_n}{a_1}\right) = (n-1) \cdot \ln \gamma, \qquad (5.7)$$

where $\gamma = \sqrt[3]{9} = 2.08$ in the ideal variant, a_n is the average value of the radius of the orbit (major semi-axis of the ellipse) n-th planet. The corresponding curves (5.6) and (5.7) are presented in Figure 5.1.

Extrapolation of the obtained relationships by the straight lines shows that there is relatively good correlation (the correlation coefficient of 0.997 in both cases). However, the determined values of β and γ differ essentially from the ideal values. It

was obtained: $\beta = 2.2338$, $\gamma = 1.71$. However, the ratio of $\ln\beta/\ln\gamma = 1{,}5$ corresponds to the Kepler's third law. For such values of the coefficients the distant planet arced 291.78^o between the two meetings, and the nearest - one turn more.
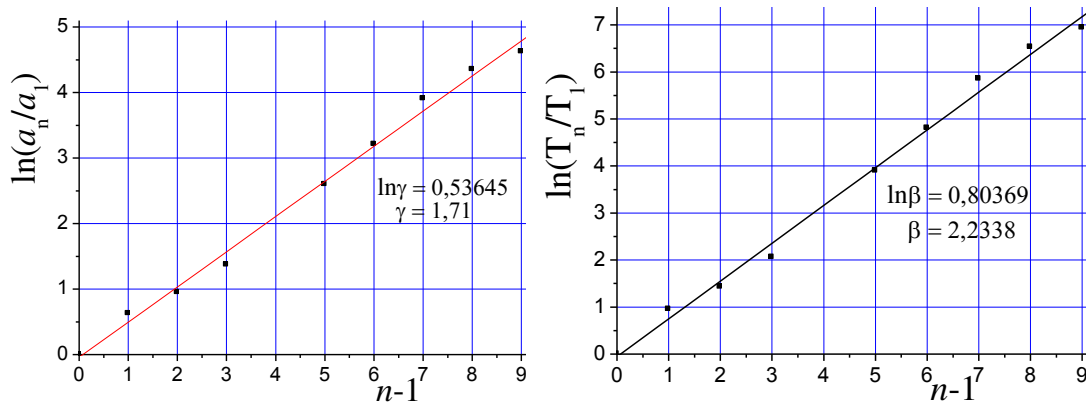

Fig.5.1. Dependence of $ln(a_n/a_1)$ and $ln(T_n/T_1)$ on the number of planets in the solar system (the data for the asteroid belt on the charts are absent).

Here we try to lay physical foundations in explaining features and patterns in the orbits of the planets of the Solar system. However, in the literature as a rule one could find the empirical relationships that describe parameters of the orbits of the Solar system planets. For example, speech is about the known empirical Titius-Bode law.

According to the Titius-Bode law, the mean orbital radius of the n-th planet in astronomical units is described by the following formula:

$$R_n = 0.4 + 0.3 \cdot 2^{(n-2)}, \ R_M = 0.4. \tag{5.8}$$

where R_M is the radius of the orbit of Mercury.

This formula can be rewritten as follows: $\dfrac{R_{n+1} - R_M}{R_n - R_M} = 2. \tag{5.9}$

According to this formula for any planet its distance to the planet of the Mercury is twice more than the distance from the previous planets to Mercury. The results of the calculations are listed in Table. 5.2.

As one can see from Table 5.2, the empirical Titius-Bode law is performed only with great stretch. It is usually supposed that the results for Neptune fall out of this law, but one should take the Pluto data instead of the Neptune.

Let's try to clarify the relationship (5.8). One could rewrite it as follows:

$$R_n = R_M + c \cdot d^n. \text{ (distance in astronomical units)}$$

Table 5.2. Data on check of the empirical Titius-Bode law.

Planet	N	2^{n-2}	The radius of the orbit (a.u.)		$\dfrac{R_n - R_M}{R_{n-1} - R_M}$
			according to the rule	actual	
Mercury	1		0.4	0.39	
Venus	2	1	0.7	0.72	
Earth	3	2	1.0	1.00	1.825
Mars	4	4	1.6	1.52	1.855
Asteroid Belt	5	8	2.8	2.2-3.6	2.096 (the orbit of Ceres)
Jupiter	6	16	5.2	5.20	2.021
Saturn	7	32	10.0	9.54	1.9
Uranus	8	64	19.6	19.22	2.053
Neptune		drops		30.06	1.579
Orc	9	128		39.173	
Pluto	9	128	38.8	39.5	2.078 (with respect to Uranus)
Haumea	9	128		42.985	
Quaoar	9	128		43.405	
Makemake	9	128		45.4365	
2007 JJ$_{43}$	9	128		47.910	
Eris	10	256	77.2	67.7	1.721

In this case

$$ln(R_n - R_M) = ln\ c + n\ lnd \qquad\qquad (5.9)$$

The graphs are corresponding to the dependence, shown in Figure 5.2.

As follows from Figure 5.2, the data on Neptune normally lie on a straight line, while the results for Plutoid (Pluto and Eris) deviate significantly. By processing these graphs the corresponding values $ln\ c = -1.1283$, $ln\ d = 0.66198$, c = 0.32358; d = 1.9388. The correlation coefficient is 0.99963. So, from Fig. 5.1 and Fig. 5.2 (although the corresponding dependences are correctly unfounded) it can be concluded that there are resonant dependences between the orbits of the planets of the solar system.

Data on the Figure 5.2 show that the resonance is really observed in a wide array of planets if minor planets (Pluto and Eris) are assigned the number to one less. Other small planets Plutoid (other than Eris) and Neptune are disposed near. It confirms the fact that **these celestial bodies were created in the complex**, just as together created the Earth and Moon.
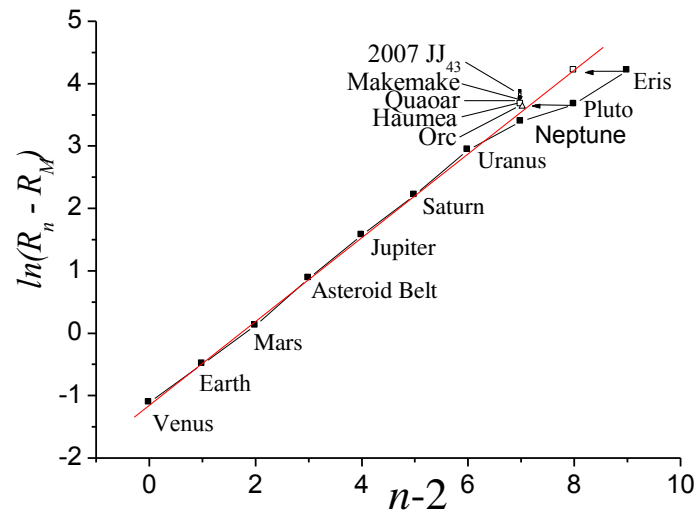
Fig. 5.2. The dependence of $ln(R_n - R_M)$ on the number of planets (figure includes small planets).

However, the certain forces, initially acting during expansion of a space, break the links between the small planets and Neptune, causing Neptune slides from the resonance orbit. The minor planets orbits deviate significantly from the equatorial plane of the Sun.

However, the interaction between these celestial bodies continues to hold them in orbits, dropping out of the resonance series, which are characteristic for all the planets of the Solar system.

Moreover, the orbits of the Pluto and the Neptune turned out to be synchronized: the periods of turnover for the Pluto, Neptune and Uranus around the Sun are as 3: 2: 1 (hence the 3 turnover of the Neptune correspond to 2 ones of the Pluto). Another important feature, which confirms the unity of minor planets and Neptune, is as follows: the Neptune's equatorial plane is inclined to the orbital plane of the planets around the Sun (the ecliptic) at 29°, and the plane of Pluto's orbit is tilted at $17,1^o$. It can be assumed that the alien force has led not only to a breakdown in communication between Pluto and Neptune, but also to a shift in the direction of the angular momentum of Neptune.

Finally, the last thing that's important to understand is a distribution of mass and density between the planets of the Solar system.

Using the Law of similarity, one can understand that the laws of quantum mechanics were acted at the initial stage of expansion of the Universe, when motions

were relativistic. Let's look at a qualitative picture of the distribution of the electron wave function in 2s, 3p or 4d states (Figure 5.3.). Based on the dependence of this kind, where the value of the abscissa is chosen so that the function changes sign at x = αr = 8, it can be found that the mass of the Mercury should be small, and the mass of the Earth in the Earth's group should be the biggest. Any planet can't appear on the orbit of asteroids ($f(x) = 0$). The Jupiter's mass must be maximized. The mass of the planets located beyond the Jupiter, should naturally decrease.
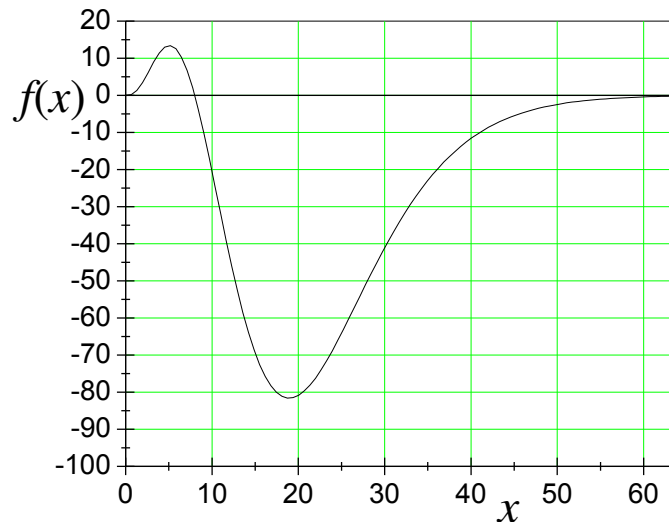

Fig. 5.3. The amplitude of the probability of finding the particle distance from the center of the field (in relative terms, $f(x) = x^2(x-x^2/8)\cdot\exp(-x/4)$).

Figure 5.3 shows the dependence of the amplitude, not the probability distribution of mass. To obtain a weight distribution, it is necessary to bring the function $f(x)$ to a square. The fact that the probability amplitude outside the asteroid belt has a negative sign, suggesting that the relevant planet must consist of atoms and molecules of a different nature than nearer to the sun planet. In addition, this type of weight distribution on the distance could be formed only in the early stages of evolution of the Universe, when acted quantum effects. In the later stage, only the cleaning of the space created by the planets. The asteroid belt was never planet. It remains the same as it was formed in the early stages of evolution of the Universe.

The fact that the density of large planets is small can be explained on the basis of the Boltzmann law for the distribution of gas concentration with increasing altitude in the vicinity of the Earth. This distribution is described by the formula:

$$\frac{n}{n_0} = \exp\left(-\frac{mgh}{kT}\right),\qquad(5.10)$$

where m - mass of the molecule, n_0 - the concentration of the corresponding molecules near the surface of the Earth. This dependence corresponds to the distribution shown in Fig. 5.4.

As follows from the dependencies shown in Figure 5.4, a concentration of heavy molecules is substantially reduced with the increase of height above ground level and the atmosphere is represented mainly by the night molecules. So it was at the origin of the solar system: heavy atoms are distributed close to the star, and light ones form the distant planets.

If we consider the distribution on the weight and the distances of the Jupiter's or Saturn moons, we note that in these cases it is correct the quantitative feature, described by the function $f(x)$. The Earth has the single heavy satellite. Yet another small satellite of a little mass is at a distance of 19 million km. But the general rule requires that between the Earth and the Moon there were a few small satellites not seen until now. It is possible to estimate the corresponding distances: $224 \cdot 10^3$ km, $131 \cdot 10^3$ km, $77 \cdot 10^3$ km, $45 \cdot 10^3$ km and $26 \cdot 10^3$ km (similarly, beyond the orbit of the Moon).

Above we described the mechanism of the origin of a planetary system and showed that the heavy atoms firstly born at the early stages of evolution of the Universe with high efficiency. Thus there appeared free neutrons, electrons and protons, and then atoms of helium as a result of the activity of α-heavy nuclei. Since bineutrons born in the vicinity of atomic nuclei, the mass of the nucleus is constantly increasing. The simultaneous processes of radioactive decay led to the presence of dynamic equilibrium and the Earth and other planets like it has a high content of heavy nuclei beyond the stability (massive lead nuclei). And if there are uranium deposits, then the plutonium additives must be in these deposits. This really takes a place on the Earth (there are discovered ^{239}Pu found with a half-life 24,100 years and ^{244}Pu with a half life of 80 million years).
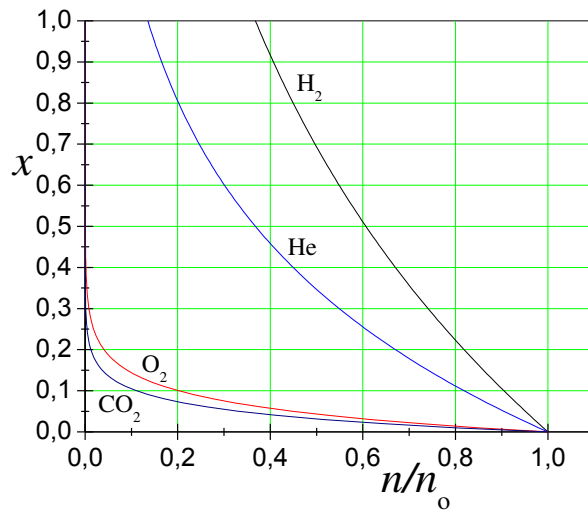
Fig. 5.4. The dependence of the relative concentration of gases from the height
($x=mgh/kT$).

It follows that not only the planets, but t**he inner regions of the star consist of predominantly of the heavy nuclei of chemical elements**. These regions provide the energy flow and consistency in the emission ability of the stars, not belonging to the class of the thermonuclear stars. Among these stars are the Sun and other stars, emission characteristics of which are described by the experimentally found "mass-luminosity" law [13]. Thus, the only way to understand the huge emissivity of cool giant stars (Betelgeuse, ε Aurigae).

With the expansion of the Universe the contribution of this mechanism of creation of the atomic nuclei and atoms will be reduced. When the concentration of light nuclei become predominant, then stepwise conversion of light nuclei into heavier due ones due to the creation of bineutrons in their neighborhood will be dominant. In the ordinary stars contribution of the thermonuclear reactions into conversion of light nuclei into heavier one is insignificant. Moreover, it is not determinative in the thermonuclear stars.

Above we have considered an almost perfect case where, despite the occurrence of uncontrolled nuclear transformation reactions in the star embryo, it has the shape of a perfect disk. In reality, this form can be stretched or even chaotic. In any case, there is arisen the possibility star formation of not one, but two or more stars at this step, when the gravitational compression of substance into a star. The turnover periods in the stellar pairs can reach many thousands of years (in the distribution of

the maximum). But more interesting is the case where the turnover period is only 11 minutes. In this case, a white dwarf star at a speed of 1200 km/s moves around the 19-kilometer neutron star, which corresponds to the Sun by weight [14]. The distance between stars in this pair is 126,000 km, i.e. at 3 times less than the distance between the Earth and the Moon. This fact raises questions about the mechanism of formation of such a pair of stars.

The generally accepted mechanism of formation of the neutron stars through supernova explosion cannot explain an existence of this close pair of stars, because the radius of the big star before its exposure significantly exceeds 126,000 km. For comparison, the radius of the Sun (the ordinary star) is 696 000 km. In this case, one should assume that a close pair of stars from the outset was the pair. In other words, it is the rare case when the initial neutron matter has not evolved into the structure of a normal star.

The reason is just that a close pair of stars of the future is created from the beginning. It has taken a place a powerful influence of one star to the other, so that one star remains by the neutron, while the second one could only evolve to a state of the white dwarf (intermediate density between a neutron star and a normal star that is at million times greater than the density of the ordinary star). As a consequence, **given the fact clearly speaks in favor of the proposed mechanism of origin of the galaxies, stars, planetary systems**.

The probability of this kind of evolution of a star formation is quite large, as the double stars are often observed in the Milky Way. The triple stars are observed considerably (about 20 times) rarer. They usually consist of a close double star (main pair) and its distant satellite, which rotates around the main pair, both around a single body. As an example of the triple star one could mention our nearest neighbor - Alpha Centauri the distant star Proxima Centauri, which rotates around the binary Alpha Centauri (Alpha Centauri A and Alpha Centauri B). The system of three stars is stable only with this structure. The four-time stars for the stability of the system should be two tight pair of stars, which are at large distances greater than the distance in a pair of stars not less than 5 times. At last, one could mention the five and six-

times star systems, in which the third pair of stars rotates around the double star. In Ref. [15] it is noted a number of systems increases in about four times under lowering star multiplicity by one. The double systems are about 75% of all systems, the triple stars are a little less than 20%, the quadruple ones - about 5%, the quinary ones - 1.2%, six-times - 0.3%.

5.2. Conclusion

We considered the mechanism of origin of a planetary system, based on the model of creation of the Universe with minimum initial entropy. The development of this model has shown that:

1. The embryo of the future star is the fractal element, rotating with relativistic velocity. As the mass and size of the fractal element increases, it acquires the disc-like shape. Then it is realized a case, when the peripheral regions of a disk detach from the disc, taking a significant part of the momentum of a system. The orbits of all the planets have to be in the equatorial plane of a star. The direction of the rotation axes should vary from planet to planet.

2. Torn away masses form a planetary system. Between the orbits of planets the resonance phenomena occur, resulting in that dependence of a distance from the planet to the star is placed into the geometric progression. An analysis of the resonance phenomena lead to the conclusion that the Plutoid (except Eris) were originally by satellites of the Neptune.

3. If the fractal of a future star evolves in such a way that its shape is elongated, a fractal gap leads to the origin of pair or a great number of the interacting stars.

4. It has been fulfilled an analysis of the motion of electron in an atom and a planet in the Solar system. This comparison showed that *a*) in the group of planets from the Mercury to the Mars, the Earth must have the maximum mass, *b*) a planet is absent on the asteroid orbit, *c*) the Jupiter must have the largest mass in the giant planets group, *d*) the planets of the Earth group must be characterized by the large value of matter density, while the giant planets – by the low density.

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CHAPTER 6. **Scalar field in the new model of the Universe**

In the Chapter 1 the author has proposed a model of the birth of our Universe with minimal initial entropy [1] based on the Law of similarity and Law of unity.. According to this model, our Universe is a part of the Super-Universe. Moreover, the Super-Universe is represented by a fiber space [2], and the adjacent layers differ by a space dimension of space per unit. All layers of a fiber space expand over time with the speed of light. The standard three-dimensional space (four-dimensional (3+1) Universe) is adjacent to the two-dimensional space (World 3) of quarks [3,4]. Similarly, the two-dimensional space borders with a one-dimensional space (World 2) of diones. Finally, the one-dimensional space borders with a zero-dimensional space (the World-1) of a scalar Field-time. Between the adjacent spaces there exists an information interaction through a single delocalized point. Filling of the fiber bundle by an energy starts with a World-1. Then the spaces of higher dimensions are filled, each in turn. The energy entered the World-2 has an ability to create particles of the World-2. Similarly, the energy, entered the World-3 and World-4, has the **ability to create** of **quarks and bineutrons** in the vicinity of atomic nuclei respectively. An important characteristic of these groups is the absence of charges (colored, electric, magnetic) and magnetic moments.

In contrast to the Standard model of origin of Universe [5-9] from singularity with infinitely large density of matter and infinitely high temperature, and therefore infinitely large entropy, the model proposed of origin of the Universe provides the lowest possible value of entropy, the cold initial state and the limited density of a matter.

In the proposed model a zero-dimensional space of Field-time could interact with other spaces and determine a program of evolution of the Universe.

In this Chapter, we consider properties of a Field, which are able to explain all possible processes occurring in a Microcosm and a Macrocosm of the World-4.

6.1. Scalar Field

In 1921 T. Kaluza had published the article in which he proposed a method of unification of the gravitational and electromagnetic interaction (general theory of relativity and Maxwell's theory of electromagnetic field) on the basis of the hypothesis according to which our world can be represented as a curved five-dimensional space-time. However, as for four-dimensional space-time one supposes that one coordinate is temporal, and four of them are dimensional [10,11].

In this case, we write for five-dimensional interval[25]

$$dI^2 = G_{AB}dx^A dx^B, \qquad (6.1)$$

where the indexes A and B run the values of 0, 1, 2, 3, 5 (4 is intentionally omitted). Now components of the G tensor can be written in the form of a matrix

$$G = \begin{pmatrix} G_{00} & G_{01} & G_{02} & G_{03} & G_{05} \\ G_{10} & G_{11} & G_{12} & G_{13} & G_{15} \\ G_{20} & G_{21} & G_{22} & G_{23} & G_{25} \\ G_{30} & G_{31} & G_{32} & G_{33} & G_{35} \\ G_{50} & G_{51} & G_{52} & G_{53} & G_{55} \end{pmatrix} \equiv \begin{pmatrix} G_{\alpha\beta} & G_{\alpha 5} \\ G_{5\beta} & G_{55} \end{pmatrix} = \begin{pmatrix} g_{\alpha\beta} & A_\alpha \\ A_\beta & G_{55} \end{pmatrix}$$

$$(6.2)$$

In this formula, the Greek indices α and β run four values: 0, 1, 2, 3. The G tensor is symmetric one and therefore it has only 15 different components. Here 10 components correspond to a tensor of the Einstein's general theory of relativity, four components correspond to components of the electromagnetic vector potential A_α ($G_{5\alpha} = 2A_\alpha\sqrt{\gamma}/c^2$, where γ is the gravitational constant in the Newton's formula) and additional component G_{55} is unknown. From the structure of the G matrix it follows that the component G_{55} corresponds to unknown Scalar Field.

Therefore, the Kaluza's theory requires an existence of additional Scalar Field and corresponding interaction. Considering the matrix (6.2), it can be argued that both gravitational and electromagnetic fields manifest in Microcosm and Macrocosm and the unknown Scalar Field should manifest in Microcosm and Macrocosm. Common for these fields is the dependence of their intensity on a distance. The

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[25] In theoretical physics it is usually accepted not to write a sign of summation, and assumed that it exists, if the indices in the formula are repeated.

electromagnetic field is much stronger than the gravitational one and it mostly manifests in the structure of atoms and molecules and in the interaction between charges. Most likely, **exactly** a **Scalar Field which is always present in the Universe is responsible** for an **existence of mass** (mass – scalar quantity)[26] **of elementary particles**. As a mass of elementary particles does not depend on coordinates in Metagalaxy, the effect of a Scalar Field is the same throughout the Universe. Moreover, it can be even stated that a **Scalar Field forms the Universe**. Therefore, one could identify a Scalar Field with Field of World-1 of the Kaluza's theory [1]. From the expression (6.2) one could make the conclusion that a Scalar Field creates other fields and provides an origin of matter, existence of life and evolution of the Universe.

Earlier it has been stated that a World-1 is zero-dimensional. However, it should be noted that not all possible coordinates in a World-1 are disclosed, they are closed to themselves in a ring of the small radius. In fact, **the local symmetry of a Field can be spherical in multidimensional space**. A Field of high symmetry has an ability to generate spaces and particles with lower symmetry. In addition, a World-2 and a World-3 have the cylindrical symmetry, and a World-4 allows all possible symmetries, including the spherical symmetry in three-dimensional space, so that additional information is injected from a World-1 into a World-4 [1].

6.2. Vacuum particles

The formation of the most important modern physics concepts of physical vacuum (PV) is very difficult process. During two thousand years it is believed that a space is filled by pervasive ether. In the twentieth century the ether was replaced by an absolute emptiness. However, for explaining different phenomena (amendment to magnetic moment of the electron, a shift of the hydrogen atom fine structure, etc.) there are introduced such concepts as "vacuum amendments." Currently, PV is

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[26] The theorists believe that the mass of elementary particles are generated due to their interaction with the Higgs scalar boson field (*Peter Ware Higgs*). Quantum mechanics has the hard rule: states with the same symmetry can interact among themselves. So, could the Higgs boson, **the probability of an existence of which in the Universe is equal zero**, provide an existence of the mass of all possible particles (both bosons and leptons, both scalar and vector particles)?

considered as the lowest state of quantum fields. At the present time, the different attempts are continuing to impart to PVs more and more not explained, but tightly postulated properties. It is stated, for example, that the real particles can be obtained from the empty PV by acting particle creation operator on PV. Any hint on the mechanism of this process is absent [12]. This is understandable, because four known types of physical interactions cannot explain the processes linked with the PV nature.

In the [12] it has been firstly proposed the following hypothesis about the PV nature and structure: **while annihilating particle-antiparticle pair they are not eliminated, but combined into a system which is called by an elementary vacuum particle** (EVP). At EVP in the unexcited state in our laboratory space all quantum numbers are equal zero. According to Ref. [12], the PV basis is a proton-antiproton (p^+p^-) vacuum. The concentration of EVP in this type of vacuum is equal to $1.54541 \cdot 10^{39}$ см$^{-3}$ while concentration of the electron-positron vacuum EPV is equal to $1.73009 \cdot 10^{29}$ см$^{-3}$, that is at 10 orders smaller. In all, nine kinds of physical vacuum, including neutrino-antineutrino vacuum, is counted in Ref. [12]. However, the reasons and mechanisms of the particle-antiparticle pair transformation into EVP vacuum are not analyzed in [12].

Let us take the approach given in [12] as basis to describe the PV. In this regard it is interesting to consider a nature of the particles annihilation. The electrostatic or gravitational interaction cannot explain this phenomenon. Especially it concerns the annihilation of neutrino with the corresponding antineutrino. The Coulomb interaction between electron and positron is able only to describe creation of the positronium atom, which is observed in experiments.

Therefore, one can conclude that a creation of vacuum particle from the particle-antiparticle pair with zeroth distance between them requires another type of interaction. In all cases, the vacuum particle is scalar. Therefore, we can conclude that namely a *Scalar* **Field creates vacuum particles**. Consequently, **one of the properties of a Scalar Field is its participance in the creation of vacuum particles**. In fact vacuum particles are closed for an external influence. Vacuum particle should be polarized for converting the vacuum particles into pair of real

particles. If this is pair of charged particles (electron-positron, quark-antiquark), then polarization occurs in the Coulomb field of atomic nuclei and transformation of this virtual pair into pair of free charged particles is possible because of the polarized vacuum particle excitation by the electromagnetic radiation quantum of ($h\nu \geq 2mc^2$). Such a process is permitted as it is permitted an inverse process, namely, emission of photons under the particle-antiparticle annihilation.

On the other hand, annihilation occurs when particle interact with the corresponding antiparticle, regardless of an electric charge, spin, and mass. This fact confirms that namely a Field is responsible for an annihilation process. As a Field is able to create the particles with definite mass, a statement about a possibility of annihilation (disappearance of mass and other physical characteristics) of a particle with its antiparticle must be truthful.

Thus, the interaction between the particle and its antiparticle with the participation of a Field can reduce the distance between them to zero, and the energy of interaction will be equal $2mc^2$.

It should be taken for the fact that EVP in the World-3 is created according to the same mechanism, where interaction occurs between quarks and antiquarks.

A possibility of Field participance in the processes of annihilation requires that **all the particles and their antiparticles are carriers of interactions through a Field**. Thus, **atomic nuclei are simultaneously carriers of Scalar Field. O**therwise in their neighborhood it would be impossible creation of a pair or group of neutron pairs as it is required by the model of origin and evolution of the Universe [1]. Moreover, strictly identical contribution of a Field corresponds to the same masses of protons. In this case, the VPs, created on the basis of neutrinos, will be polarized **with the participation of a Field** in a vicinity **of nuclei**. Excitation of these polarized particles by the Scalar Field leads to possibility of particles pair creation by neutrino and antineutrino. In this regard one can mention the author's (Ref. [12]) belief that excitation of the VP, created on the basis of the neutrino-antineutrino pair, is

responsible for the background radiation, known as the cosmic microwave background radiation of the Universe[27].

It is worth to pay attention to another opportunity, namely, **a Field-induced excitation of EVP into states whose energy is less than $2mc^2$**. This possibility is essentially to describe interaction between particles with participation of virtual bosons. At the same time the energy states of virtual bosons must lie below the energy states of the same bosons in a free state and, in addition, they must lie above the EVP states. Besides, an energy state of virtual boson must be as lower, as bigger its mass in a free state.

Considering processes of origin and evolution of the Universe, the author [1] has introduced the reaction of creation of the bineutrons in a vicinity of the existing atomic nuclei. Therefore, Field has an ability to create bineutrons or bineutrons clusters in a vicinity of particles that are carriers of the same Field. However, a mechanism of the matter creation in the Universe at the beginning (the first millisecond) of its evolution is different from mentioned ones.

The matter is in the fact that there was absent a matter in the first moments of the Universe origin. However, the Universe was born and began to expand with a constant rate. In order the Universe began to be filled by matter, it is necessary that since its origin all possible vacuum particles were constantly present in it. Under a small initial volume of the Universe a Field's density of energy, that entered into the Universe, was extremely high. In this case, Field was able to excite all the possible particle-antiparticle pairs, and then, bineutrons and their clusters were created in a vicinity of the formed particles. In this process a contribution of antiparticles to the creation of a matter quickly decreased to zero as the competing processes became quickly and steadily more intense. Now Field is also able to create the particle-antiparticle pairs from a vacuum, but the concentration of these particles decreases with time inversely proportionally to cube of lifetime of the Universe. This is

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[27] The author of this book has another concept regarding a nature of the cosmic microwave background radiation [23].

extremely small quantity in comparison with concentration of the created bineutrons in a field of atomic nuclei.

6.3. Time discreteness of in the solitary Universe

Earlier, the author had attempted to describe the discreteness of time on the basis of the Law of unity in the Universe [13]. In this attempt the Universe was treated in the traditional sense. Based on the postulate of time discreteness, it was clear that unity in the Universe could be achieved while the **simultaneous** existence of all particles of Metagalaxy. This was possible only under conditions that signal of unity would cover the total Universe for the period of time discreteness. This discreteness period can be determined by the formula

$$\Delta t = \frac{h}{M_U c^2}$$

(6.3)

where M_U - mass of matter in the Universe.

To find these settings, some certain axioms were introduced in Ref. [13]. In particular, there were considered available in the literature numerous historical and geological data (beginning from Plato and Pythagoras to modern theories of civilizations and lithological plates). These data indicate that the Earth is in a field that is described by the dodecahedron (icosahedron) symmetry. Thus, t**he symmetry of the dodecahedron (in the local approximation) should describe the physics of the Universe.** Our usual three-dimensional space corresponds to the symmetry of the cube three edges of which at the top correspond to three spatial coordinates. Respectively, the rectangular facet corresponds to four dimensions. Accordingly, **the symmetry of the dodecahedron indicates on existence of three spatial coordinates** (three edges at the top) **and five dimensions** (pentagonal facet).

It turned out that the dodecahedron group (I_h) allows the existence of two one-dimensional (H_{1g}, H_{1u}), four three-dimensional (H_{2g}, H_{2u}, H_{3g}, H_{3u}), two four-dimensional (H_{4g}, H_{4u}) and two five-dimensional (H_{5g}, H_{5u}) images (subspaces).

The number and symmetry of representations of the I_h group gave the reason to believe [13] that there are 4 types of matters: matter (mass m), antimatter (anti-mass

$\tilde{m}$) negative-matter (negative-mass $\overline{m}$) and anti-negative-matter (anti-negative-mass $\overline{\tilde{m}}$). The value of m and $\tilde{m}$ are positive values, and $\overline{m}$ and $\overline{\tilde{m}}$ are negative ones. Then, the total symmetry of the Universe in respect of mass will be ensured. As negative energy of free particles corresponds to negative mass, it provides symmetry of the world regarding to energy and temperature.

To describe the time discreteness and an instant distribution of interaction in our time-space, author of the Ref. [13] has proposed to add additional time dimension (besides of the usual time t it was introduced another time coordinate τ, which is orthogonal to t). It was assumed that the carrier of such an interaction is the gravitational field with its quanta - graviton. Introduction of two times coordinates leas to the fact that we have de Sitter's space of type II (space of anti-de-Sitter [14] with signature of 1, 1, -1, -1, -1).

Further the material Universe is represented as being made up of three components (m, $\overline{m}$ and m), separated by intervals of time $\Delta t/2$, where Δt is quantum of time. In this case, the total mass is equal m.

Graviton seems like the double vortex, which has mass m and negative-mass $\overline{m}$.

There is interaction between a mass, which corresponds to the time $t = 0$, and graviton, which is in the past regarding to the matter (actually vortex $\overline{m}$ is absorbed and vortex m erodes a function of the element of mass m in time). The graviton motion along the closed time coordinates τ ensures its full absorption by mass m. This absorption causes the pair (m, $\overline{m}$) disappearance and instead of this symmetrically with respect to the third element m there is a new pair ($\overline{m}$, m) with time coordinates 3 $\Delta t/2$ ($\overline{m}$) i $2\Delta t$ (m), and also a new graviton, shifted regarding the first graviton in time on Δt. The process is repeated indefinitely.

One should note that mass must have the structure ($\overline{m}$, m, $\overline{m}$) in accordance to the model for the time current t in the opposite direction.

This consideration gives the value of the time discreteness $\Delta t \approx 10^{-103}$ c. To ensure the unity of the Universe speed of information transfer should have the order of $\sim 1 \cdot 10^{131}$ m/c.

This discrepancy of received result and the speed of light was overcome only in the new model of the Universe, as part of the fiber Super-Universe [1].

It is interesting to pay attention on the information received on the basis of analysis of the spacecraft WMAP a year after the publication of the article [10]. This information allowed to the authors of the papers [15-17] hypothesize that the Universe is a space dodecahedronical space of Poincare.

If there was no world unity, then the graviton, emitted by an elementary particle, could interact only with the same particle, as other elementary particles would exist at other time points. This would lead to a lack of gravitational interaction and, consequently, to the disappearance or impossibility of existence of the material world. Therefore, unity is absolutely necessary and it is provided in the total Universe **by the mutual affection of all identical elementary particles**. Actually, for this they need their identity. The mutual affection of particles in the Universe is possible only with instantaneous transfer of information in all space of the Universe. This possibility exists in the fiber Super-Universe.

6.4. Synchronization and unity in the Super-Universe. Quantum of time

Now let us consider the fact that our Super-Universe is fiber on the different dimensions Worlds, and our Universe is a brane of four-dimensional space [1].

One can assume that synchronization processes in the World-4 would occur from the center of four-dimensional space, which is a brane of the World-4. However, such synchronization will occur with a delay, equal to the time of reaching the signal from the four-dimensional center space to three-dimensional surface.

Considering the fiber Super-Universe, we notice significantly more powerful effects that can be successfully used not only for synchronization of the matter motion in discrete time, but for **instantaneous transmission of information between arbitrary points of the World-4**.

We have already mentioned that the connection between the layers of the fiber space occurs only in one point, and this point delocalized is in each of the adjacent layers. As information is transferred from the point, this means that information from

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every part of the World-4 at the same time will be transmitted to every part of the World-3. Then, this information will be transmitted to the World-2 and, finally, to the World-1, and World of Time-Field that has no extension in space. In addition, information from the World-3 can be transmitted in the arbitrary World-4.

As the World of Time- Field interacts directly with all points of our Universe, the information in it may come from every point of our space.

Thus, it is consequentially to conclude that **synchronization and Unity of the World-4 may be provided directly from the Field**, which sends the directives down to the hierarchical stairs.

Let us note that the matter supplies from the Field in all layers of the fiber space at constant speed. In this case, the matter supplies to the World-4 occurs with speed *dM/dt* = 5000 solar masses per second [1]. Therefore, it is consequentially to assume that this mass will determine time discreteness (quantum of time):

$$\Delta t_0 = \frac{h}{Mc^2} = \frac{6.626 \cdot 10^{-34}}{1 \cdot 10^{34} \cdot 9 \cdot 10^{16}} = 7.36 \cdot 10^{-85} sec. \tag{6.4}$$

This value is greater than the value, determined in Ref. [13] on 17 orders, but less time Strap for 41 orders.

We determined time discreteness in our space, however, the Field sets it, more precisely, and it sets its oscillation. If time discreteness is equal to the period of the Field oscillations, the frequency of this oscillation is:

$$v_0 = \Delta t_0^{-1} = 1.36 \cdot 10^{84} sec^{-1}. \tag{6.5}$$

One should make one more amendment. The matter is at once created in all the layers of the fiber Super-Universe. It means that time discreteness step (4) is reduced in about three times ($2.45 \cdot 10^{-85} c$), and frequency (6.5) of the Field oscillations is increased by similar times ($4.08 \cdot 10^{84} c^{-1}$).

In order the scheme, which explains the time discreteness [13], would be valid, it needs to take energy and negative energy instead of mass and negative-mass. Thus, the Field is characterized by two states: with positive and negative energy.

While filling the World-1 by the Field, graviton[28] motion occurs along the coordinates of τ. Since a point has zeroth dimension, the graviton will be able to cover the Field at the time, which does not exceed the value Δt_0 for arbitrary graviton speed. Moreover, it is logical to assume that the graviton moves along the closed path; it means that the axis τ is rolled into the ring with duration Δt_0.

Now it is easy to understand the manifestation of all identical particles unity in the Universe: it is provided by interaction between layers of the fiber Super-Universe space, particularly between the Field and the World-4, as well as between the particles of the World 4 and the World-3.

A mutual affection between identical particles lead to the fact that every elementary particle with certain phase of their existence function will be presented in every moment of discrete time. For example, the function of particles existence with mass m_i can be described by expression $\psi_i = a \cdot \exp(-i\omega_i t)$, where $\omega_i = 2\pi/\Delta t_i$, $a = c \cdot \sqrt{m_i}/h$ is the normalization factor, $\Delta t_i = h/(m_i c^2)$. In this case, the oscillation period Δt_i is filled by the periods of the Super-Universe oscillations, that is $\Delta t_i = N_i \Delta t_0$, where $N_i = M/m_i$ - integer.

6.5. Hierarchy structure of the Universe

Above we mentioned about hierarchical levels in the structure of the Universe and the Super-Universe. In this regard it is necessary to mention that the hierarchical structure of the Universe is sufficiently described in papers [17-19]. It is interesting to note that in this case the mechanism of interaction between elements of the given level corresponds to every separated hierarchical level in the Universe. Particularly, the weak interaction corresponds to the level of elementary particles, strong interaction – to the structure of baryons (including nucleons) and atomic nuclei, electromagnetic interaction – to the structure of atoms, molecules and systems of interacting particles, and at last, the gravitational interaction – to the structure of planetary and stellar systems etc. Also it is necessary to say, that the structuring of the Universe structure is completely caused by the action of the Field, which makes its

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[28] In this case, it is a conventional name.

field contribution to each member of the Universe hierarchy and determines its structuring.

6.6. Instant transfer of information in the World-4

Analysis of the scientific literature has shown that there is information about experimental data, which was not notices by the experts up to this time. For example, speech is about data, obtained by Kozyrev [21,22]. These data indicate on the possibility of instantaneous transfer of information about the coordinates of distant stars. In fact, N. Kozyrev has shown the reality of Minkowski's four-dimensional geometry (Fig. 6.1).

In Figure 6.1 it is shown one spatial coordinate and time coordinate t. The point O is the position of the observer. Points 1, 2 and 3 denote the positions of the stars in the remote past, at the present time, and in the future. The rays at an angle to the coordinate system show the path of the electromagnetic wave. A quantum of light emitted by the star at point 1, runs to laboratory coordinate system (the point O). This ray is observed visually or by using the telescope. N. Kozyrev used the reflecting telescope in the focal plane of which the sensor was put. It was shown that in this case besides of the star visible image two additional images of the same star are registered by the sensor. It was proved by the numerous experiments that the sensor registered information (entropy). It is important to note that the sensor registers the information even in the case when the nontransparent for electromagnetic waves plate is placed on the way of the light ray. Thus, there are no barriers for a flow of information.

N. Kozyrev concluded that the information could be disseminated from the star 1) from the past with the speed of light, 2) from present moment of time, and also 3) from the future along with light ray in the opposite direction (Fig.1). When using a telescope-refractor there is only one optical image of the star. Consequently, the flow of entropy (information) can be reflected from a mirror, like light ray. The lens is not capable to focus a flow of entropy.

As the visible positions of stars on the celestial sphere which corresponds to their position at the moment of light emission, are simultaneously observed, then the comparison of these results allowed to N. Kozyrev to obtain important information about a parallax of stars. In its turn this fact shows that information can be transmitted over long distances without delay.

Thus, the fiber space can provide an instant transfer of information through informational link between the World-4 and the World-3, and the links **between the World-4 and the World-1.**

The transfer of information in the negative time direction is possible only with the participation of the Field as **the Field can carry both positive and negative energies**, and hence, transfer information along time coordinate in both directions.
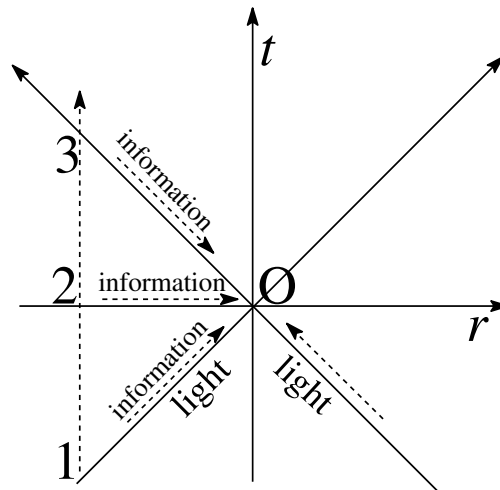

Fig. 6.1 Four- dimensional Minkowski's geometry.

The transfer of information into any point of our Universe by using of the Field properties and fiber Super-Universe is **the basis for developing an instant space communication between arbitrary points of the Universe, to carrying out methods of observation for processes in the distant space objects at any moment of time.**

At the present time this problem is of a great interest due to the fact that the space laboratories are already flying around the Solar system. It is already clear that the source of information might have an entropy nature. Narrow beam for transmission and receiving information is formed by the use of the paraboloid mirror. In this case, the direction of information distribution, and possibly information

receiver, is provided by informational interaction between the particles of the World-4 and the World-3 under participation of the World-1.

6.7. Inexhaustible source of energy

As it follows from a consideration of the Field properties, the World "Time-Field" is inexhaustible source of energy. **In future humanity should use a flow of energy from the Field – an inexhaustible source of a pure energy [24]**. It can be the secondary energy of Field that is accumulated in the bowels of the Earth, the Sun, and the Universe (in particular, energy of excited vacuum by Field). In principle it is possible carrying out direct use of Field's energy.

Permanent creation of matter due to energy of Field leads to that the total energy of the Earth bowels increases. It provides inexhaustible prospects of the energy utilization of the Earth's bowels to produce energy. For example, speech is about converting water, which is supplied through pipes to a large enough depth, to the water vapor under high pressure and its using for electricity generation and human settlements providing by hot water.

6.8. Conclusions

In this Chapter it is proposed the model of Time-Field with using the Law of unity in the Universe. It is shown that:

1) Symmetry of dodecahedra indicates on the presence of three spatial and two time-dimensions (the space of anti-de-Sitter) in the World-1.

2) Field is characterized by a high symmetry in the multidimensional space, as well as two states: **with positive and negative energy**. Only in this case it will set time discreteness.

3) The integrity of the Universe can only provide an instant transfer of information within the total Universe. In the model of isolated Universe a rate of transferring data should be extremely large. In model of fiber space all rates of information transferring with participation of the Field must be the same and equal to speed of light in vacuum. In this case, **the integrity of the Universe provides the Field property from the World-1**.

4) The mutual affection of the particles in the Universe occurs with the participation of the Field from World-1 and space of quarks. Such affection will lead to the description of the particles as oscillations with the period $\varDelta t_i = h/m_i c^2$. This fact explains the nature of the wave properties of particles.

5). Field specifies the time discreteness in our Universe – $\Delta t_o = 7.36 \cdot 10^{-85}$ s (oscillation frequency of the Field $1.36 \cdot 10^{84}$ s^{-1}). The boson responsible for discrete time moves on the closed trajectory along the axis of the second time; the second time collapses in the ring with duration Δt_0. The speed of the boson does not exceed the light speed.

6) Field provides the appearance of masses of the elementary particles.

7) Field has an ability to create the bineutrons or bineutrons clusters in the vicinity of existing particles and atomic nuclei in the World-4.

8) A particle and its antiparticle can create a vacuum particle due to the interaction through the Field. The Field can excite a vacuum particle and provide formation of pair of the real particles from it, and may also cause an excitation of vacuum particle to the state, whose energy is less than the energy of free particles pair. Therefore, the Field creates pair of virtual particles. All material particles are able to interact through the Field.

9) **Perspective conclusion**: transfer of information into any point of our Universe by using of the Field properties and fiber Super-Universe is **the basis for developing an instant space communication between arbitrary points of the Universe, to carrying out methods of observation for processes in the distant space objects at any moment of time.**

10) Time-Field World is inexhaustible source of energy. **In the future humanity should only use a flow of energy from the Field**. It can be the secondary energy of Field that is accumulated in the bowels of the Earth, the Sun, and the Universe (in particular, energy of excited vacuum by Field). In principle it is possible carrying out direct use of Field's energy.

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CHAPTER 7. **Strong interactions in the new model of the Universe**

In the Chapter 1 on the basis of the Law of Similarity and Unity a model of our Universe birth with minimal initial entropy [1] has been proposed by author. At the same time our Universe is a part of the Super-Universe [2]. In turn, the Super-Universe is presented by fiber space, with adjacent layers of different dimensionality of space per unit. Habitual for us three-dimensional space (four-dimensional (3 + 1) Universe) is bordered with a two-dimensional space of quarks. Likely the two-dimensional space is bordered with a one-dimensional space of diones that are found to be Planck particles. Finally, the one-dimensional space is bordered with a zero-dimensional space of the scalar Field-time. Between adjacent spaces the information interaction exists through a single delocalized point. A zero-dimensional space of the Field-time has the ability to interact with other spaces and set the program the evolution of the Universe.

Scalar Field subsequently fills all dimensions, producing complex of particles (that have no charge and other quantum numbers) in each of these dimensions. Such particles are represented by neutron pairs or clusters of neutron pair in singlet state in the World-4, by complexes of quarks in form of neutron pairs in the World-3 and by complexes of diones with appropriate characteristics in the World-2.

This structure of Super-Universe causes an appearance of hadrons in the Universe (World-4) as a result of interaction between the quarks in the World-3 and transmission of information on this interaction into the World-4. Thus, a single particle of the World-4 can be assigned to a group of World-3 quarks, which counts in the zero approximation two or three quarks. At the same time between the quarks and hadrons the strong interaction exists, which is under investigation in detail since 1935.

Strong intranuclear interaction was first described by the Japanese physicist Yukawa in 1935 using the exchange particles ─ mesons. The quantum chromodynamics gives the modern description of strong interaction. Quantum chromodynamics is a part of the so-called Standard Model, which represents the sum

of modern ideas about the structure of the microcosm, although it can not claim to be finalized knowledge, because it does not explain the results of some experiments and does not include the theory of gravity.

According to the model of Yukawa a strong interaction in the World-4 shows itself in result of the fact that one nucleon emits a π-meson, and the second one consumes it in a time $t \sim 10^{-23}$ seconds. Such particles are called virtual. To make these particles are real, they must be free from the interaction with nucleons. To do this, you need to provide pion energy to overcome the work function and produce kinetic energy (the analog of the photoelectric effect).

Probably, for the refined calculations of hadron interactions and related characteristics the several such groups of quarks must be taken into account. The confirmation of this assumption consists in the birth of a considerable number of elementary particles at inelastic collisions of high-energy particles. It is not surprising that in the monograph [3] it was maintained that about 6000 particles of Hidden World corresponds to hadron. Therefore, to describe the properties of the proton in the zero approximation it is necessary to take into account three quarks, and along with increase of the level of accuracy their number should increase significantly (up to 6000).

This resembles the polar molecules dissolved in water, around which the solvation shell is formed of several water molecules and exist a far zone of molecules, whose influence can be taken into account using macroscopic solvent averaged parameters.

Thus, the nucleon can be associated with up to 6000 the quarks and the quarks that can be associated with 2000 nucleons.

So now in the frame of Standard Model the connection between quarks and hadrons gas been found.

In this Chapter we study the strong interaction within the framework of a new model of creation and evolution of the Universe, characterized by minimum of initial entropy [1].

For further discussion of the material we shall take into attention a hypothesis about the nature and structure of the physical vacuum discussed in [3]: **at the annihilation of particle-antiparticle pairs they do not disappear but merge into a system called as elementary particle of vacuum** (EPV). In EPV at the unexcited state in our lab space all quantum numbers are zero. The basis of the physical vacuum, according to [3] consists of a proton-antiproton (p^+p^-) vacuum. The concentration of EPV in this form of vacuum is equal to $1.54541 \cdot 10^{39}$ cm^{-3}, while the concentration of EPV in the electron-positron vacuum is equal to $1.73009 \cdot 10^{29}$ cm^{-3}, that is 10 orders of magnitude smaller. In addition, all EPVs form all stable particles of the World-3 and World-4. In the author's paper [4] there are described the properties of the scalar Field of the World-1, which explain the reason of the vacuum particles appearance.

Other known interactions can't produce vacuum particles. That is why these interactions are missed in the Standard Model. Herewith vacuum is characterized by set of states that should match additional requirements. In particular, physicists had to introduce new concept of "vacuum corrections" to explain correction for the magnetic moment of the electron (found experimentally) and bias of level of thing structure in the Hydrogen atom. Physicists continue to add to vacuum explanation more and more stricter postulates. For example it is considered that if one influenced on physical vacuum (PV) by particle birth operator, one would get real particle from empty PV. And there is no explanation of this mechanism for this process.

7.1. Strong interaction in the Standard Model

All particles which are composed of quarks belong to a class of hadrons. Some of them consist of a quark and an antiquark, others consist of three quarks. The most famous of the last are the proton and neutron.

Proton (+1)   Neutron (0)
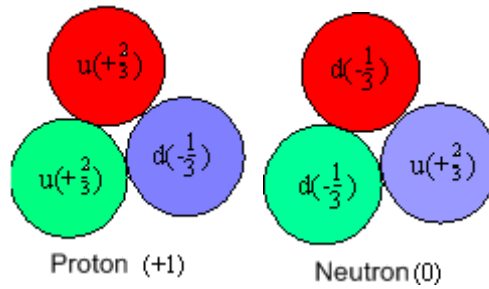
Quark charges as part of a proton combined to 1 (in elementary charge units) and for a neutron to 0.

Quarks are held together due to the gluons, i.e. quanta of the field of strong interaction.

Quarks have their own kind of charge, which is called "color". At any time, quark can be in one of three states or colors: *r, b, g* (red, blue, green). At the absorption or emission of gluons a quark color can vary, for example

$$u(b) \rightarrow g(b, \bar{r}) + u(r)$$
$$d(r) + g(b, \bar{r}) \rightarrow d(b) \qquad (7.1)$$

However, other quantum numbers of quarks and its flavor[29] does not change.

Of the three colors (*r, b, g*) and three anticolours ($\bar{r}$, $\bar{b}$, $\bar{g}$) it is possible to create a table of possible combinations of gluons (Table 7.1).

Gluon has spin 1 as the photon and has two spin states, it is electrically neutral and has a color charge $r\bar{r}, g\bar{g}, b\bar{b}, r\bar{g}, g\bar{r}, r\bar{b}, b\bar{r}, g\bar{b}, b\bar{g}$ [30].

Table 7.1. Combinations of colors and anti-colors, which carry gluons.

	r	*b*	*g*
$\bar{r}$	$\bar{r}r$	$\bar{r}b$	$\bar{r}g$
$\bar{b}$	$\bar{b}r$	$\bar{b}b$	$\bar{b}g$
$\bar{g}$	$\bar{g}r$	$\bar{g}b$	$\bar{g}g$

In fact, such an exchange of gluons between quarks is able to describe interquark interaction. However, in the quantum chromodynamics, likely to quantum

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[29] Flavor is the common name for a series of quantum numbers characterizing the type of quark or lepton.
[30] There are given the charges of gluons, which are in the field of low symmetry. The symmetry of the free gluon is described within the framework of the *SU* (3).

mechanics, description of the interaction is carried out using the wave functions, the symmetry of which must correspond to local space symmetry. So the linear combinations of the wave functions will be finding first, which satisfy the conditions of the problem. Among the elements situated out of diagonal in Table. 1, you can create 6 different color combinations:

$$g_1 = (\bar{r}b + \bar{b}r)/\sqrt{2}, \; g_2 = -i(\bar{r}b - \bar{b}r)/\sqrt{2},$$
$$g_4 = (\bar{r}g + \bar{g}r)/\sqrt{2}, \; g_5 = -i(\bar{r}g - \bar{g}r)/\sqrt{2}, \tag{7.2}$$
$$g_6 = (\bar{b}g + \bar{g}b)/\sqrt{2}, \; g_7 = -i(\bar{b}g - \bar{g}b)/\sqrt{2}.$$

At using of the three elements arranged on the diagonal ($\bar{r}r$, $\bar{b}b$, $\bar{g}g$), you can build 3 independent colorless (white) combinations. Two of them:

$$g_3 = (\bar{r}r - \bar{b}b)/\sqrt{2}, \; g_8 = (\bar{r}r + \bar{b}b - 2\bar{g}g)/\sqrt{6} \tag{7.3}$$

are carriers of the interaction, and the third

$$(\bar{r}r + \bar{b}b + \bar{g}g)/\sqrt{3} \tag{7.4}$$

is completely symmetrical with respect to colors and represents a colorless color singlet. It is believed that the particle with has such color combination can not be a carrier of the color interaction between the quarks [5, 6].

It is clear that these combinations can be cyclically ($r \rightarrow g \rightarrow b \rightarrow r$) swapped. At this action a description for all quarks will be changed excepted for fully symmetrical ones.

Three recent wavefunctions of quark are taken similarly to view of three wave functions of the interacting atoms (e.g., iodine). Thus the fully symmetrical combination gives the minimal energy of molecules, while the antisymmetric (g_3) combination is corresponding to lack of binding energy between the atoms and consequently leaves energy of components unchanged, and the third (g_8) antibonding combination characterizes the increased energy state.

To binding has occurred it is necessary that the energy of a quark plus the energy of the virtual gluon will be exceeding the quark energy. It must be considered that in the case of gluons with the fully symmetrical wave function the total energy does not differ from the quark energy, i.e. **fully symmetrical combination**

corresponds to the vacuum elementary particle. In this case, full symmetric gluon will not be able to provide binding between quarks. And the lack of interaction would not be seen in the color combination but in the total energy of the quark and virtual gluon. Quarks g_3 and g_8 also do not transmit the color but provide a binding. It is possible to consider all 8 gluons combinations as the excited states of the basic fully symmetrical state what allows them to participate in the strong interaction.

Thus, the first two symmetrical combination (g_3 and g_8) together with the six off-diagonal combinations represent 8 types of gluons wave functions as carriers of strong color interaction.

It is easy to see that the wave functions g_1 and g_2 provide interaction between the red and blue quarks, g_4 and g_5 - between red and green, g_6 and g_7- between blue and green. g_3 function describes the interaction of red and blue quarks without color change. Similarly, g_8 function describes the interaction of all three quark colors without change of color.

Since gluons, unlike photons, have color, the theory assumes that the processes of gluons emission by gluons and interaction between gluons are possible for gluons. However, this effect is possible rather for virtual gluons than for real gluons. Therefore, such interaction has not detected at any experiment.

The interaction with gluons participation is responsible for holding quarks inside a hadron. Unlike the constant of electromagnetic interaction, strong color interaction constant increases with increasing distance between the quarks.

Gluons play a significant role in the formation of the internal structure of hadrons. The processes of deep inelastic scattering of particles by nucleons yield to about one half of the nucleon energy belong to gluons.

The existence of quarks fully explains the presence of the magnetic moment of the proton ($2.79275 \cdot \mu_p$) and the neutron ($-1.93 \cdot \mu_p$).

While the magnitude of the electromagnetic interaction is characterized by a constant which is equal to $1/137.03597$ (that is a square of the amplitude (-0.08542455) absorption or emission of a virtual photon by electron), the value of the

strong interaction is determined by the gluon constant g, significantly higher than the value of the constant of electromagnetic interaction.

The strong interaction between hadrons can be described using the exchange by pions, the structure of which is represented by a quark and an antiquark which carry color and anticolours. So, pions are colorless particle with zero spin (bosons).

Pions are unstable particles.

Bosons obey Bose - Einstein: an unlimited number of particles with identical quantum numbers can be in a single quantum state. Bosons include the hypothetical **graviton** (spin 2), the **photon** (spin 1), the W and Z - **bosons** (spin 1) and **gluons** (spin 1), **mesons** and **meson resonances** (spin 0) and antiparticles of all these particles.

Based on the uncertainty relation

$$\Delta t \cdot \Delta E \geq h \tag{7.5}$$

we find the distance of virtual boson motion during time Δt

$$r = c\Delta t = \frac{ch}{\Delta E} = \frac{ch}{m_{\acute{a}}c^2} = \frac{h}{m_{\acute{a}}c} = \lambda_c \tag{7.6}$$

This distance is the radius of the particle interaction. If the boson is the pion ($m_{\pi\pm}$ = 273 m_e), then $r = 8.9 \cdot 10^{-15}$ m.

In the case of weak interaction ($W^{\pm}$-boson) $r = 1.5 \cdot 10^{-17}$ m. Such a small distance pre-determines the weak interaction. Therefore, the neutron lifetime reaches 881 sec [7]. That is why the neutrino interacts weakly with a matter.

Baryons and mesons together form a group of hadrons. In this case, it is important for us that nucleons and pions have the following quark structure $\pi^0 = u\bar{u} - d\bar{d}$, $\pi^+ = u\bar{d}$, $\pi^- = \bar{u}d$, $p = uud$, $n = udd$..

The lifetime of π^+ and π^- mesons are $2.0 \cdot 10^{-8}$ s, and for π^0-meson is $0.8 \cdot 10^{-16}$ s [8].

The strong interaction between nucleons is manifested by result of the fact that one nucleon emits a virtual π-meson (pion) and the second absorbs it over time $t \sim 10^{-23}$ seconds.

In a result of virtual processes nucleon is covered by a coat from pions:

$$p \leftrightarrow (n + \pi^+),$$
$$n \leftrightarrow (p + \pi^-),$$
$$p \leftrightarrow (p + \pi^o), \qquad\qquad (7.7)$$
$$n \leftrightarrow (n + \pi^o),$$

forming a field of nuclear forces. Details of pion birth are not described in theory. It is simply assumed that all processes take place in the framework of the uncertainty relation.

Absorption of these pions by other nucleons leads to the interaction between nucleons, which is the manifestation of nuclear forces:

$$p + n \leftrightarrow (n + \pi+) + n \leftrightarrow n + (\pi++ n) \leftrightarrow n + p$$
$$n + p \leftrightarrow (p + \pi^-) + p \leftrightarrow p + (p + \pi^-) \leftrightarrow p + n$$
$$p + p \leftrightarrow (p + \pi^o) + p \leftrightarrow p + (p + \pi^o) \leftrightarrow p + p \qquad (7.8)$$
$$n + n \leftrightarrow (n + \pi^o) + n \leftrightarrow n + (n + \pi^o) \leftrightarrow n + n$$

Now look at interaction between nucleons at the quark level. The interaction between the proton and the neutron is looking so:

$$uud + udd \leftrightarrow \left(udd + u\bar{d}\right) + udd \leftrightarrow udd + \left(u\bar{d} + udd\right) \leftrightarrow udd + uud$$

$$(7.9)$$

Here, virtual pion π^+ is born in the field of proton next this pion is transferred to the neutron with a transformation it into a proton due to the annihilation of a quark of neutron d and an antiquark $\bar{d}$ of pion. There u-quark, the remainder of pion, is a member of the newly formed protons. Since this is a pion in a virtual state, this annihilation is not accompanied by the release of energy; there is no radiation of gamma-rays.

In more details the interaction between the proton and the neutron $n = (^{-1/2}d(r) + {}^{1/2}u(g) + {}^{1/2}d(b))$ with the participation of gluons is described in the Standard Model as follows.

a) the emission of gluons with quarks changes color:

$$^{1/2}u(g) \rightarrow {}^1g(g,\bar{r}) + {}^{-1/2}u(r)$$

$$^{1/2}d(g) \rightarrow {}^1g(g,\bar{r}) + {}^{-1/2}d(r) \tag{7.10}$$

b) the absorption of gluon by another quark with a change of color:

$$^{-1/2}u(r) + {}^1g(g,\bar{r}) \rightarrow {}^{1/2}u(g)$$

$$^{-1/2}d(r) + {}^1g(g,\bar{r}) \rightarrow {}^{1/2}d(g). \tag{7.11}$$

Consequently, the gluons transfer occurs only in the singlet quark pair. In this case the spin of the quark (-½) and its color are rigidly fixed and transferred simultaneously. Thus, the spin is transferred from the first to the second quark, from second to third and from third to first, and so on around the circle. This rapid exchange of spin projections reserves total spin constant and equal to ½.

c) conversion of the virtual boson (gluon) to the virtual quark-antiquark color pair in the triplet state (the total spin = 1):

$$^1g(b,\bar{r}) \rightarrow {}^1\left[{}^{1/2}d(b) + {}^{1/2}\bar{d}(\bar{r}) \right]. \tag{7.12}$$

Here the question arises: can a virtual gluons turn into a colored quark pair in the triplet virtual state? The new model of such a reaction is not possible. Rather, the virtual pair of quarks (pion) can only be a colorless (white) boson.

d) sequential reaction (7.11) and (7.12) the quark $^{1/2}d(b)$, emitting a gluon $^1g(b, \bar{r})$, became a quark $^{-1/2}d(r)$. Consequently, in this case it has two identical quark $^{1/2}d(r) + {}^{1/2}u(g) + {}^{-1/2}d(r)$. ***It is clear that such a quark structure of the nucleon is not possible***. Therefore, conversion to a virtual gluon emitted color quark-antiquark pair in the triplet state is ***impossible***[31]. However, the Standard Model bypass this issue by introducing separation of one of the two identical quarks $^{-1/2}d(r)$, which then communicates with the quark $^{1/2}d(b)$, which is part of a virtual pair, i.e. combined with an antiquark $^{-1/2}\bar{d}(\bar{r})$, forming a virtual pion in π^o singlet state. The freed quark $^{1/2}d(b)$

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[31] In the quantum mechanics the probability of a quantum transition is expressed by integral in which the function under sign of integral contains the wave functions of initial and final states as well as the operator of quantum transition. The quantum transition is impossible because the final state is impossible.

is connected to the other two, completing three quarks $^{½}d(b)+$ $^{½}u(g)+$ $^{-½}d(r)$ with a total spin ½.

e) pion π^o ($^{-½}d(r)+$ $^{½}\bar{d}(\bar{r})$ is transferred to the proton $p^+ = (^{½}d(g)+$ $^{-½}u(r)+$ $^{½}u(b))$. As between the quarks that make up protons a constant exchange of gluons occurs, the quark spins are constantly changing. Next pion π^o ($^{-½}d(r) +$ $^{½}\bar{d}(\bar{r})$) interacts with a quark $^{½}d(g)^{32}$. At the same time as a result of the exchange of quarks released quark $^{-½}d(r)$, which becomes an integral part of the proton, and a pair of virtual quarks ($^{½}\bar{d}(\bar{r})+^{½}d(g)$) becomes colored in the triplet state, with the result that turns into a gluon $^1g(g,\bar{r})$, converting $^{-½}d(r)$ on $^{½}d(g)$. This complex process is introduced in order to provide symmetrical processes of gluons conversion into the pair of quarks and conversion of a pair of quarks into gluons.

So, gluon is transferred into a pair of quarks and the quarks pair is transferred into gluons. And what will cause a strong interaction? Probably, this is a time from the birth of gluons to absorption of gluons after the transfer of pion. In this case, in order to maintain the strong interaction at the constant level it is need to be born a new cycle of pion exchange immediately after the pion was exchanged.

If the gluon in the reaction c) splits into a pair of u - quarks

$$^1 g(b,\bar{r}) \rightarrow {}^1[^{½}u(b) + {}^{½}\bar{u}(\bar{r})],$$

then the union $^{-½}d(r) + {}^{½}\bar{u}(\bar{r})$ will pion π^-, and instead of neutron a proton is formed

$$^{-½}d(r) + {}^{½}u(g) + {}^{½}u(b) = p^+.$$

The pion π^- transferred into a proton p^+, turning it into a neutron n.

Through similar analysis on the example of a proton, it is easy to establish the possibility of creating pions π^+ and the conversion of a proton into a neutron. The pion π^+ transferred to the neutron n, turning it into a proton p^+.

Thus, the above scheme explains in the framework of the Standard Model the strong interaction between quarks in the nucleon and between nucleons (colorless particles) in the nucleus. Unacceptable places in this scheme correspond to the reactions of pion production from gluon and vice versa. Both reactions are to be

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[4]What causes a such exchange it does not understand.

unlikely, or even improbable. However, experiments show that the neutral and charged pions are easily formed as in the interaction of cosmic rays with the Earth's atmosphere, as well as in the laboratory.

Now consider additional aspects of the criticism of the Standard Model of strong interaction. The first thing that arises that is discrepancy between the exchange interaction model and potentials which describe the strong interaction between the hadrons. The potentials found by theorists did not follow from metabolic processes in hadrons. In addition, it seems that the gluons somehow know in what direction they must radiate. From what this knowledge, when anything besides gluons between hadrons do not exist? The exchange interaction in the model described above should rather be chaotic, and not strictly deterministic. What directs the virtual gluons, providing deterministic interaction between hadrons? It seems incredible and hypothetical mechanism of conversion of virtual gluons into the quarks pair.

7.2. Strong interaction in the model of the Universe with minimal initial entropy

The law similarity acts in the nature. Therefore, the interaction between quarks via bosons (gluons) can be considered as an example of interaction between the atoms by using a pair of electrons (also bosons) in the singlet state. The guiding force for the movement of these bosons will be an electromagnetic field. Consequently, the movement of gluons should provide by the appropriate Field.

Let's change the scheme of the strong interaction, so that it will be consistent with the new model of the Universe birth as an integral part of the Super-Universe.

In this case, the quarks and gluons are in the World-3, and nucleons and pions in the World-4. This approach has been used when we considered the weak interaction [9]. Now we use it to describe the details of the strong interaction between quarks and hadrons.

As the quarks and nucleons are both **carriers of the Field** [4].

It is possible to accept as basis the cyclic transfer of gluons among the three quarks $[^{1/2}d(g) + ^{1/2}u(r) + ^{-1/2}u(b)]$ in the case of a proton or triple $[^{1/2}d(g) + ^{-1/2}d(r) + ^{1/2}u(b)]$ in

the case of the neutron. At the same time the gluon with spin projection 1 is transferred to the quark whose spin is equal to (-½), and vice versa if the gluon spin projection is opposite. In addition, the color composition of the gluons should correspond to the colors of the quarks, between which it is transferred. This exhausts the strong color interaction between quarks.

Strong colorless interaction between nucleons takes place simultaneously in the World-3 and World-4. In the World-4 we have a standard Yukawa scheme of virtual pion transfer between nucleons. Virtual pions in the World-3 are born by way of the excitation by energy of Field of the quarks of polarized vacuum particles $\left[{}^{1/2}d(\alpha)^{-1/2}\overline{d}(\overline{\alpha}) \right]$ or $\left[{}^{1/2}u(\alpha)^{-1/2}\overline{u}(\overline{\alpha}) \right]$, where $\alpha = r, g, b$. Consequently, the energy of Field of quark originates from the vacuum particles in low symmetry only neutral quark-antiquark pair which corresponds to the neutral pions in the World-4. If this pair is born among the three quarks that are constituents of a neutron, it should have the quark structure $\pi^0 = {}^{-1/2}u(\alpha)^{1/2}\overline{u}(\overline{\alpha})$, and in the proton $\pi^0 = {}^{-1/2}d(\alpha)^{1/2}\overline{d}(\overline{\alpha})$. These neutral pions in the World-4 are born of polarized by Field nucleons of vacuum particles of World-4 due to the energy of the same Fields.

In all cases from the vacuum particles the colorless virtual quark pair are being produced primarily in the World-3 and neutral pions (themselves are particles and antiparticles), which consist of a quark and an antiquark in the singlet state. **The energy system of quarks that make up the nucleon is reduced by the amount of excitation of the virtual neutral pion**. This virtual pair has the ability to interact with the trio of quarks that spawned it (as in the World-3 and in the World-4), or return to the vacuum state. In the latter case, recovering the energy Fields of the nucleon occurs.

Virtual pair (pion π^o) has the ability to move to another nucleon, causing colorless strong interaction between nucleons. Moving virtual pion between nucleons causes movement in the opposite direction of the energy of Field which caused the

birth of virtual pair[33]. After moving the virtual pion will return back to vacuum state. The energy of the nucleon Fields will increase to the standard state. **Overlapping of scalar Fields of interacting nucleons and reducing total energy of Fields determines a direction of movement of the virtual boson, and the interaction between nucleons** (Fig. 7.1). Consequently, the role of the Field in the interaction between nucleons with taking part of bosons is similar to the role of the electromagnetic field in the interaction between the atoms with a taking part of the pair of electrons in the singlet state.

After giving birth of virtual pion $\pi^0 = {}^{-1/2}u(\alpha)^{1/2}\bar{u}(\bar{\alpha})$ in the neutron is possible the quarks exchange without changing their colors.

$${}^{-1/2}d(\alpha) + \pi^0 = {}^{-1/2}d(\alpha)^{1/2}\bar{u}(\bar{\alpha}) + {}^{-1/2}u(\alpha) = \pi^- + {}^{-1/2}u(\alpha). \tag{7.13}$$

At the same time the neutron emits the pion π^-, and the neutron transfers into a proton.

Similarly, the reaction is going in the proton. In this case, the exchange of quarks occurs

$${}^{-1/2}u(\alpha) + \pi^0 = {}^{-1/2}u(\alpha) + {}^{-1/2}d(\alpha)^{1/2}\bar{d}(\bar{\alpha}) = {}^{-1/2}u(\alpha)^{1/2}\bar{d}(\bar{\alpha}) + {}^{-1/2}d(\alpha) = \pi^+ + {}^{-1/2}d(\alpha) \tag{7.14}$$
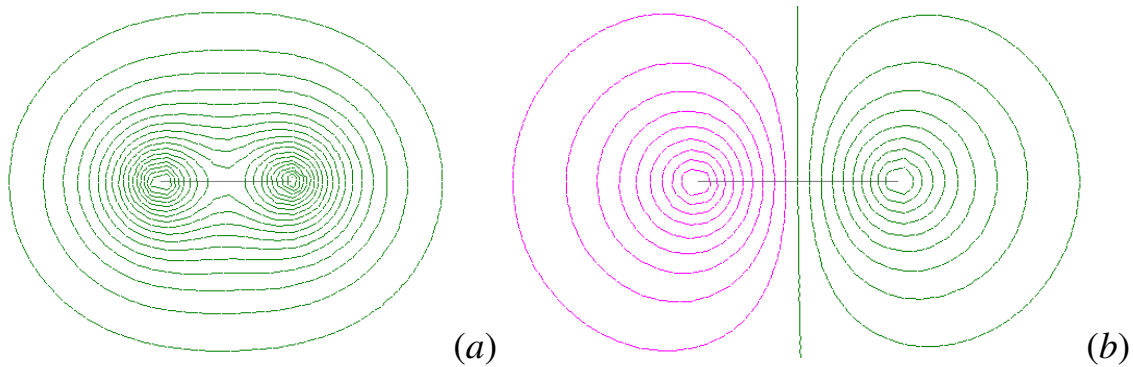

(*a*)   (*b*)

Fig. 7.1. Overlapping of scalar Fields of interacting nucleons.

So, a pion p$^+$ flies out of proton and proton is converted into a neutron. It can be expected that the exchange of quarks with a virtual neutral pion will require additional energy from the Fields of quarks.

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[33] Moving the pion resembles a ship moving through the narrow channel between two small ponds. The ship displaces the water from the reservoir in which it is located. Moving the ship in the second body of water causes the flow of water from the second reservoir to the first.

Movement of charged pion to the nucleon-partner requires reverse reaction of conversion the charged pion into the neutral pion and a relaxation of the latter into the vacuum state. In all processes of transformation the antiquark which is part of the original virtual particles remains as a part of the virtual particles.

The process of the virtual particle creation and its relaxation into virtual state resembles an oscillatory process. Therefore, this process takes place continuously, ensuring constancy of the interaction between quarks and between nucleons.

There is an **additional opportunity** for the manifestation of the strong interaction between nucleons. World 4-pion π^+ is the antiparticle to the pion π^-. Consequently, the energy of the total Field of the neutron and the proton may create the virtual pair $(\pi^-\pi^+)$. In the electrostatic field of the proton this virtual pair is polarized, then pion π^- interacts with a proton and a pion π^+ with a neutron:

$$p^+ + \pi^- \rightarrow n + \pi^o,$$
$$n + \pi^+ \rightarrow p^+ + \pi^o. \tag{7.15}$$

The last process in the reactions (7.15) is the return of the neutral pion in the vacuum state.

In the World-3 a creation of the virtual pair $(\pi^-\pi+)$ means the simultaneous production of virtual pairs of quarks $^{-1/2}d(\alpha)^{1/2}\overline{d}(\overline{\alpha})$ and $^{-1/2}u(\alpha)^{1/2}\overline{u}(\overline{\alpha})$. In the field of the quarks group that makes up protons and neutrons, the polarization of pairs of quarks and sharing in their structures occurs:

$$^{-1/2}d(\alpha)^{1/2}\overline{d}(\overline{\alpha}) + {}^{-1/2}u(\alpha)^{1/2}\overline{u}(\overline{\alpha}) \rightarrow {}^{-1/2}u(\alpha)^{1/2}\overline{d}(\overline{\alpha}) + {}^{-1/2}d(\alpha)^{1/2}\overline{u}(\overline{\alpha}), \tag{7.16}$$

what in the World-4 corresponds to the formation of pions π^+ and π^-.

The first of the formed pairs has the charge "+", and the second has "-". The group of quarks which are the component of neutron makes a combination with the first pair:

$$(^{-1/2}d(r)+{}^{1/2}u(g)+{}^{1/2}d(b))+({}^{-1/2}u(r)^{1/2}\overline{d}(\overline{r}))\rightarrow({}^{-1/2}u(r)+{}^{1/2}u(g)+{}^{1/2}d(b))+({}^{-1/2}d(r)^{1/2}\overline{d}(\overline{r})). \tag{7.17}$$

As a result, two groups of quarks are formed that make up protons and neutral pion.

Similarly, a group of quarks that make up protons, combined with the second pair:

$$(^{-1/2}u(r)+^{1/2}u(g)+^{1/2}d(b))+(^{-1/2}d(\alpha)^{1/2}\bar{u}(\bar{\alpha}))\rightarrow(^{-1/2}d(r)+^{1/2}u(g)+^{1/2}d(b))+(^{-1/2}u(\alpha)^{1/2}\bar{u}(\bar{\alpha})).$$

(7.18)

Now the group of quarks is formed constituting neutron and a neutral pion.

It is important to note that at consideration of the interaction of two protons or two neutrons, reaction (7.16) is not possible. Consequently, interaction between the same nucleons is possible only through the exchange by neutral pions. In turn, this leads to impossibility of formation for a stable nucleus of helium-2, which consisted only of the two protons (biproton).

It is known that binding energy between protons in biproton equals to -0.5 MeV. As electrostatic repulsion energy is about 1 MeV, so binding energy, caused by transfer of neutral pion between neutrons, equals to 0.5 MeV [10, 11]. The same processes should take place in bineutron. But neutron decays due to processes of weak interaction.

From the other side, binding energy in deuteron equals to 2.22457 MeV [12], because it caused by transfer of charged pions pair (i.e. much higher binding energy).

Let's mention one more important detail. In common state deuteron and bineutron have spin 1. If spin value equals to 0, then binding energy between nucleons decreases by 1 order of magnitude. The reason for this could be easily understood looking on Fig. 7.1. Positive amplitude of the Field corresponds to particular spin direction, when negative − to opposite direction. In such case, amplitudes are summed together in triplet state, producing the channel for pion transfer (Fig. 7.1, left side). In singlet state the channel is approximately absent (Fig. 7.1, right side). But from the quantum chemistry theory it is known, that the system could be in fully covalent bond only in triplet state, when in singlet state it is ionic bond that is always mixed up [13]. Using this analogy it could be understood, that bineutron should have weak binding channel in singlet state. Herewith several mechanisms of such binding could exist, e.g. spins precession in magnetic field of other spin and oscillatory processes of quarks moving within bineutron. Energy of

such binding in bineutron equals to around 70 KeV [11]. But the Field uses bineutrons in singlet state for the Universe and atoms creation.

The relaxation of the virtual neutral pions formed by the reactions (7.17) and (7.18) in the vacuum state promotes to the birth of the next pair of virtual pions. And so on to infinity in time. This scheme easy gives explanation to the appearance of charged pions at the interaction of cosmic rays with the Earth's atmosphere.

The interaction between quarks, which are included in the structure of charged or neutral pions, takes place only with the participation of gluons g_3 and g_8 (i.e. $r\bar{r}$, $g\bar{g}$, $b\bar{b}$), which do not change the color and flavor of quarks, but the exchange of the spins occurs. In these quark pairs the birth of a neutral pair of virtual quarks with the same color charges is also possible.

Since the neutral pion itself is the antiparticle, its lifetime is very small (see above). Quite another thing is a charged pion, which is composed of a quark and an antiquark with different flavors. Such a pair of quarks can not be annihilated, and that is why its lifetime is increased by more than 8 orders of magnitude. This is due to the fact that the charged pion must first exchange by quarks with the surrounding environment of the quark to create a neutral pion, which then annihilates.

Thus, considering the strong interaction in the framework of a model of the Universe with minimal initial entropy looks simply and convincingly. And it is clear that there must be a purposeful transfer of boson between quarks and between nucleons. And this trend provides by a scalar Field, which is proper for all particle with a mass. The overlap between the distribution Fields of two neighboring quarks and nucleons allows the formation of a bridge for the transfer of bosons are responsible for the strong interaction.

It is important to understand that the excitation of the virtual bosons from the vacuum state is provided solely by the presence of Field in the vicinity of all the particles having mass. At the same time the birth of the virtual boson or a pair of virtual bosons is possible only within the interacting quarks and nucleons.

7.3. Conclusions

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On the base of consideration of the strong interaction in the Standard Model and in the model of the Universe with minimal initial entropy there are shown the next.

1) There are many complaints about the physics of strong interaction, adopted in the Standard Model: a) forming a reaction with colored gluon quark pair in the triplet state, and vice versa must be unlikely, or improbable; b) there is an imbalance of the exchange interaction model with potentials that describe the strong interaction between hadrons; c) is not known from gluons know in which direction to move them to the appearance of strong interactions.

2) In the new model, each quark and each hadron is simultaneously the carrier of a scalar Field. This Field is fully controls the emission and absorption of gluons, the birth of virtual pairs of particles from vacuum, a taking part of gluons and virtual particle pairs in the strong interaction processes.

3) Transfer of gluons between quarks is completely deterministic: it is going between the quarks with a change of spin per unit; the colored characteristic of gluons is matched with the colors of the quarks, between which the transfer of gluons occurs. Features gluons and transfer direction are defined by the scalar Field.

4) Gluon can not be transferred into a virtual pair of colored quarks and can not spontaneously decay into gluons.

5) The processes of production of virtual quark pairs in the World-3 are fully synchronized with the birth of pions in the World-4. As virtual pairs of quarks and virtual pairs of pions have birth by way of the excitation of the respective vacuum particles by energy of a scalar Field localized on mass particles (respectively, quarks and nucleons). Birth of quark-antiquark pairs in the World-3 corresponds to the creation of a neutral pion π^o in the World-4. Transfer of pion π^o between nucleons makes a contribution into a strong interaction between them. At the birth of the virtual pion π^o in the neighborhood of nucleon the energy Fields of the nucleon decreases. Moving of pion to another nucleon is accompanied by the displacement of the Field energy in the opposite direction. Return of the pion in the vacuum state recovers energy of nucleon Fields. The process of creation and recombination of virtual pairs is oscillatory process, which is repeated endlessly.

6) The total scalar Field of the proton and the neutron has the ability to initiate a virtual pair (p⁻p⁺), that in the World-3 means the simultaneous formation of two quark virtual pairs $^{-1/2}d(\alpha)^{1/2}\overline{d}(\overline{\alpha})$ and $^{-1/2}u(\alpha)^{1/2}\overline{u}(\overline{\alpha})$, their polarization in the Coulomb field of the proton and the conversion into two charged virtual pairs $^{-1/2}u(\alpha)^{1/2}\overline{d}(\overline{\alpha})$ and $^{-1/2}d(\alpha)^{1/2}\overline{u}(\overline{\alpha})$, the first of which corresponds to π^+, while the second corresponds to π^-. The first virtual pair turns the neutron into a proton, and the second pair transfers a proton into a neutron. As a result of such processes in both cases a virtual neutral pion has formed, which is converted into a vacuum particle. This process provides a much greater contribution to the strong interaction than in the case of the birth of the virtual neutral pion.

7) The strong interaction between two protons or two neutrons realizes only as a result of the transfer of a neutral pion. However, such interaction can not overcome the Coulomb repulsion between protons in a hypothetical helium-2 nucleus, in result such a nucleus does not exist.

8) The interaction between quarks, which are the components of the pion, is going due to the exchange by gluons, which do not change the color and flavor of quarks.

9) The increased stability of the charged free pions compared with neutral pions is explained by the need of reactions of quarks exchange $^{-1/2}u(\alpha)\leftrightarrow^{-1/2}d(\alpha)$ with the environment. At this reaction the neutral pions appear which quickly annihilate.

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