

## FRactal Structure of the Universe

*It is a hypothesis about the hierarchical fractal structure of the Universe. According to the hypothesis the Universe consists of an infinite number of spatial and hierarchic fractal- spherical levels of matter that are nested within each other. In ascending order of spatial hierarchy, the following main fractals Universe that conventionally associated with the types of interactions of matter: nuclear, atomic, electromagnetic, gravitational. It can also be assumed that there exist fractals which are older than the gravitational ones. Each fractal is characterized by finite geometrical dimensions and finite value of its own energy, consequently, by the finite value of the spatial density of energy. Hypothesis on the fractal structure of the Universe admits the absence of the dark energy. The apparent effect of its presence in the electromagnetic fractal of the Universe due to its finite geometrical dimensions, the spherical shape and the presence of the rotational motion of the sphere at least around one of the axes.*

*Keywords: fractal, structure, Universe, expansion, rotation, space, dark energy, dark matter, the Hubble constant, Planck's constant, universal proportions of Planck.*

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## ФРАКТАЛЬНАЯ СТРУКТУРА ВСЕЛЕННОЙ

*Рассматривается гипотеза об иерархической фрактальной структуре Вселенной. Согласно гипотезе Вселенная состоит из бесконечного числа вложенных один в другой пространственно-иерархических фрактально-сферических уровней материи. В порядке возрастания пространственной иерархии, выделены следующие основные фракталы Вселенной, которые условно связаны с видами взаимодействий материи: ядерный, атомный, электромагнитный, гравитационный. Можно также допустить, что существуют фракталы, которые старше гравитационного. Каждый фрактал характеризуется конечными геометрическими размерами и конечным значением собственной энергии и, следовательно, - конечным значением пространственной плотности энергии. При переходе от фракталов меньшего иерархического уровня (ядерных) к большим (гравитационным) наблюдается инфляция пространства и пространственной плотности энергии. Гипотеза о фрактальной структуре Вселенной допускает отсутствие в ней темной энергии. Кажущийся эффект ее наличия в электромагнитном фрактале Вселенной объясняется его конечными геометрическими размерами, сферической формой и наличием вращательного движения этой сферы по крайней мере вокруг одной из осей.*

*Ключевые слова: фрактал, структура, Вселенная, расширение, вращение, пространство, темная энергия, темная материя, константа Хаббла, константы Планка, универсальные пропорции Планка.*

### Introduction

Consider some modern ideas about the structure of the Universe. Professor Martin Rees (Institute of Astronomy, University of Cambridge) argues that the Universe has a cellular structure, each such cell in the trillions of times smaller than an atom [1,2,3].

Professor Michael Longo (University of Michigan in Ann Arbor), having studied [4,5] in the framework of Sloan Digital Sky Survey (SDSS) database project SDSS DR5, which contains about 40,000 galaxies (of them - more than 15,000 spiral galaxies), for which the value of redshift  $z < 0,04$ , came to the conclusion that left twisted spiral galaxies is much larger than spiral galaxies swirling right. Conclusions of professor Michael Longo confirmed a group of scientists led by Professor Lior Shamir (Lawrence Technological University) [6]. Was investigated about 250 thousand spiral galaxies, for which the value of redshift  $z < 0,3$ . Professor Lior Shamir also found that galaxies left more than right. Symmetry breaking between the right- and left - twisted spiral galaxies is about seven percent, but the probability that is a cosmic accident is very low - claims Professor Michael Longo. The results of research professors Michael Longo and Lior Shamir contradict the notion that the Universe is homogeneous and symmetric. Scientists believe that the asymmetry of the Universe emerged in the Big Bang at the expense of the initial rotation of the Universe space counterclockwise.

This means, firstly, that the space of the Universe could have existed before the Big Bang, and secondly, as claims Professor Michael Longo universe revolves now. The rotation of the space of the universe is also supported by research Professors S.-C. Su and M.-C. Chu (Department of Physics and Institute of Theoretical Physics, The Chinese University of Hong Kong, Shatin, Hong Kong, China) [7].

In 2006, Professor Laura Mersini-Houghton (University of North Carolina at Chapel Hill), Richard Holman (Carnegie Mellon University) and Tomo Takahashi (Saga University), in joint papers [8,9], predicted the existence of anomalies relic microwave background of the Universe and suggested that the cause of these anomalies may be an impact on observable of the Universe other of the Universes, which are located close by.

On the possible impact on observable of the Universe other of the Universes expressed [10] Dr. Stephen M. Feeney (University College London), Dr. Matthew C. Johnson (Perimeter Institute for Theoretical Physics,

Waterloo, Ontario N2L 2Y5, Canada), Dr. Daniel J. Mortlock (California Institute of Technology, Pasadena), Dr. Hiranya V. (Astrophysics Group, Imperial College London) and Dr. Peiris (Institute of Astronomy and Kavli Institute for Cosmology, University of Cambridge).

Examining data on the microwave background of the Universe, which are obtained based on the results of seven years of observations WMAP, the researchers found four spots with abnormal values CMB, which scientists believe are the result of collisions (close approach) of the observable Universe and other Universes.

Professor Douglas Scott (University of British Columbia), investigating anomalies CMB [11,12] concluded that the observed Universe has a spherical shape.

Professor Roger Penrose (Oxford University) together with Professor Vahe Gurzadyan (Yerevan Physics Institute in Armenia) conducted a study of the cosmic background radiation anomalies [13]. Professors claim to have found evidence of the existence of the Universe before the Big Bang.

Proposes to consolidate all of the above findings of theoretical and experimental studies in one hypothesis - a fractal structure of the Universe.

The Universe is an infinite aggregate of spatial hierarchic fractals of a spherical shape. Spatial hierarchy of fractals means that the smaller by size (and by hierarchy) fractals lie within the greater fractals, i.e., fractals are nested within each other. A certain linear dimension of the space length makes the similarity basis of the Universe fractals. This dimension tends to zero, however our knowledge about Nature does not still allow us of making analysis with the use of the linear dimensions which are smaller than the Planck dimension  $l_p$  [18]:

$$l_p = 1.616199 \times 10^{-35} m.$$

Let us consider that the Planck dimension is the universal constant for the all level fractals of the Universe.

Therefore, the basis of the spatial fractal structure of the Universe is selected as follows:

- for vacuum - the Planck cube. Its volume equals:  $Q_p^c = 4.221672 \times 10^{-105} m^3$ ;
- for the space where a mass is - the Planck sphere. Its volume equals:  $Q_p^s = 1.768370 \times 10^{-104} m^3$ .

Let us consider the most accessible for observation electromagnetic fractal of the Universe – it is the observable Universe. We assume that it is shaped as a limited-size sphere. The sphere rotates in a single plane, as a minimum. Electromagnetic fractal of the Universe is located within the gravitational fractal of the Universe. In its turn electromagnetic fractal is senior in relation to the atomic and nuclear fractals.

The assumption that the sphere of the electromagnetic fractal of the Universe rotates makes useless the hypotheses about the expanding and accelerating Universe and dark energy. Really.

Any theory that is not confirmed by experience, or on the basis of which it is possible to make ambiguous judgments and conclusions, is a hypothesis. In terms of conclusions about the character and nature of the red shift from of distant objects of observable Universe, and depending on their speed from the Hubble constant, both hypotheses: expanding with an acceleration of the Universe and the rotating Universe [14] is equal. Their fundamental difference - in the choice of the reference system and the conditions of observation. The hypothesis of the existence of dark energy is incorrect due to incorrectly chosen frame of reference, and not properly defined the conditions of observation. Apologists for dark energy to repeat the mistakes that once made Archimedes and Ptolemy, and who chose the reference system with the Earth at the center of the Universe, and then Copernicus, who replaced in the reference frame the Earth to the Sun. Really. Solution of Einstein's equations of general relativity is carried out in the reference system, which is linked to the observable Universe, and which is declared as a global and absolute. In accordance with the choice of the reference system [14] of the observable Universe becomes the center of the whole Universe – Mega Universe. Further, by solving the equations of general relativity reference system actually breaks down into two parts: one of them - relatively immobile, and the second is removed rapidly from the first (if the chosen of reference system is global - the question is - where is removed?). The source of this accelerated movement of the second reference system is declared negative vacuum pressure (lambda constant in Einstein's equations of general relativity):  $-P\Delta V$ , where  $(-P)$  - is a negative vacuum pressure,  $\Delta V$  - this volume of space, increased under negative vacuum pressure. However, this formula is valid only for closed systems. That is, systems in which the vacuum pressure inside and outside are different, in other words in the formula  $-P\Delta V$  instinctively understood that the vacuum pressure in the observable Universe, and the vacuum pressure in the rest of the Universe, vary. This violates the requirement that the lambda - it is constant for the entire Universe. The observable Universe is not closed, it is limited. For a limited system to change the position of their boundaries (eg, extension), you must have a vacuum pressure differential  $\Delta P$ , that is, must:  $-\Delta P\Delta V$ . The differential vacuum pressure at the limited observable Universe means that the lambda - it is not a constant.

Conclusion: the negative vacuum pressure can not be the source of dark energy.

The hypothesis [14] of a rotating space of the observable Universe, i.e. her of electromagnetic of fractal of the Universe, is considered in a global of reference system, which is associated with Mega Universe – i.e. with her of gravitational of fractal of the Universe, and that includes the observable Universe as a part of it. Currently, the expansion of the observable Universe since the Big Bang is finished. The observable Universe is limited. Expansion of the observable Universe ended up at a time when its gravity factor (vacuum pressure) was equal gravity factor (vacuum pressure) the part of the Mega Universe in which is located the observable Universe. Equal gravity factors derived from the opposite hypothesis of a rotating Universe, which admitted the existence of dark energy force and the lack of rotation of the observable Universe space, and where it was found that the gravity factor observable

Universe has become equal to the acceleration of dark energy force, and actually gravity factor that part Mega Universe in which is located the observable Universe.

Conclusion: the assumption of the rotation of the observable Universe of space allows us to solve the question of the sources as dark energy and dark matter.

Further evidence of the lack of dark energy is the new law of physics [15]: "Universal Plank Proportions" (UPP), which establishes significant, sustained and repeated relations and connections between the three self-sufficient characteristics of any an object of the observable Universe (including itself), which is endowed with the mass, namely, the actual mass  $m$ , radius of curvature space  $S$ , a time delay  $t_{dm}$  signal light.

According to this law, in the observable Universe anybody having mass  $m$ , creates a gravitational field that curves the surrounding space with a radius of curvature  $S$  (actually  $S$  -is the length of a gravitational wave) and introducing into this space time delay  $t_{dm}$  in the dissemination of signal. Body characteristics  $m, S, t_{dm}$  interconnected universal proportions Planck:

$$m = \frac{m_p}{l_p} S; m = \frac{m_p}{t_p} t_{dm}; S = \frac{l_p}{t_p} t_{dm}; S = \frac{l_p}{m_p} m; t_{dm} = \frac{t_p}{l_p} S; t_{dm} = \frac{t_p}{m_p} m,$$

where  $l_p, m_p, t_p$  - is the Planck constant, respectively - length, mass and time.

Each body characteristics:  $m, S, t_{dm}$  separately from other uniquely determines him the energy parameters:

$$E = mc^2 = F_p S = h_e t_{dm},$$

where:  $h_e = \frac{E_p}{t_p}$  - is the quantum of Planck energy, where  $E_p$  - Planck energy:  $E_p = m_p c^2$ ;  $F_p$  - is the

Planck power:  $F_p = m_p a_p$ , where  $a_p$  - is Planck accelerating:  $a_p = \frac{l_p}{t_p^2}$ , and for two bodies with weight  $m_1$

and  $m_2$ , length of a gravitational wave  $S_1$  and  $S_2$ , the time delay  $t_{dm1}$  and  $t_{dm2}$  at a distance  $R$  from each other, the law of gravity is given by:

$$F = G \frac{m_1 m_2}{R^2} = F_p \frac{S_1 S_2}{R^2} = F_p c^2 \frac{t_{dm1} t_{dm2}}{R^2}.$$

where  $G$  - is the gravitational constant,  $c$  - is the speed of light in vacuum.

Before this law, we know only one characteristic of the object - its mass. On the basis of the law UPP openly and confirmed by experiments a new property of matter – its gravity-electromagnetic resonance (GER) [15,16]. It is known that today in astrophysics is not possible to accurately determine the mass of distant objects observable Universe, and using the law UPP and the GER we can accurately calculate their mass. It is sufficient to measure the frequency of the envelope of the radiation spectrum [16]. On the basis of the UPP and GER, we can create new sources of energy. The versatility, efficiency, stability and repeatability of Planck of proportions also lies in the fact that for the gravitational constant  $G$ , of constants of Planck:  $l_p, m_p, t_p$ , of the relevant characteristics of the observable Universe:  $R_{Ue}, M_{Ue}, T_{Ue}$ , as well as of the relevant characteristics of any her body:  $S, m, t_{dm}$  is true [17]:

$$G = \frac{l_p^3}{m_p t_p^2} = \frac{R_{Ue}^3}{M_{Ue} T_{Ue}^2} = \frac{S^3}{m t_{dm}^2} = 6.67408 \times 10^{-11} m^3 kg^{-1} s^{-2}.$$

On the basis of the Planck of proportions, we can also go to the geometrical system of units in physics, that additionally underscores their versatility.

Most dynamic physical processes have two basic states - steady state and transient state. In the steady state (when there is no movement of the masses with an acceleration when there is no merging of massive bodies) the gravitational field of the body, which has a mass, bends space around itself. This forms a kind of standing gravitational waves that are can be found only indirect methods, for example, based on gravitational-electromagnetic resonance. The LIGO experiment observed the process of transition, which occurred as a result of deformation of surrounding curved space formed to move in space gravitational wave. The parameters of curved space in steady state (standing gravitational waves) and the parameters of gravitational waves in the transition process to the same bodies are different.

As the fractal hierarchy grows, the Universe does expand but that expansion is fractal and stationary.

### 1. Evaluation of main spatial and energy parameters of the electromagnetic fractal of the Universe

The observable Universe is electromagnetic of fractal of the Universe. According to [18] National Institute of Standards and Technology (NIST) for 2015 constants  $G, c, l_p, m_p, t_p$  have the following meanings:

$$\left. \begin{aligned} G = 6.67408(31) \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}; c = 299792458 \text{ ms}^{-1}; l_p = 1.616229(38) \times 10^{-35} \text{ m}; \\ m_p = 2.176470(51) \times 10^{-8} \text{ kg}; t_p = 5.39116(13) \times 10^{-44} \text{ s}. \end{aligned} \right\} \quad (1)$$

According to Planck's mission [19] Hubble constant  $H$  is equal to:

$$H = 67.80 \pm 0.77 (\text{km}^1 \text{s}^{-1}) / \text{Mpc} \text{ or } H = 2.197248345 \times 10^{-18} \text{ s}^{-1}. \quad (2)$$

In [14,15,16,17] it is shown that the Gravity factor  $g_{Ue}$ , the radius  $R_{Ue}$  and mass  $M_{Ue}$  of the observable Universe can be represented as:

$$g_{Ue} = cH, \quad (3)$$

$$R_{Ue} = \frac{c}{H}, \quad (4)$$

$$M_{Ue} = \frac{g_{Ue} R_{Ue}^2}{G}, \quad (5)$$

or based on (4,5):

$$M_{Ue} = \frac{c^3}{HG}. \quad (6)$$

Expressions (3,4,6) shows that Gravity factor  $g_e$ , the radius  $R_{Ue}$  and mass  $M_{Ue}$  of the observable Universe depends only on the constants  $c$ ,  $H$  and  $G$ . Then, in view of their numerical values (1,2) quantitative estimates of Gravity factor  $g_e$ , the radius  $R_{Ue}$  and mass  $M_{Ue}$  of the observable Universe are equal to:

$$g_{Ue} = 6.57184822 \times 10^{-10} \text{ m}^1 \text{ s}^{-2}; R_{Ue} = 1.364399517 \times 10^{26} \text{ m}; M_{Ue} = 1.837348566 \times 10^{53} \text{ kg}. \quad (7)$$

According to [20] of the International Astronomical Union, a light year is equal to 9460730472580800m. Then  $R_{Ue}$  radius of the observable Universe is 14.42 billion light-years, which correlates with the experimental data [19]. From (4) it follows that the value of the inverse of the Hubble constant - this is a temporary  $T_{Ue}$  delay [15] of the observable Universe:

$$T_{Ue} = \frac{1}{H}, \quad (8)$$

or taking into (2) evaluation of  $T_{Ue}$  is:

$$T_{Ue} = 4.551469 \times 10^{17} \text{ s}. \quad (9)$$

Obviously,  $T_{Ue}$  - is the period of rotation of the sphere electromagnetic of the fractal of the Universe.

Evaluation of the volume  $Q_{Ue}$  of the sphere of the electromagnetic fractal of the Universe equals:

$$Q_{Ue} = \frac{4}{3} \pi R_{Ue}^3 = 1.06393 \times 10^{79} \text{ m}^3. \quad (10)$$

Evaluation of the spatial (volumetric) density  $\rho_{Ue}$  of the mass of the electromagnetic fractal of the Universe equals:

$$\rho_{Ue} = \frac{M_{Ue}}{Q_{Ue}} = 1.727 \times 10^{-26} \text{ kg}^1 \text{ m}^{-3}. \quad (11)$$

The Hubble constant value for 2010 [21] which was obtained on the basis of seven years measurements made by NASA (Wilkinson Microwave Anisotropy Probe -WMAP) in combination with other methods of measurement is equal to:  $70.4_{-1.4}^{+1.3}$  (km/s)/mpc. As WMAP reported, the Hubble constant value for 2012 equals:  $69.32 \pm 0.80$  (km/s)/mpc [22,23]. According to the observation data published by the Planck Mission of the European Space Agency in 2014, the Hubble constant value for 4 years (from 2009 to 2013) comprise:  $67.80 \pm 0.77$  (km/s)/mpc [19]. Based on this data it can be supposed that the Hubble constant scattering for various methods of measurement and by years can also be caused by precession of the rotating sphere of the electromagnetic fractal of the Universe in the plane being at any a small angle to the major rotation axis.

The main kinds of matter motion within the electromagnetic fractal of the Universe are:

1. Motion of matter along the rotation axis of the electromagnetic fractal of the Universe caused by the Big Bang. This motion is similar to the existing vision about motion of the matter after the Big Bang, however without space expansion.

2. Rotational motion of matter around one of the axis of the sphere of the electromagnetic fractal of the Universe.

3. Motion of matter caused by precession of the sphere of the electromagnetic fractal of the Universe.
4. Motion of matter caused by centrifugal forces in the rotating and precessing sphere of the electromagnetic fractal of the Universe (effect of a centrifuge with precession).
5. Motion of matter caused by the own gravitational interaction forces.
6. Motion of matter caused by dark matter.

All above motions are independent. After superposition of all kinds of motion the resultant vectors of total velocity of matter in each point of space in the sphere of the electromagnetic fractal of the Universe within the near field of view zone will have a chaotic distribution of directions and meanings of the absolute values. As the distance from the observation point (Earth) increases, the component of the total velocity vector conditioned by the rotating motion of the sphere of the electromagnetic fractal of the Universe will grow proportionate to the Hubble constant and the distance. From the distance of 5 billion light-years and more the contribution of this component will become prevailing, which is confirmed by the experimental Hubble law. The effect of the imaginary presence of dark energy is most pronounced at a distance of 5 billion light-years too.

## 2. Evaluation of main spatial and energy parameters of the nuclear and atomic fractals of the Universe

As hydrogen comprises more than 75 percent of the baryon mass of the electromagnetic fractal of the Universe [24,25], the hydrogen nucleus and atom were selected as the model. Correspondingly, the proton mass and radius are [18]:

$$m_{pr} = 1.672621777 \times 10^{-27} \text{ kg}; r_{pr} = 8.768 \times 10^{-16} \text{ m}.$$

The mass and radius of the nuclear fractal of the Universe equals:

$$M_{Un} = m_{pr} = 1.672621777 \times 10^{-27} \text{ kg}; R_{Un} = r_{pr} = 8.768 \times 10^{-16} \text{ m}. \quad (12)$$

Then the volume of the sphere of the nuclear fractal of the Universe equals:

$$Q_{Un} = 2,823516 \times 10^{-45} \text{ m}^3. \quad (13)$$

The volumetric density of the nuclear fractal of the Universe equals:

$$\rho_{Un} = 5.92389721 \times 10^{17} \text{ kg}^1 \text{ m}^{-3}. \quad (14)$$

The mass of the atomic fractal can be determined at a first approximation as the sum of masses of the proton  $m_{pr} = 1.672621777 \times 10^{-27} \text{ kg}$  and

of the electron  $m_e = 9.10938291 \times 10^{-31} \text{ kg}$  [18]:

$$M_{Ua} = m_{pr} + m_e = 1.673532715291 \times 10^{-27} \text{ kg}. \quad (15)$$

The radius of the sphere of the atomic fractal of the Universe  $R_{Ua}$  is the Bohr radius, [1] i.e.:

$$R_{Ua} = r_b = 5,2917721092 \times 10^{-11} \text{ m}. \quad (16)$$

The volume of the sphere of the atomic fractal of the Universe equals:

$$Q_{Ua} = 6.2071466797 \times 10^{-31} \text{ m}^3. \quad (17)$$

The volumetric density of the atomic fractal of the Universe equals:

$$\rho_{Ua} = 2.6961385023 \times 10^3 \text{ kg}^1 \text{ m}^{-3}. \quad (18)$$

Let us construct a graph (log-log plot) which reflects dependence between the volumetric (spatial) density of the mass of nuclear, atomic and electromagnetic fractals of the Universe and their volumes (Fig.1).

The analysis of the graph and numeric characteristics of the atomic fractal of the Universe leads to a conclusion that this fractal is transitional, boundary between two basic fractals of the Universe -electromagnetic and nuclear. It can also be assumed that there exists a transitional fractal between the electromagnetic and gravitational fractals of the Universe. Based on the analysis of the atomic fractal characteristics it can be assumed that the fractal structure of the Universe can not have well-defined transitions between the main fractals. That is, the transitions between the main fractals Universe is not clear, fuzzy and "smoky" (sfumato), and the spatial structure of the Universe is actually sfumato-fractal. It is obvious that evaluation of the radius (and volume) of the electromagnetic fractal of the universe - it is their bottom verge.

## 3. Evaluation of main spatial and energy parameters of the gravitational fractal of the Universe

As fractals are self-similar events, processes and spatial forms, then the geometrical dimensions of the gravitational fractal of the Universe can be evaluated after we find the spatial analogue coefficient which correlates the electromagnetic and gravitational fractals of the Universe. The spatial analogue coefficient linking the gravitational fractal of the Universe and its electromagnetic fractal is determined similar to Coulomb laws and the universal law of gravitation:

$$F_e = \frac{kq_1q_2}{r_{12}^2}; F_g = \frac{Gm_1m_2}{r_{12}^2}, \quad (19)$$

where  $k$  is the electrical constant,  $k = 8.854187817 \times 10^{-12} F^1 m^{-1}$  [18];

$G$  is the gravitational constant.  $G = 6.67408(31) \times 10^{-11} m^3 kg^1 s^{-2}$ .

Let:  $m_1 = m_2 = 1 kg$ , for the gravitational force:  $r_{12} = 1 m$ .

Based on the formulas (19):

$$F_g = G.$$

As it is known [18] the elementary charge value  $q_e$  equals:

$$q_e = 1.602176565 \times 10^{-19} K.$$

Let us find a distance at which the force created by two elementary charges equals the force created by two bodies of 1 kg mass each that are located at 1 m distance from each other.

Based on the formulas (19):

$$r_{12}^2 = \frac{kq_1q_2}{G} = 3.405600411 \times 10^{-39} m^2. \quad (20)$$

Hence:

$$r_{12} = 5.8357522317 \times 10^{-20} m. \quad (21)$$

The ratio  $\frac{1}{r_{12}}$  is assumed at a first approximation as similarity coefficient  $k_f$  between the gravitational and electromagnetic fractals of the Universe:

$$k_f = \frac{1}{r_{12}} = 1.713575149 \times 10^{19}. \quad (22)$$

Subsequently, the radius of the gravitational fractal of the Universe  $R_{Ug}$  equals:

$$R_{Ug} = R_{Ue} k_f = 2.303 \times 10^{45} m. \quad (23)$$

The volume of the gravitational fractal of the Universe  $Q_{Ug}$  equals:

$$Q_{Ug} = 5.117 \times 10^{136} m^3. \quad (24)$$

Define the upper and bottom border evaluation of the mass and evaluation of volumetric density mass of the gravitational of fractal of the Universe. The bottom border evaluation of the mass  $M_{Ug}^-$  and evaluation of volumetric density mass  $\rho_{Ug}^-$  of the gravitational of fractal of the Universe determined on the basis of the law [15] "Universal Plank Proportions":

$$M_{Ug}^- = m_p \frac{R_{Ug}}{l_p} = 3.101 \times 10^{72} kg; \rho_{Ug}^- = \frac{M_{Ug}^-}{Q_{Ug}} = 6.06 \times 10^{-65} kg^1 m^{-3}. \quad (25)$$

Define the upper border evaluation of the mass  $M_{Ug}^+$  and evaluation of volumetric density mass  $\rho_{Ug}^+$  of the gravitational of fractal of the Universe on the basis of fractal similarity logarithms volumetric density of the mass of nuclear, electromagnetic and gravitational fractals of the Universe. Let us construct a graph (log-log plot), which reflects dependence between the volumetric (spatial) density of the mass of nuclear and electromagnetic fractals of the Universe and their volumes (Fig.2), and extrapolate this graph to the common logarithm value of the volume of the gravitational fractal of the Universe.

It follows from the graph Fig. 2 that the value  $Lg(Q_{Ug}) = 136.7$  of the common logarithm of the volume of the gravitational fractal of the Universe corresponds to the volumetric density of the fractal mass in the log scale which equals  $Lg(\rho_{Ug}^+) = -46.68$ . Assuming this upper border evaluation of density, the upper border

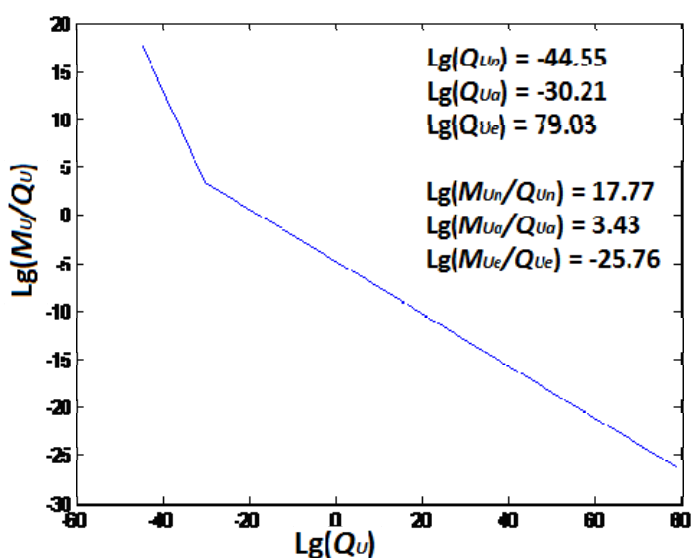


Fig. 1. Volumetric density mass of fractals of the Universe versus its volume for the nuclear, atomic and electromagnetic fractals of the Universe.

evaluation of mass  $M_{Ug}^+$  of the gravitational fractal of the Universe is:

$$M_{Ug}^+ = 7,943 \times 10^{89} \text{ kg} . \quad (26)$$

To evaluate the gravity factor (for upper border evaluation of mass  $M_{Ug}^+$ ) of the gravitational fractal of the Universe  $g_g$ , we apply its simplified model: let all mass of the fractal lies in the centre of its sphere and let the gravitational constant value is the same as for the electromagnetic fractal of the Universe, then (with formula 26):

$$g_g = \frac{GM_{Ug}^+}{R_{Ug}^2},$$

$$g_g = 1.0446 \times 10^{-11} m^1 s^{-2}. \quad (27)$$

The magnitudes of the gravity factor and volumetric density of the mass of gravitational of fractal of the Universe excludes the possibility for him to become a source of dark energy in the electromagnetic of fractal of the Universe.

Should the gravitational fractal of the Universe rotate, its period  $T_g$  can be determined by the formula of mathematical pendulum, then with formula (27):

$$T_g = 2\pi \sqrt{\frac{R_{Ug}}{g_g}},$$

$$T_g = 9.2246 \times 10^{28} \text{ s} . \quad (28)$$

There are fractals that are older than of the gravitational. Their scale factor is so big that we can not detect their presence by modern devices. If you assign serial numbers fractals (excluding transition fractals): nuclear - 1, electromagnetic - 2, gravitational - 3, ..., and take into account that the ratio of logarithms of the masses and the logarithms of the volume of fractals, and too the ratio of logarithms of masses and logarithms volumes junior and senior fractals is range of about 0.618 - the basis of the golden fractal, it can be assumed that the spatial and energy structure of the Universe is an algebraic multiplicative gold fractal, i.e. logarithms of masses and logarithms of volumes of fractals of the Universe are sequences of Fibonacci numbers . Then the fractal with the serial number 4, and older than the gravitational fractal, taking into account the upper estimate of its mass, is true:

$$Lg(Q_{U4}) = Lg(Q_{Ue}) + Lg(Q_{Ug}) = 79.03 + 136.7 = 215.73,$$

$$Lg(M_{U4}) = Lg(M_{Ue}) + Lg(M_{Ug}^+) = 53.26 + 89.9 = 143.16.$$

Proof of the fractal structure of the universe is also the fact that the fundamental constants are also algebraic structure of the gold fractal [17].

### Conclusion

In each fractal of the Universe there is a dominant kind of energy (force interaction) while the "traces" of any and all kinds of energy of other fractals are also present. The energy value of these "traces" decreases with the increase of the difference of fractal numbers and is inversely proportionate to the product of similarity of fractal coefficients by energy between the intermediate fractals.

According to the adopted hypothesis the Universe has a sfumato-fractal structure with spatial and energy characteristics which is based on multiplicative golden fractal. Inflation of space and of energy of the Universe is a stationary sfumato-fractal process that does not require an assumption concerning expansion of the Universe due to dark energy. There exists no dark energy. The effect interpreted as a presence of dark energy is created by a rotary motion of the electromagnetic fractal spherical space.

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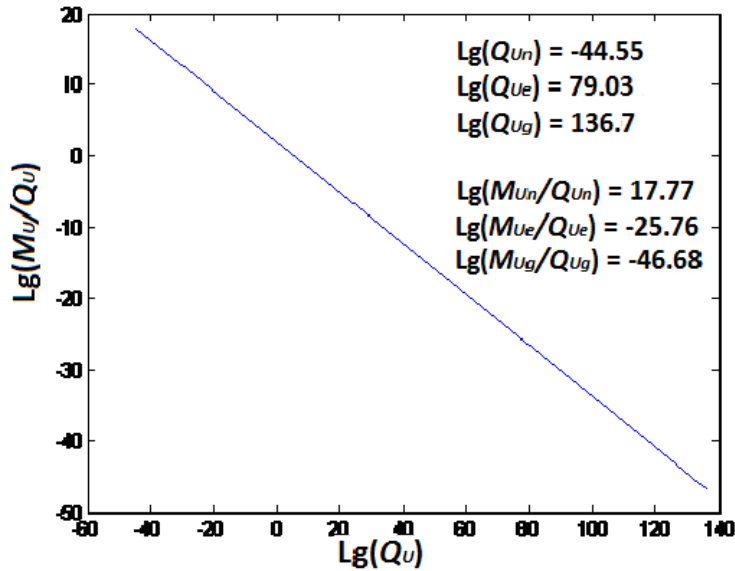


Fig. 2. Volumetric density mass of fractals of the Universe versus its volume for the nuclear, electromagnetic and gravitational fractals of the Universe.

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