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THE LAW OF BARYOGENESIS. SINGLE FRACTAL MECHANISM OF LEPTOSYNTHESIS, BARYOSYNTHESIS AND NUCLEOSYNTHESIS WITH PARTICIPATION OF ANTIMATTER.

Abstract. *This paper explores the fractal mechanism of baryosynthesis involving antiparticles. The remarkably perfected fractal mechanism of baryosynthesis demonstrates that only two types of particles (electrons and positrons) are sufficient for the formation of protons, neutrons, and all the visible matter in the Universe. The baryosynthesis mechanism reveals that matter and antimatter can not only annihilate but also coexist and interact, creating elementary particles. Matter and antimatter from themselves create leptons, protons, neutrons and the whole variety of substances. The fractal mechanism of baryogenesis involving antimatter is a universal mechanism, realized in the stages of leptosynthesis, baryosynthesis, and nucleosynthesis. The interaction and coexistence of matter and antimatter without annihilation are the primary conditions for baryosynthesis. It is shown that without antimatter, the formation and existence of matter in the Universe are impossible. The law of baryogenesis directly follows from the fractal mechanism of baryosynthesis. The law of baryogenesis unveils the mystery of the mass spectrum of elementary particles. The law of baryogenesis has enabled the derivation of essential dimensionless constants of elementary particles, such as 1836.15... (for the proton), 1838.68... (for the neutron), 206.76... (for the muon), 3670.48... (for the deuteron), 3477.2 (for the tau-meson), 5496.92... (for the triton), 5495.88... (for the helium nucleus). These fundamental constants have not been obtained within the framework of the standard model. A new constant, the mass defect of elementary particles, has been introduced for elementary particles. This new constant is a key constant in unraveling the mechanism of strong interaction.*

Keywords: *law of baryogenesis, antimatter inside the proton, fractals of elementary particles, origin of muon, proton, and neutron mass, mass defect, electron, positron, positronium, dimuonium, true tauonium, kaonium, protonium, electron-positron catalysis, catalytic baryogenesis, baryon asymmetry, Mersenne numbers.*

1. Introduction

Antimatter - enigmatic antiparticles that captivate the imaginations of scientists and science fiction enthusiasts alike. They are subjects of study in physics and objects of fascination in works of science fiction. Antiparticles are the exact opposite of ordinary matter particles. In the early stages of the Universe, there was complete symmetry between matter and antimatter. Where is antimatter now in the Universe? Numerous hypotheses have been proposed regarding this. In some hypotheses, antimatter is relegated to the outskirts of the Universe. Can antimatter exist very close - within particles like protons and neutrons? This article provides an answer to this question. It is shown in this article that the actual behavior of antiparticles, their place, and role in the origin of the Universe's matter are so unusual and paradoxical that it may be perceived as a science fiction plot. It comes close to the fantastic conclusion that all the matter around us, including ourselves, is composed partly of antimatter. There is no annihilation. Antimatter participates in the formation of substance on an equal

footing with matter. Without antimatter, the existence of protons and neutrons would be impossible. Understanding the role and place of antimatter in the mechanism of baryosynthesis leads to the law of baryogenesis. The law of baryogenesis is a fundamental law of nature. It is the unified law of matter and antimatter synthesis in the Universe. The law of baryogenesis solves the problem of the mass spectrum of elementary particles. The law of baryogenesis reveals the secrets of the fundamental constants of elementary particles. The law of baryogenesis allows us to unveil the mechanism of strong interaction.

2. Antiparticles and particles not only annihilate; they also participate in reactions for elementary particle synthesis.

The concept that particles and antiparticles cannot coexist is erroneous in the matter-antimatter problem. The concept of annihilation between matter and antimatter unduly dominates in physics. Here, we propose the concept of elementary particle synthesis involving antimatter. We demonstrate that the synthesis of elementary particles is impossible without the participation of antimatter. The participation of antimatter in elementary particle synthesis is a fundamental property of antimatter, supported by experimental evidence. The discovery of positronium [1] was the first precursor to the reality of matter and antimatter coexisting. The cross-section for positronium formation is 50 times greater than annihilation, resulting in a bound state - positronium - before annihilation. This is the first step toward the baryosynthesis reaction involving antimatter. The lifetime of positronium is 0.1244 ns and 138.6 ns, significant time intervals for micro-world processes. During this time, an additional electron or positron can attach to positronium, forming positronium ions. The formation of positronium ions constitutes the second step in the baryosynthesis reaction involving antimatter. Furthermore, positronium atoms can combine to form positronium molecules, confirming the coexistence of matter and antimatter. For both matter and antimatter, synthesis is the natural process, not annihilation.

Historically, the existence of positronium ions and molecular positronium was predicted by Wheeler in 1946 [2]. In 1981, Allen Mills obtained negative positronium ions consisting of two electrons and one positron [3]. In 2007, molecular positronium was experimentally observed [4 - 6]. Since then, the nature of positronium ions has been actively studied [7 - 9].

In addition to positronium, other composite particle-antiparticle systems have been created, such as pion-antipion (pionium) and proton-antiproton (protonium) systems [10 - 12].

The existence of the aforementioned composite particle-antiparticle systems prompts the search for other systems composed of matter and antimatter, including the muon-antimuon system (dimuonium) [13], the true tauonium system [14], and the kaon-antikaon system (kaonium) [15]. As we can see, particle-antiparticle annihilation is not the only outcome when matter and antimatter interact. This article emphasizes the synthesis of elementary particles and demonstrates that without antimatter, the formation of matter in the universe is impossible.

3. Fractal Mechanism of Baryogenesis Involving Antimatter.

After the publication of Mandelbrot's book [16], it became clear that fractals could be of interest for modeling physical processes. Fractals have become a tool in the study of hadron structure

[17 - 21]. Antimatter inside the proton no longer seems exotic but becomes a subject of study on par with matter [22].

In [23 - 27], fractals of the proton and deuteron are presented, and a fractal mechanism of elementary particle synthesis is proposed. A fractal (topological) formula for the proton has been derived, and for the first time, the mass defect of elementary particles was calculated [17, 18, 26]. It is demonstrated that fractals of elementary particles serve as successful models for depicting the participation of particles and antiparticles in synthesis reactions. Antimatter and matter are represented in fractals as equal participants in the synthesis of elementary particles. Fractals of the muon and neutron are presented in [27], showing that not only the proton and deuteron are formed with the involvement of antimatter but also the synthesis of the muon and neutron occurs through a fractal mechanism.

The fractal formula for a neutral particle is given as [26, 27]:

$$P = 2(2(...2(2(2+1)+1)+1)+...+1) \qquad (1)$$

The fractal formula for a particle with an electric charge is given as [26, 27]:

$$P = 2(2(...2(2(2+1)+1)+1)+...+1)+1 \qquad (2)$$

The foundation of the fractal formula is based on a construction of the form (2+1). The sequence of stages in the structural formation of elementary particles reflects a block of fractal formulas. The block of fractal formulas is represented by a fractal triangle [26, 27] (Fig. 1).

2,
2+1,
2(2+1),
2(2+1)+1,
2(2(2+1)+1),
2(2(2+1)+1)+1,
2(2(2(2+1)+1)+1),
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2(2(2(2(2+1)+1)+1)+1),
2(2(2(2(2+1)+1)+1)+1)+1,
2(2(2(2(2(2+1)+1)+1)+1)+1),
… ,
2(2(…2(2(2(2+1)+1)+1)+1)+…+1)+1 = M_j

Figure 1. The fractal triangle represents the stages of structural formation of elementary particles.

The block of fractal formulas for an elementary particle (fractal triangle) illustrates the mechanism of elementary particle synthesis. It displays the sequence of stages in particle formation. The fractal triangle defines the magic numbers Mj of particles participating in structural formation. The magic numbers Mj are part of the formula for the baryogenesis law. Figure 2 shows fractals of the muon, proton, and deuteron, along with their fractal formulas and fractal triangles [17, 18, 26, 27].

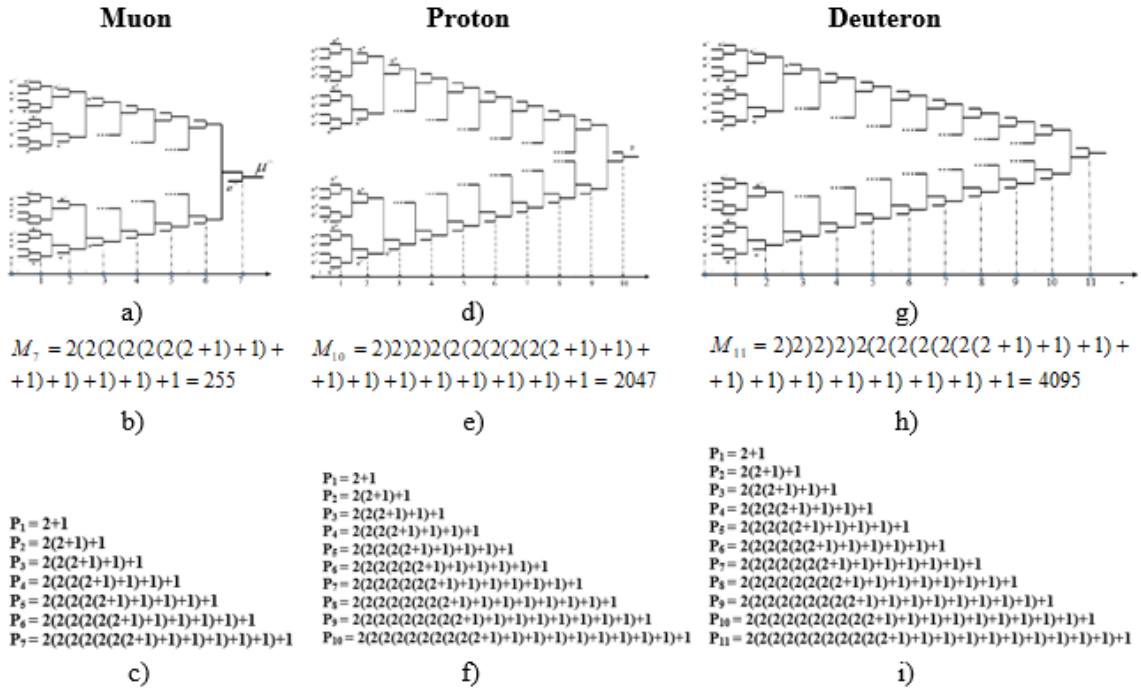


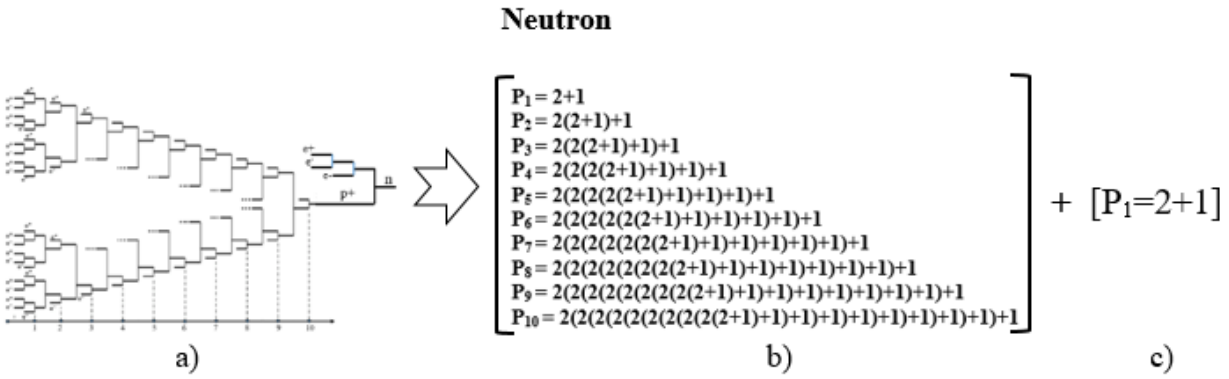
Figure 2. Fractal of the muon (a), magic number of the muon (b), block of fractal formulas related to the muon (c), fractal of the proton (d), magic number of the proton (e), block of fractal formulas related to the proton (f), fractal of the deuteron (g), magic number of the deuteron (h), block of fractal formulas related to the deuteron (i).

The muon is formed with the participation of 128 electrons and 127 positrons. The block of fractal formulas related to the muon consists of fractal formulas of intermediate elementary particles preceding the muon. The last fractal formula in the fractal triangle defines the value of the muon's magic number.

The proton is formed with the participation of 1023 electrons and 1024 positrons. The block of fractal formulas related to the proton consists of fractal formulas of intermediate elementary particles preceding the proton. The last fractal formula in the fractal triangle defines the value of the proton's magic number.

The deuteron is formed with the participation of 2047 electrons and 2048 positrons. The block of fractal formulas related to the deuteron consists of fractal formulas of intermediate elementary particles preceding the deuteron. The last fractal formula in the fractal triangle defines the value of the deuteron's magic number.

Figure 3 shows the fractal of the neutron, its combined fractal triangle, and the combined fractal formula of the neutron.



$$M_n = [2)2)2)2(2(2(2(2(2(2(2+1)+1)+1)+1)+1)+1)+1)+1)+1)+1] + [P_1 = 2+1] = 2050$$

d)

Figure 3. Fractal of the neutron (a), block of fractal formulas related to the neutron (b), fractal formula of particle P1 (c), fractal formula of the neutron (d).

The fractal of the neutron is a combined fractal. It includes the fractal of the proton and the elementary cell of fractal P1. The neutron is formed with the participation of 1025 electrons and 1025 positrons.

From the examples of the muon, proton, deuteron, and neutron fractals, it can be seen that particles are formed in different ways:

1. Some particles are formed through the replication and doubling of the mass of intermediate particles and antiparticles through the fractal mechanism.

2. Other particles are formed through the combination of particles and antiparticles formed through the fractal mechanism.

The elucidation of the fractal mechanism of baryogenesis has made it possible to obtain crucial dimensionless constants for the proton (1836.15...), deuteron (3670.48...), muon (206.76...), and neutron (1838.68...) [17, 25, 26, 27]. These constants were not obtained within the framework of the standard model. The fractal mechanism of baryogenesis and the new constants of elementary particles allow for a generalization and formulation of the fundamental law of baryogenesis.

4. The Law of Baryogenesis.

The Law of Baryogenesis is formulated as follows (Fig. 4):

$$m_j = M_j \bullet m_e - \Delta m_j$$

Figure 4. The Law of Baryogenesis. Mj - the magic number of an elementary particle, mj - the mass of an elementary particle, me - the mass of an electron, Δm - the mass defect of an elementary particle.

The formulation of the Law of Baryogenesis is as follows: *"The mass of an elementary particle is equal to the sum of the masses of electrons and positrons participating in baryosynthesis, reduced*

by the mass defect." The Law of Baryogenesis reflects the mechanism of the formation of the masses of elementary particles and directly follows from the fractal mechanism of baryogenesis.

To derive the Law of Baryogenesis, the concept of mass defect was introduced for elementary particles. Fractals of the proton and deuteron were discovered [17, 18, 26]. It was found that only two types of particles, electrons and positrons, are sufficient to form the masses of the proton and neutron. Antimatter (positrons) and matter (electrons) play equal roles in the mechanism of baryogenesis.

The Law of Baryogenesis allowed for unraveling the mystery of the constant mp/me = 1836.152... and discovering a new constant, the mass defect of the proton (107.7427... MeV) [17, 18, 25, 26]. The binding energy of the proton is determined by the mass defect of particles and antiparticles participating in the formation of the proton's mass. The mass defects of elementary particles are their key constants. These constants of elementary particles lead to a new method for calculating the strong interaction coupling constant. For the first time, it becomes possible to directly calculate the strong interaction coupling constant from the Law of Baryogenesis.

5. Magic Numbers of Elementary Particles.

The formula of the Law of Baryogenesis includes a magic number. The magic numbers Mj are new constants of elementary particles. The Law of Baryogenesis shows that the mass of an elementary particle is determined by the quantity of matter and antimatter particles participating in baryosynthesis, along with the magnitude of the mass defect Δm. The magic numbers Mj indicate how many electrons and positrons were involved in the formation of the corresponding particle or antiparticle.

As an example, in Figure 5, formulas for calculating the magic numbers of the muon (3), proton (4), deuteron (5), and neutron (6) are presented:

$$M_7 = 2(2(2(2(2(2(2+1)+1)+1)+1)+1)+1)+1 = 255 \quad (3)$$

$$M_{10} = 2)2)2)2(2(2(2(2(2(2+1)+1)+1)+1)+1)+1)+1)+1)+1 = 2047 \quad (4)$$

$$M_{11} = 2)2)2)2)2(2(2(2(2(2(2+1)+1)+1)+1)+1)+1)+1)+1)+1)+1 = 4095 \quad (5)$$

$$M_n = [2)2)2)2(2(2(2(2(2(2+1)+1)+1)+1)+1)+1)+1)+1)+1)+1] + [P_1 = 2+1] = 2050 \quad (6)$$

Figure 5. Formulas for calculating the magic numbers of the muon (3), proton (4), deuteron (5), and neutron (6).

The blocks of fractal formulas related to elementary particles (fractal triangles) generate a sequence of magic numbers. For the muon, the sequence of magic numbers is shown in Figure 6:

$$M = 1, 1, 2, 3, 6, 7, 14, 15, 30, 31, 62, 63, 126, 127, 254, 255$$

Figure 6. Sequence of magic numbers of the muon.

For the proton, the sequence of magic numbers is shown in Figure 7:

M = 1, 1, 2, 3, 6, 7, 14, 15, 30, 31, 62, 63, 126, 127, 254, 255, 510, 511, 1022, 1023, 2046, 2047

Figure 7. Sequence of magic numbers of the proton.

The sequence of magic numbers of elementary particles is a combination of two sequences. One of the sequences is the Mersenne numbers [28]:

1, 3, 7, 15, 31, 63, 127, 255, 511, 1023, 2047. (7)

The second sequence of magic numbers consists of doubled Mersenne numbers:

0, 2, 6, 14, 30, 62, 126, 254, 510, 1022, 2046. (8)

The magic numbers of electrically charged elementary particles are Mersenne numbers, while the magic numbers of neutral elementary particles are doubled Mersenne numbers.

6. Mass Defect of Elementary Particles as a Result of Matter-Antimatter Interaction.

The formula of the Law of Baryogenesis includes the mass defect Δm_j. The mass defect is a new constant of elementary particles, and its value quantifies the binding energy of elementary particles. The mass defect arises from the interaction of matter and antimatter during the formation of an elementary particle. This is a consequence of a synthesis reaction in which both antiparticles and particles participate. At each step and stage of baryogenesis, new particles or antiparticles are synthesized from electrons and positrons. As a result, the mass of the new elementary particle is less than the sum of the masses of the particles and antiparticles involved in the synthesis.

The value of the mass defect constant is determined from the fractal of the elementary particle. The mass defect of an elementary particle consists of the mass defects of intermediate particles and antiparticles on the path of synthesizing a specific elementary particle. In [26, 27], a formula for calculating the mass defect constant is presented as follows:

$$\Delta m_j = m_e \bullet \sum_{i=1}^{L_j} (2^i - 1) \bullet (1 - k_s^{9-i}) \qquad (9)$$

Where: m_e - the mass of the electron, Δm_j - the mass defect of the elementary particle, k_s - a constant that determines the mass defect, L_j - follows from the relationship: $M_j = 2^{L_j} - 1$.

The construction of the formula for calculating the mass defect constant reflects the topological features of the fractal of the elementary particle. The quantity L_j represents the number of stages in the structural development of the elementary particle. The dimensionless constant k_s contains the fine-structure constant α (1/137). The idea that the fine-structure constant α (1/137) is somehow related to the nuclear mass defect was first proposed by the Chicago physicist Arthur Lund in 1922 [29].

In quantum electrodynamics, for large distances (> 10^{-15} m), the constant 1/137 is used. For small distances, constants 1/133 and 1/129 are used [30 - 36]. The choice of the constant depends on the scale of distances at which the interaction occurs and the energy of the process. The theories involve three values of the electromagnetic interaction constant: 1/137, 1/133, and 1/129 [30 - 36].

Values of the constants 1/133 and 1/129 are desirable to be known with accuracy close to the precision of the fine-structure constant α . In [34] and [35], values of 1/133.29 and 1/133.472±0.007 for the constant 1/133 were proposed. We use more accurate values of the constants 1/133 and 1/129 based on the assumption that these constants are related to the number π [23, 24, 27]:

$$\sqrt[20]{\pi \bullet 10^{-43}} = \frac{1}{133.395907639...}, \qquad (10)$$

$$\frac{\alpha}{\sqrt[10]{\pi \bullet 10^{-43}}} = 129.85250805... \qquad (11)$$

The correctness of determining the values of the constants 133.395907639... and 129.85250805... is confirmed by their application in the Law of Baryogenesis, which allows for obtaining fundamental constants with high accuracy: 1836.15... for the proton, 1838.68... for the neutron, 206.76... for the muon, 3670.48... for the deuteron, and the value of the Dirac large number D_0 = 4.16561... x 10^{42} [23 - 27]. The quantitative measure of the mass defect when transitioning to higher energy scales is provided by two ratios of the constants: k_{s1} = 133/137 = 0.973436969 and k_{s2} = 129/137 = 0.947579533. The equivalent formulas for calculating the constants k_{s1} and k_{s2} are as follows:

$$k_{s1} = \frac{133.395907639...}{137.03599908...} = \sqrt[10]{D_0} \bullet \alpha^2 = \frac{\alpha}{\sqrt[20]{\pi \bullet 10^{-43}}} = 0.973436969 \quad (12)$$

$$k_{s2} = \frac{129.85250805}{137.03599908...} = (\sqrt[10]{D_0} \bullet \alpha^2)^2 = \frac{\alpha^2}{\sqrt[10]{\pi \bullet 10^{-43}}} = 0.947579533 \quad (13)$$

Where: α - the fine-structure constant, D_0 - the Dirac large number (D_0 = 4.16561... x 10^{42}).

Thus, each magic number is associated with two values of the mass defect. The first value is determined by the parameter k_{s1} = 0.9734369693, while the second value is determined by the parameter k_{s2} = 0.947579533:

$$\Delta m_{j1} = m_e \bullet \sum_{i=1}^{L_k} (2^i - 1) \bullet (1 - k_{s1}^{9-i}) \qquad (14)$$

$$\Delta m_{j2} = m_e \bullet \sum_{i=1}^{L_j} (2^i - 1) \bullet (1 - k_{s2}^{9-i}) \qquad (15)$$

The constant k_{s1} in formula (14) allows for obtaining the mass defect value for "heavy" particles, while the constant k_{s2} in formula (15) allows for obtaining the mass defect value for "light" particles. Both particles are formed using a unified fractal algorithm. The mechanism of forming light and heavy particles is the same. Fractal (topological) formulas for light and heavy particles are also the same. Therefore, the magic numbers for "light" and "heavy" particles are identical. The only difference lies in the involvement of different modifications of positronium in the fractal mechanism of baryosynthesis. The origins of the formation of "light" and "heavy" particles can be traced back to two modifications of positronium (parapositronium, orthopositronium).

Below, we will demonstrate that the fractal mechanism of baryogenesis involving antimatter is a universal mechanism for synthesizing elementary particles. It occurs in the stages of leptosynthesis, baryosynthesis, and nucleosynthesis. We will show that the Law of Baryogenesis applies not only to the muon, proton, and neutron but also to other elementary particles. The universal nature of the Law of Baryogenesis will be demonstrated through examples of the synthesis of π^- - mesons, kaons, tau-leptons, tritons, and helium nuclei.

7. Fractal of the π^- - meson.

The fractal π^- - meson is a composite fractal. It includes the fractal μ^- - meson, fractal antiparticle P_5^+, and fractal particle P_3^-. The fractal π^- - meson appears as follows (Fig. 8):

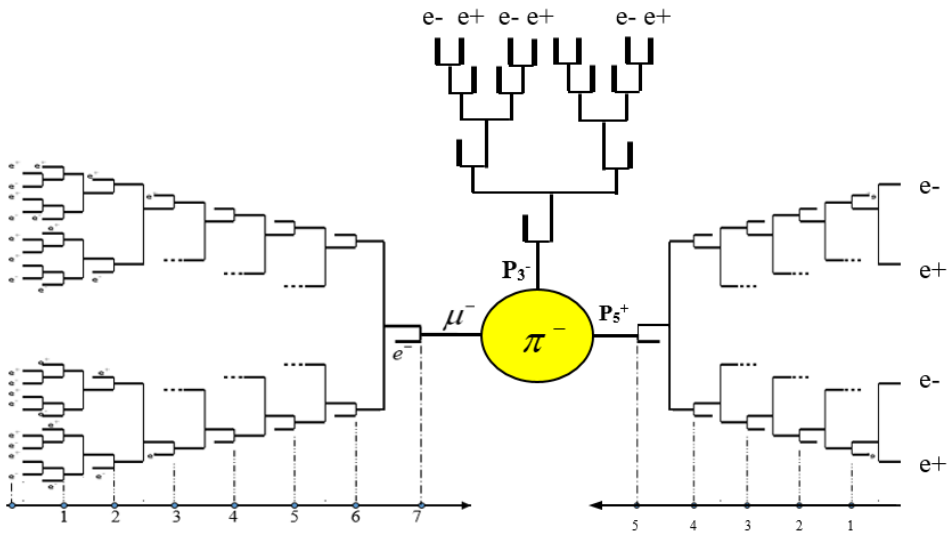


Fig. 8. Fractal of the π^- - meson.

8. Calculated mass value of the π^- -meson from the baryogenesis law.

Let's determine the mass value that should be obtained from the fractal π^- - meson and the baryogenesis law. We will compare the calculated mass value with the experimental mass value of the π^- -meson. The calculated mass value of the π^- -meson will be derived from the baryogenesis law applied to the fractal π^- - meson:

$$m_\pi = M_\pi \bullet m_e - \Delta m_\pi \qquad (16)$$

The fractal formula for the π^- -meson yields the following value for its magic number:

$$M = P_7 + P_5 + P_3 = 255 + 63 + 15 = 333$$

From the fractal π^- - meson and its fractal formula, it follows that the π^- -meson is formed with the participation of 167 electrons and 166 positrons. The experimental mass value of the π^- - meson is $273.132m_e$. The experimental mass value of the muon is $P_7 = 206.7682830m_e$. Values of the particle masses $P_5 = 56.5m_e$ and $P_3 = 13.4m_e$ are provided in [26]. The mass defect of the π^- -meson upon combining particles P_7, P_5, and P_3 is 3.5 m_e:

$$206.7682830m_e + 56.5m_e + 13.4m_e - 273.132m_e = 3.5\ m_e$$

The total mass defect of the π^- -meson over its entire synthesis path is the sum of mass defects at all stages of its structurogenesis. This sum includes:

1. Mass defect of particle P_3 at the lepto-synthesis stage (15 m_e - 13.4 m_e = 1.6 m_e) [26].

2. Mass defect of particle P_5 at the lepto-synthesis stage (63 m_e - 56.5 m_e = 6.5 m_e) [26].

3. Mass defect of the muon at the lepto-synthesis stage (255m_e - 206.7682830m_e = 48.231717m_e) [26, 27].

4. Mass defect of the π^--meson upon combining particles P_7, P_5, and P_3 (3.5 m_e).

The sum of these listed mass defects yields a value of 59.8m_e:

$$\Delta m_\pi = 1.6\ m_e + 6.5\ m_e + 48.231717\ \ m_e + 3.5\ \ m_e = 59.8\ m_e$$

From equation (16), we obtain the mass value of the π^--meson:

$$m_\pi = 333\ m_e - 59.0\ m_e = \ 273.2\ m_e$$

The obtained calculated mass value of the π^--meson (273.2m_e) is very close to its experimental value (273.132 m_e).

9. Fractal of the K^0 kaon.

The fractal of the K^0 kaon appears as follows (Fig. 9):

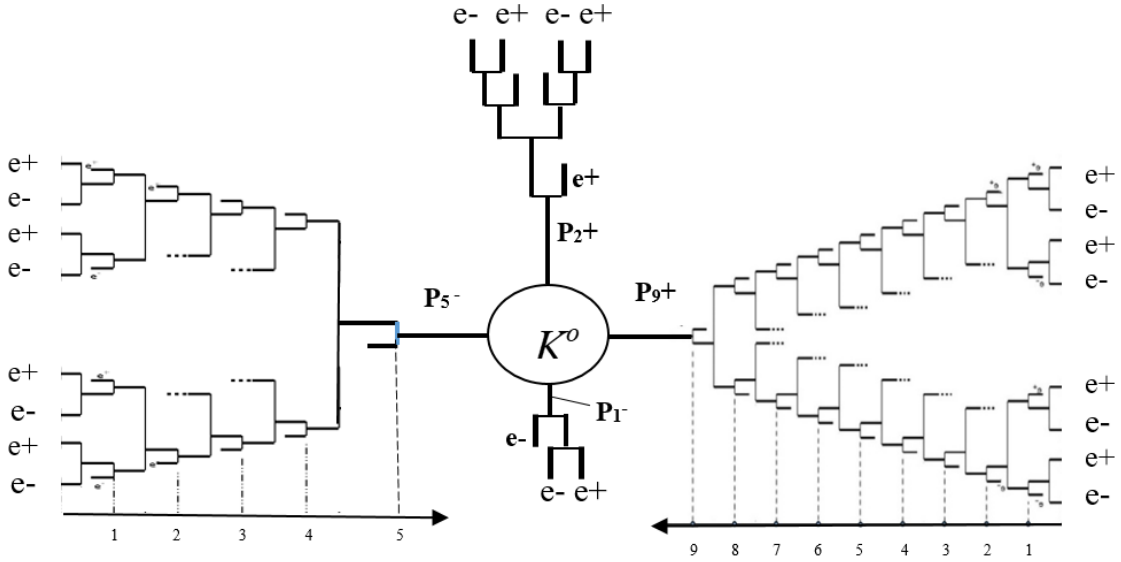


Fig. 9. Fractal of the K^0 kaon.

The K^0 kaon fractal is a composite fractal. It includes the fractal of particle P_1^-, fractal antiparticle P_2^+, fractal of particle P_5^-, and fractal antiparticle P_9^+.

10. Calculated mass value of the K^0 kaon from the baryogenesis law.

Let's determine the mass value that should be obtained from the K^0 kaon fractal and the baryogenesis law. The calculated mass value of the K^0 kaon will be derived from the baryogenesis law applied to the K^0 kaon fractal:

$$m_{K^0} = M_{K^0} \bullet m_e - \Delta m_{K^0} \qquad (17)$$

The fractal formula for the K0 kaon yields the following value for its magic number:

$M_{K^0} = P_1 + P_2 + P_5 + P_9 = 3 + 7 + 63 + 1023 = 1096$

From the K^0 kaon fractal and its fractal formula, it follows that the kaon is formed with the participation of 548 electrons and 548 positrons. The mass defect of the K^0 kaon upon combining particles P_1, P_2, P_5, and P_9 is 3.09 m_e [1-6]:

$$917.6\ m_e + 50.0\ m_e + 2.7\ m_e + 6.6\ m_e - 973.806 m_e = 3.09\ m_e$$

The total mass defect of the K^0 kaon over its entire synthesis path is the sum of mass defects at all stages of its structurogenesis. This sum includes:

1. Mass defect of particle P_1 at the lepto-synthesis stage (0.2594 m_e) [26].
2. Mass defect of particle P_2 at the lepto-synthesis stage (0.4 m_e) [26].
3. Mass defect of particle P_5 at the lepto-synthesis stage (14 m_e) [26].
4. Mass defect of particle P_9 at the lepto-synthesis stage (1023 m_e - 917.6 m_e = 105.4 m_e) [26].
5. Mass defect upon combining particles P_1, P_2, P_5, and P_9 (3.09 m_e).

The sum of these listed mass defects yields a value of 122.249 m_e:

$$\Delta m_{K^0} = (3 - 2.7406)\ m_e + 0.4\ m_e + 14\ m_e + 104.5 m_e + 3.09 m_e = 122.249\ m_e$$

From equation (17), we obtain the mass value of the K^0 kaon:

$$m_{k^0} = 1096\ m_e - 122.249\ m_e = 973.75\ m_e$$

The obtained calculated mass value of the K^0 kaon (973.75 m_e) is very close to its experimental value (973.806m_e).

11. Fractal of the K^- Kaon.

Fractal of the K^- Kaon appears as follows (Fig. 10):

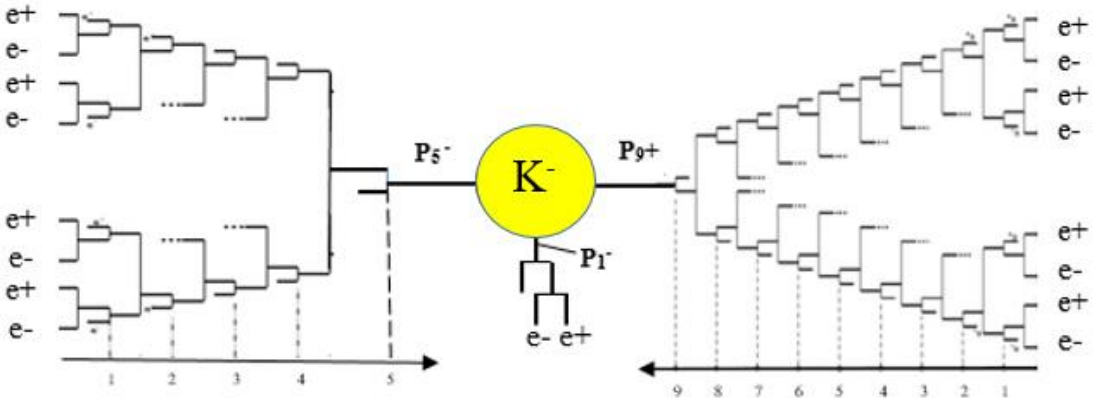


Fig. 10. Fractal of the K^- Kaon .

Fractal of the K^- Kaon is a composite fractal. It includes the P_1^- fractal, P_5^- fractal, and P_9^+ fractal.

12. Calculated mass value of the K^- kaon from the baryogenesis law.

Let's determine the mass value that should be obtained from the K^- kaon fractal and the baryogenesis law. The calculated mass value of the K^- kaon will be derived from the baryogenesis law applied to the K^- kaon fractal:

$$m_{K^-} = M_{K^-} \bullet m_e - \Delta m_{K^-} \qquad (18)$$

The fractal formula for the K^- kaon yields the following value for its magic number:

$$M_{K^-} = P_1 + P_5 + P_9 = 3 + 63 + 1023 = 1089$$

From the K^- kaon fractal and its fractal formula, it follows that the K^- kaon is formed with the participation of 545 electrons and 544 positrons. The mass defect of the K^- kaon upon combining particles P_1, P_5, and P_9 is 4.22 m_e:

$$917.6\ m_e + 50.0\ m_e + 2.7\ m_e - 966.082 m_e = 4.22\ m_e$$

The total mass defect of the K^- kaon over its entire synthesis path is the sum of mass defects at all stages of its structurogenesis. This sum includes:

1. Mass defect of particle P_1 at the lepto-synthesis stage (0.2594 m_e) [26].
2. Mass defect of particle P_5 at the lepto-synthesis stage (14 m_e) [26].
3. Mass defect of particle P_9 at the lepto-synthesis stage (1023 m_e - 917.6 m_e = 105.4 m_e) [26].
4. Mass defect upon combining particles P_1, P_5, and P_9 (4.22 m_e)

The sum of these listed mass defects yields a value of 123.879 m_e:

$$\Delta m_{K^-} = (3 - 2.7406)\, m_e + 14\, m_e + 104.5 m_e + 4.22 m_e = 123.879\, m_e$$

From equation (18), we obtain the mass value of the K^- kaon:

$$m_{K^-} = 1089\, m_e - 123.879\, m_e = 965.12\, m_e$$

The obtained calculated mass value of the K^- kaon (965.12 m_e) is very close to its experimental value (966.082m_e).

13. Fractal of the Tau-Lepton.

Fractal of the Tau-Lepton has the following form (Fig. 11):

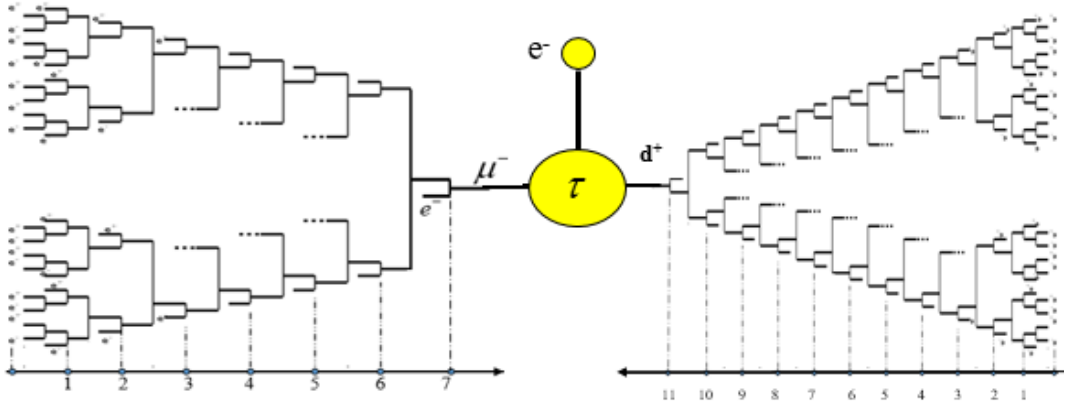


Fig. 11. Fractal of the Tau-Lepton.

Fractal of the Tau-Lepton is a composite fractal. It includes the fractal of the 'heavy' muon, the fractal of the 'light' deuteron, and an electron.

14. Calculated Mass Value of Tau-lepton from the Baryogenesis Law.

Let's determine the mass value that should be derived from the Fractal of the Tau-Lepton and the baryogenesis law. The calculated mass value will be obtained from the baryogenesis law applied to Fractal of Tau-Lepton:

$$m_\tau = M_\tau \bullet m_e - \Delta m_\tau \qquad (19)$$

The fractal formula for the tau-lepton gives the following value of its magic number:

$$M\tau = P_7 + P_{11} + e^- = 255 + 4095 + 1 = 4351$$

From the Fractal of Tau-Lepton and its fractal formula, it follows that the tau-lepton is formed with the participation of 2176 electrons and 2175 positrons. The mass defect of the tau-lepton when the muon, deuteron, and electron are combined is 3.8 m_e:

$$3251{,}4m_e + 228{,}7m_e + 1m_e - 3477.23m_e = 3{,}8m_e$$

The total mass defect of the tau-lepton along its entire synthesis path is equal to the sum of mass defects at all stages of its structure genesis. This sum includes:

1. Mass defect of the 'light' deuteron (4095 - 3251.4 = 843.6)m_e [26].
2. Mass defect of the 'heavy' muon (255 - 228.7 = 26.3)m_e [26].
3. Mass defect when combining particles P_7, P_{11}, and the electron (3.8m_e).

The sum of the listed mass defects gives a value of 873.77m_e:

$$\Delta m_\tau = 843.6\, m_e + 26.3\, m_e + 3.8 m_e = 873.7\, m_e$$

From equation (19), we obtain the mass value of the tau-lepton:

$$m_\tau = 4351\ m_e - 873.7\ m_e = \ 3477\ .3\ m_e$$

The obtained calculated mass value of the tau-lepton (3477,3m_e) is very close to its experimental value (3477.23 m_e).

15. Fractal of the Triton.

The triton consists of two neutrons and one proton. Fractal of the triton has the following form (Fig. 12):

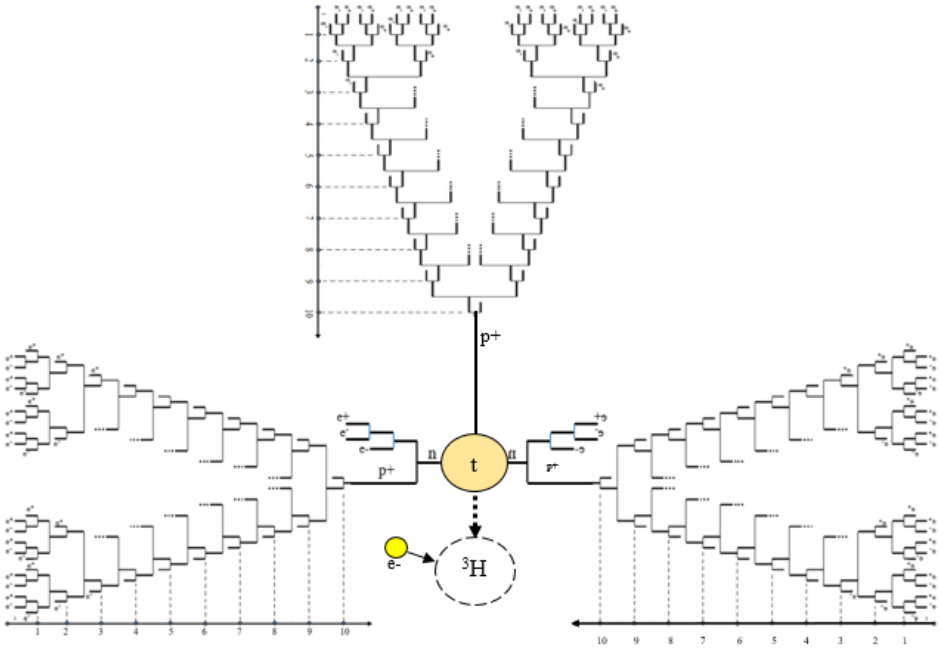


Fig. 12. Fractal of the triton.

Fractal of the triton is a composite fractal. It includes the fractal of proton and two fractals of neutron. The fractals of neutron, in turn, includes the fractal of proton and the particle P_1 fractal.

16. Calculated Mass Value of Triton from the Baryogenesis Law.

Let's determine the mass value that should be derived from the fractal of triton and the baryogenesis law. The calculated mass value of the triton will be obtained from the baryogenesis law applied to the fractal of triton:

$$m_t = M_t \bullet m_e - \Delta m_t \quad (20)$$

The fractal formula for the triton gives the following value of its magic number:

$M_t = P_{10} + 2P_n = 3P_{10} + 2P_1 = 3 \times 2047 + 2 \times 3 = 6147$

From the fractal of triton and its fractal formula, it follows that the triton is formed with the participation of 3073 electrons and 3074 positrons. The excess of one positron gives the triton a positive charge. The attachment of a free electron to the triton leads to the formation of tritium (Fig. 12).

The nuclear mass defect of the triton is 16.59846116 m_e:

1836.152 673 43 m_e + 2 x 1838.683 661 73 m_e - 5496.921 535 73m_e = 16,59846116m_e

The total mass defect of the triton along its entire synthesis path is equal to the sum of mass defects at all stages of its structure genesis. This sum includes:

1. Mass defect of particle P1 at the leptosynthesis stage (0.2594 m_e) [26].
2. Mass defect of the proton at the baryosynthesis stage (2047 m_e - 1836.15267343 m_e) [26].
3. Mass defect when combining particle P_1 with a proton (0.216461 m_e) at the baryosynthesis stage (formation of a neutron) [26].

Nuclear mass defect of the triton (16.59846116 m_e) at the nucleosynthesis stage. The sum of the listed mass defects gives a value of 650.0921 m_e:

$$\Delta m_t = 3 \bullet (2047 - 1836.15267343) m_e + 2 \bullet (3 - 2.7406) m_e + 2 \bullet 0.216461 m_e + \\ + 16.59846116 m_e = 650.0921 m_e$$

From equation (20), we obtain the mass value of the triton:

$$m_t = 6147\ m_e - 650.0921 m_e = 5\ 496.9079 m_e$$

The obtained calculated mass value of the triton (5496.9079 m_e) is very close to its experimental value (5496.92153573 m_e)."

17. Fractal of the helion

Fractal of the helion has the following form (Fig. 13):

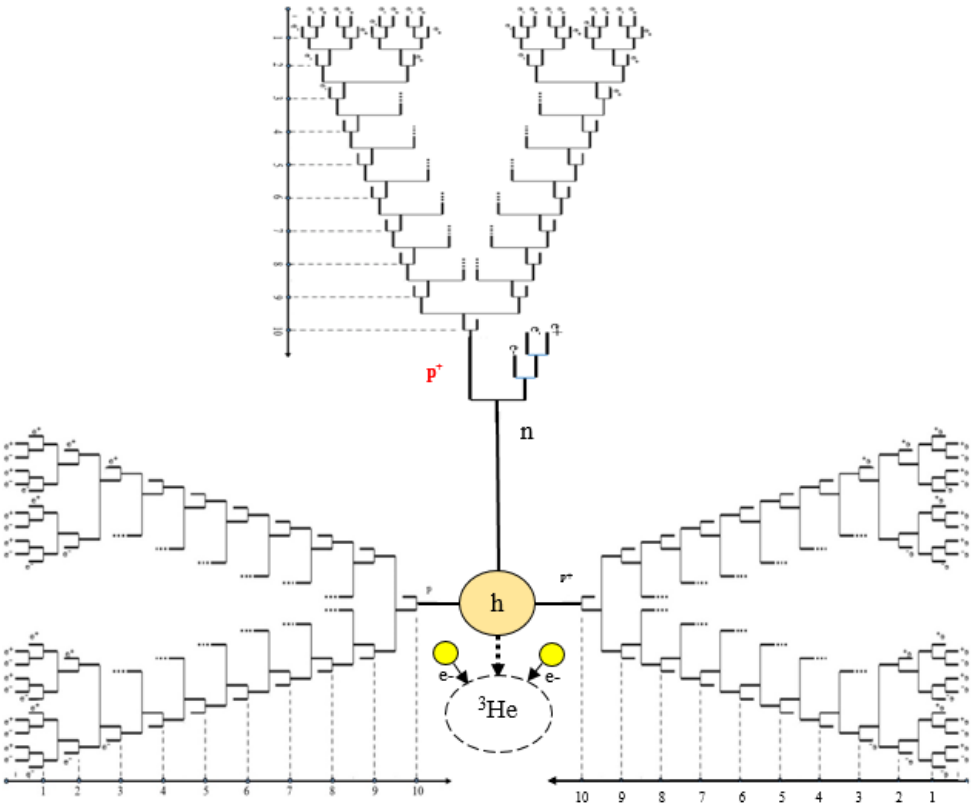


Fig. 13. Fractal of the helion.

Fractal of the helion is a composite fractal. It includes a neutron fractal and two proton fractals.

18. Calculated helion Mass Value from the Baryogenesis Law.

Let's determine what mass value should be derived from the helion fractal and the baryogenesis law. The calculated mass value will be obtained from the baryogenesis law applied to the helion fractal:

$$m_h = M_h \bullet m_e - \Delta m_h \qquad (21)$$

The fractal formula for helion yields the following value of the magic number:

$M_h = 2P_{10} + P_n = 3P_{10} + P_1 = 3 \text{ x } 2047 + 3 = 2 \text{ x } 2047 + 2050 = 6144$

From the helion fractal and its fractal formula, it follows that helion is formed with the participation of 3071 electrons and 3073 positrons. The nuclear mass defect of helion is equal to 15.10372852 me:

$2 \text{ x } 1836.152\,673\,43\ m_e + 1838.683\,661\,73\ m_e - 5495.885\,280\,07\ m_e = 15{,}10372852\ m_e$

The total mass defect of helion along its entire synthesis path is equal to the sum of mass defects at all stages of its structure genesis. This sum includes:

1. Mass defect of particle P1 at the leptosynthesis stage (0.2594 m_e) [26].
2. Mass defect of protons at the baryosynthesis stage (2047 - 1836.15267343) m_e [26].
3. Mass defect when combining particle P1 with a proton (0.216461 m_e) at the baryosynthesis stage (formation of a neutron) [26].
4. Nuclear mass defect of helion (15.10372852 m_e) at the nucleosynthesis stage.

The sum of the listed mass defects gives a value of 648.1216 me:

$$\Delta m_h = 3 \bullet (2047 - 1836.15267343 m_e + (3 - 2.7406\ m_e) + 0.21646 m_e + \\ + 15.10372852 m_e = 648.1216\ m_e$$

From equation (21), we obtain the mass value of helion:

$$m_h = 6144\ m_e - 648{,}1216\ m_e = 5495{,}8784\ m_e$$

The obtained calculated mass value of the triton (5495.8784 me) is very close to its experimental value (5495.88528007 me).

19. Step-by-step description of the mechanism of baryosynthesis.

We provide a step-by-step description of the baryosynthesis mechanism. Initially, electrons and positrons create primary atoms from themselves - positronium atoms P_s (Fig. 14). These are the first neutral particles in the baryosynthesis process. Then, by attaching an electron and a positron to positronium atoms, oppositely charged pairs of positronium ions P_s^- and P_s^+ are formed (Fig. 14).

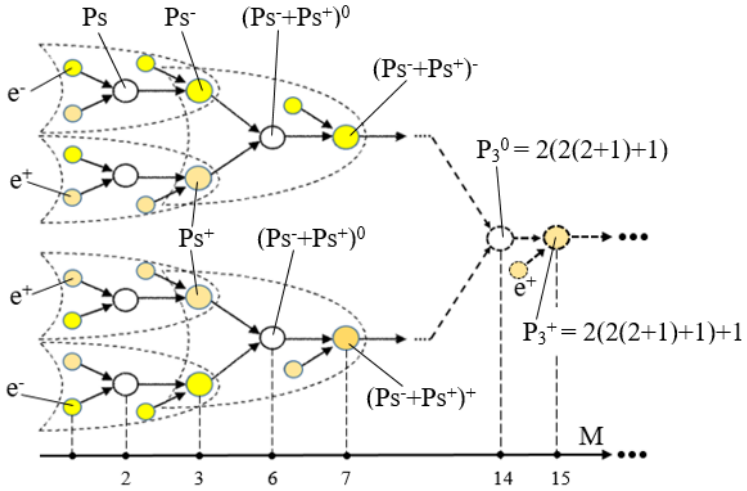


Fig. 14. Fractal mechanism of baryosynthesis.

Positronium ions, through Coulomb interaction, create new (second) neutral particles $(P_s^- + P_s^+)^0$. In this process, no other particles are required. Only electrons and positrons are involved! At the stage of forming P_s^- and P_s^+ ions and at the stage of forming neutral particles $(P_s^- + P_s^+)^0$, electrons and positrons act as reactants and catalysts in the baryosynthesis process [37 - 40]. They are part of the reaction products. They form oppositely charged P_s^- and P_s^+ particles. Thanks to the electron and positron, the fundamental Coulomb interaction is involved in the baryosynthesis mechanism.

The catalytic process of baryosynthesis continues by attaching an electron and a positron to the second neutral $(Ps- + Ps+)^0$ particles. This results in the formation of oppositely charged ion pairs $(Ps- + Ps+)^-$ and $(Ps- + Ps+)^+$. These ions, through Coulomb interaction, create subsequent (third) neutral particles P_3^0. The fractal mechanism of replication of elementary particles is realized (P_3^0 = 2(2(2+1)+1), $P_3^{(+)(-)}$ = 2(2(2+1)+1)+1). Again, nothing extra, only electrons and positrons! The process repeats and copies itself following the structure doubling principle. This leads to the formation of stable protons and antiprotons (P_{10} = 2(2(2(2(2(2(2(2(2(2(0+1)+1)+1)+1)+1)+1)+1)+1)+1)+1). On the eleventh stage, the fusion of a proton and an antiproton leads to the formation of a deuteron. When an electron and a positron attach to protonium atoms, oppositely charged protonium ions are formed. The

process continues in the direction of deuterium following the replication and structure doubling principle. Throughout the baryosynthesis process, the formation of a new particle or antiparticle is accompanied by the loss of mass by the participants in the baryosynthesis process.

The fractal mechanism of baryosynthesis is similar to the DNA replication mechanism. It is based on copying the previous structure and doubling it. The fractal formula of the baryogenesis mechanism is as follows: P=2(2(…2(2(2+1)+1)+1)+…+1)+1. The fractal mechanism of baryogenesis is represented by the following numerical sequence: 2, 3, 6, 7, 14, 15, 30, 31, 62, 63, 126, 127, 254, 255, 510, 511, 1022, 1023,… This is a sequence of magic numbers of elementary particles. It is represented by a combination of two sequences, represented by Mersenne numbers and doubled Mersenne numbers."

20. Prevalence of Synthesis over Annihilation in Nature.

The fractal mechanism of baryogenesis reveals the mechanism of antimatter's involvement in the formation of elementary particles. Through examples of the synthesis of muon, proton, neutron, π^--meson, kaons, tau-lepton, triton and helion, it is shown that the fractal mechanism of baryogenesis involving antimatter is a universal mechanism. It operates during the stages of leptosynthesis, baryosynthesis, and nucleosynthesis. As we can see, particle-antiparticle annihilation is not the sole outcome when matter and antimatter interact. In nature, synthesis prevails over annihilation. The mere existence of the Universe is experimental confirmation that synthesis processes dominate over annihilation processes. The inevitability of annihilation in the interaction between particles and antiparticles has proven to be greatly exaggerated. The coexistence of matter and antimatter is not only possible but is also the primary condition for baryosynthesis. Without antimatter, the formation and existence of matter in the Universe would be impossible.

21. Antimatter is Concealed Within Protons and Neutrons.

The consequences arising from the law of baryogenesis are both unexpected and paradoxical. Antimatter is sought at the outskirts of the Universe, making it a big surprise that antimatter hasn't disappeared but is actually quite close. It is just as much a participant in baryosynthesis as matter. This follows from the law of baryogenesis and the fractal mechanism of baryogenesis. It might still be perceived as science fiction that antimatter exists within protons and neutrons. It might seem like science fiction that protons and neutrons owe their existence to antimatter. Nature cleverly concealed antimatter within protons and neutrons! Antimatter has organically become a part of all elementary particles. The phrase that without antimatter, the existence of the Universe would be impossible may still be unconventional. Everything that exists in nature consists half of antimatter and half of matter. This is also surprising: all matter around us, including ourselves, is composed half of antimatter. There is no annihilation. This is the remarkable and paradoxical solution to the problem of antimatter in the Universe.

22. Baryonic Asymmetry in the Presence of Complete and Absolute Matter-Antimatter Symmetry.

The symmetry between matter and antimatter that existed in the early Universe remains unbroken in the modern Universe. The problem of baryonic asymmetry was unjustly linked to the nonexistent asymmetry between matter and antimatter. The problem of baryonic asymmetry has a different origin. It is not associated with the symmetry or asymmetry between matter and antimatter. The problem of baryonic asymmetry is much more complex. Protons have a predominance of antimatter (positron). The electron additional to this positron remained free. This explains the ubiquity of electrons in matter. The ubiquity of free electrons in the modern Universe is a direct consequence of the proton synthesis mechanism. Protons with a predominance of antimatter have become the foundation of the Universe's matter, and antiprotons with a predominance of matter (electrons) are not. The problem of baryonic asymmetry requires a different formulation, unrelated to the symmetry or asymmetry between matter and antimatter.

23. Conclusion.

The law of baryogenesis demonstrates that the mass of an elementary particle is equal to the sum of the masses of electrons and positrons involved in baryosynthesis, reduced by the mass defect. From the law of baryogenesis, it follows that the symmetry between matter and antimatter in the Universe remains unbroken. All substances is composed half of antimatter**.** Antimatter is both near us and within ourselves. This is not an assertion; it is a consequence of the unparalleled perfection of the natural mechanism of baryosynthesis. According to this mechanism, only two types of particles and antiparticles are sufficient to generate the entire family of elementary particles and chemical elements. Only electrons and positrons, and nothing more! They are the sole primary building material of the Universe.

The simplicity and perfection of the natural mechanism of baryosynthesis are truly astounding. Electrons and positrons create new structures from themselves. They act as reagents in the baryosynthesis reaction. Electrons and positrons catalyze the formation of more complex structures from simple ones, which, in turn, are created by electrons and positrons. No other reagents or catalysts are required. Electrons and positrons simultaneously serve as both reagents and catalysts in the baryosynthesis reaction. The quantity of reagents (electrons and positrons) during baryosynthesis determines the mass of the synthesized particle. What other synthesis mechanism can compare to such a perfect and simple mechanism of baryogenesis? "*Nature does nothing in vain when less will serve; for Nature is pleased with simplicity and affects not the pomp of superfluous causes*" - Isaac Newton.

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