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Phase Transitions of Spacetime and Ultimate Theory

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Scientific papers Contents

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Key points:

- *Four phase transitions of spacetime composed of tachyons lead to the stable objects: closed strings, neutrinos, cores of baryons, and objects before big bangs suited to life.
- *Outside of the core of baryons is obligatory the Titius-Bode law for strong interactions.
- *In very dense matter are obligatory the symmetrical decays of mesons and nuclei.
- *Existence of the gravitational charges of neutrinos solves many problems.
- *The object before big bang suited to life exited from state of black hole due to the transition of this object into neutrino.
- *The lacking dark energy is inside the neutrinos the chaotic vectorial field (this field consists of the binary systems of neutrinos), responsible for the long-distance electromagnetic interactions, consists of.

Abstracts

Experimental Data and Program of Ultimate Theory

Abstract: Experimental data suggest how ultimate theory should look.

Phase Transitions of Spacetime and Nucleons

Abstract: Ultimate theory starts from four succeeding phase transitions of granulated spacetime. Only seven parameters describe whole nature. It leads to the internal structure and other properties of the closed strings, neutrinos, cores of baryons, and objects before big bangs suited to life. Here is also described internal structure of nucleons. There are the mean fractional electric charges and eight electromagnetic loops leading to the symmetric eta meson and to the Titius-Bode law for the strong interactions.

Unification of All Interactions

Abstract: The fundamental force associated with the dynamic viscosity of the tachyons, resulting from the smoothness of their surfaces, and their eternal linear and rotational motions lead from gravity to the other interactions. The four-neutrino symmetry solves many problems. Here also the characteristic total cross sections for nucleon-nucleon and pion-nucleon scattering are calculated. New interpretation of the uncertainty principle defines the entangled particles. In history of evolution of our part of cosmos, the symmetry of the field composed of the binary systems of neutrinos was broken three times.

New Cosmology

Abstract: On base of the four possible phase transitions of granulated spacetime and the Titius-Bode laws for strong and gravitational interactions, is described evolution of the object before big bang suited to life, cosmogony of the Solar System, and cosmogony of the massive spiral galaxies. The anisotropy power for the quadrupole is calculated.

Structure of Particles

Abstract: On base of the four possible phase transitions of granulated spacetime and the Titius-Bode laws for strong interactions is described internal structure of mesons, hyperons, selected resonances, and leptons.

Four-shell Model of Atomic Nucleus

Abstract: On base of the four possible phase transitions of granulated spacetime and the Titius-Bode laws for strong interactions is described internal structure of atomic nuclei. Between other things are calculated volumetric binding energy, the magic numbers, radii of nuclei, groups of nucleons, binding energies for selected nuclei. Here is also formulated very simple theory of deuteron.

Theoretical Value of Gravitational Constant

N-N Scattering

Curvature of Space and Cosmological Constant

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Experimental Data and Program of Ultimate Theory

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Abstract: Experimental data suggest how ultimate theory should look.

Conclusions from experimental data

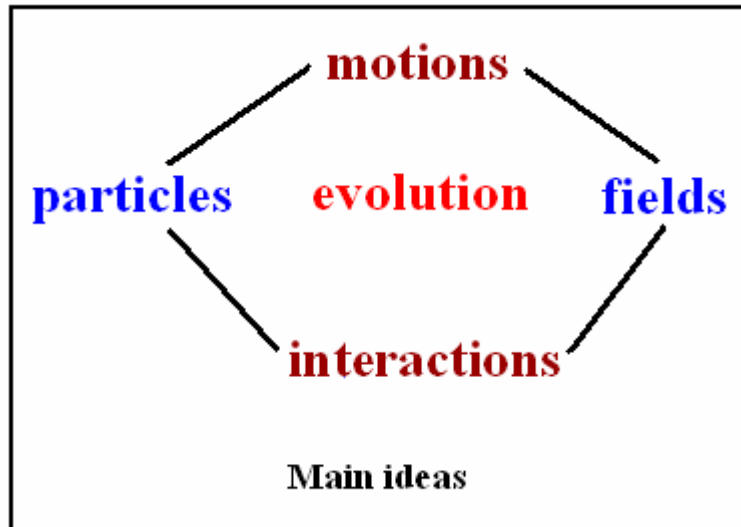
1. In the main channels of decays of the Lambda and Sigma+ hyperons, appear pions. In decays of hyperon Lambda, in about 63.9% cases appear π^- whereas the π^0 in about 35.8% [1]. On base of these experimental data we can assume that neutron with probability $x \sim 0.63$ is composed of positively charged core and negative pion and with probability $1-x$ is composed of neutral core and neutral pion. In decays of hyperon Sigma+ in about 51.6% cases appear π^0 whereas the π^+ in about 48.3% [2]. On base of these experimental data we can assume that proton with probability $y \sim 0.51$ is composed of positively charged core and neutral pion and with probability $1-y$ is composed of neutral core and positive pion.
2. We know that the nucleon-nuclear magnetic moment ratios are about +2.79 for proton [3] and -1.9 for neutron [4]. On base of these experimental results, we can assume that mass of the charged core is about $H(\text{charged}) \sim 727$ MeV and of the relativistic charged pion is $W(\text{charged}) \sim 216$ MeV. Such values of the probabilities and masses lead to the experimental data for magnetic moments.
3. In the very energetic collisions of ions appears a liquid-like substance [5]. It also suggests that inside the nucleons is a massive core.
4. The triplet n-p scattering length is approximately 5.4 fm. The singlet n-p effective range is approximately 2.7 fm whereas the triplet n-p effective range is approximately 1.7 fm. Assume that outside of the core of nucleons is obligatory the Titius-Bode law for strong interactions $r(d) = A + dB$ where $A \sim 0.7$ fm, $B \sim 0.5$ fm, and $d = 0, 1, 2, 4$. Then diameter of last 'orbit' is $2r(d=4) = 2(A + 4B) = 5.4$ fm, radius of last orbit is $r(d=4) = A + 4B = 2.7$ fm, whereas radius of the last but one orbit is $r(d=2) = A + 2B = 1.7$ fm.
5. We know that gravitational constant has the same value for all masses. It suggests that whole matter should be composed of identical and not flexible closed strings differing only by internal helicity. Closed strings having internal helicity can curve granulated spacetime.
6. The wave function describing a quantum particle is a coherent mathematical object only if distant points of it can quickly communicate. It means that coherent quantum physics needs particles moving with superluminal speeds i.e. the tachyons. Entangled particles separated spatially also need the tachyons.
7. The very dense cosmic objects, as for example the NGC 4261 galaxy (there is 'point' mass in centre of ring/torus), and some stable particles having high internal energy density should look similarly because the macrocosm and microcosm describes the same set of physical laws.
8. The broken unitariness for very energetic neutrinos colliding with baryons suggests that baryons are composed of neutrinos or/and binary systems of neutrinos.
9. Creation of one additional baryon for about billion baryon-antibaryon annihilations leads to the to-day temperature of the Universe about 240 billion times higher than the

measured. It suggests that baryon-antibaryon symmetry was broken before big bang. It also suggests that inflationary models describe nature incorrectly.

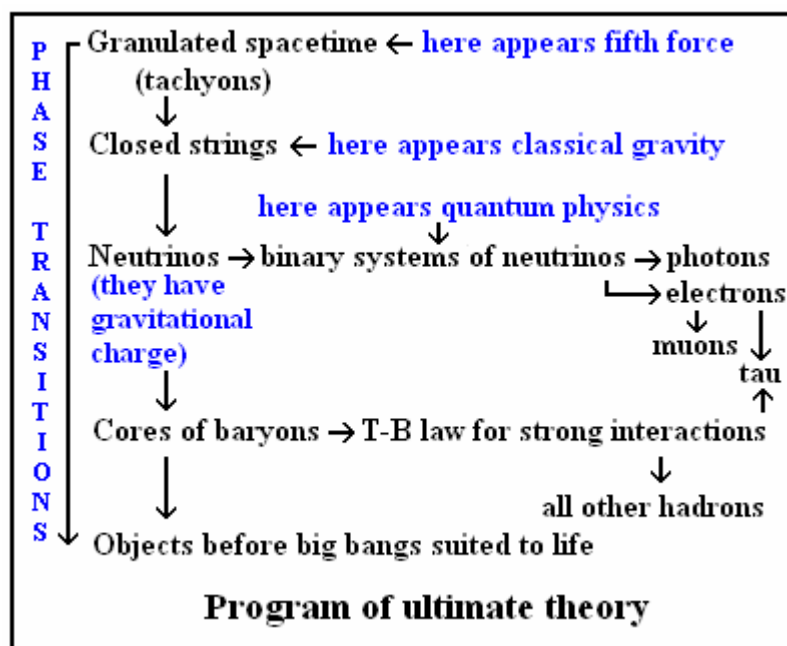
10.

We do not see products of neutrino-antineutrino annihilations. It suggests that neutrinos are very stable particles. It also suggests that oscillations of neutrinos are impossible. The observed 'oscillations' of neutrinos should have different origin – see the explanation: the chapter 'Program of ultimate theory', point 3.

Program of ultimate theory



We do not need a string/M theory based on vibrations of a closed string because such theory leads to too many solutions. We need theory describing possible phase transitions of spacetime leading to internal structures of the stable objects and fields and to the postulates of the general theory of relativity (constancy of the speed of light in spacetime and equivalence of the inertial and gravitational masses) and the quantum physics (physical meaning of the uncertainty principle and the wave function).



Then, there is not needed a new equation dependent on time but some selection rule for the phase transitions. We also need good theory of nucleons. It is also obvious that knowing internal structure of the stable objects we should in simply way, without the scattering theory, calculate the cross sections, lengths of scattering, and effective ranges, also the needed coupling constants, and so on. Simplest scheme of ultimate theory show figures titled 'Main ideas' and 'Program of ultimate theory'. Equations depending on time should describe the motions and interactions but such equations already are in existence. We need descriptions of internal structures of particles and fields within one homogeneous description and it is the lacking element of ultimate theory. If ultimate theory bases on succeeding phase transitions of spacetime then mathematical descriptions of the lower and lower levels of nature should be simpler and simpler. It suggests that origin of ultimate theory should be associated with classical physics. The lacking part of ultimate theory is the extended classical gravity. There appear the phase transitions of spacetime described by new constant $K=0.790 \cdot 10^{10}$, gravitational charge of neutrinos, four-neutrino symmetry, and the Titius-Bode law for the strong interactions.

1.

Whole nature consists of granules so also spacetime should consist of particles/tachyons. The tachyons must move with superluminal speeds.

2.

There are possible phase transitions of spacetime composed of tachyons. Spacetime can transform itself into identical and not flexible closed strings having internal helicity. Such closed strings interact with the granulated spacetime because of the dynamic viscosity of the tachyons as the result of the smoothness of the surfaces of the internally structureless tachyons. It is the fifth fundamental force leading to the gravitational interactions. The fifth fundamental force and the internal helicity of the closed strings cause that the chaotic motions of the tachyons in spacetime transform themselves into the divergently moving tachyons. The divergently moving tachyons collide with granulated spacetime – it creates negative pressure in spacetime. The attractive gravitational force is associated with the gradient of the negative pressure.

3.

There are possible following phase transitions: spacetime into closed strings, closed strings into neutrinos, neutrinos into binary systems of neutrinos. The chaotic vectorial field composed of the binary systems of neutrinos, filling infinite volume, is responsible for the long-distance electromagnetic field. The neutrinos have gravitational charges then the binary systems of neutrinos are the gravitational dipoles. The quantum particles consist of the binary systems of neutrinos. Because the chaotic vectorial field fills infinite volume and because spacetime is composed of tachyons, the quantum particles can disappear in one place of spacetime and almost simultaneously appear in another place even if they are very distant, and so on. Such behavior of the quantum particles leads to the wave function. We see that gravity is classical whereas the quantum physics appears on higher level of nature and is associated with the chaotic vectorial field. The quantum physics is coherent only if the chaotic vectorial field interacts with spacetime composed of the tachyons moving with superluminal speeds.

The chaotic vectorial field can transform itself into the cores of baryons and into the electrons. Outside the core of baryons is obligatory the Titius-Bode law for the strong interactions.

Photons are the excitations of the chaotic vectorial field.

The baryons can transform into the objects before big bang suited to life when their total mass has strictly determined value.

Sometimes free neutrino force out a constituent of the binary system of neutrinos. It means that masses of neutrinos we cannot calculate on base of their ‘oscillations’. Experimental data lead to the tau neutrino only if the assumption that neutrinos can oscillate is true. This ultimate theory leads to conclusion that neutrinos cannot oscillate due to tremendous energy frozen inside them. The observed ‘oscillations’ are due to the exchanges of the neutrinos in the binary systems of neutrinos. Because neutrinos can differ only by sign of the gravitational charges and by the internal helicity then there are in existence only two families of neutrinos.

4.

Neutrinos, electrons, cores of baryons, and the objects before big bangs look similarly as the NGC 4261 galaxy i.e. there is ‘point’ mass in centre of torus. The surface of torus looks similarly to the Ketterle surface for a strongly interacting Fermi gas [6]. The tori consist of binary systems of smaller tori. The tori are stable objects because the components of tori exchange loops created on the equators of the binary systems of tori. Distances of the components of the tori are about $2\pi r$, where r is the radius of equator of the component. Structure of tori defines the charges and spins of particles. Torus of neutrino is composed of the binary systems of closed strings. Torus of core of baryons and electrons (electron are only the polarized in specific way the chaotic vectorial field) are composed of the binary systems of neutrinos. Torus of the objects before big bang suited to life is composed of deuterium. All the binary systems are the dipoles (spin=1). The binary systems of neutrinos are the gravitational dipoles.

We know that surface of a torus defines following equation:

$$(x^2+y^2+z^2-a^2-c^2)^2=4c^2(a^2-z^2)$$

The tori are most stable when $c=2a$ because then length of waves created by exchanged particles the tori are built of is equal to $4a$ – such length additionally stabilizes the tori. It means that the external radius of torus is $3/2$ times greater than the mean radius. Additional stabilization is due to the negative pressure created in thickened beams of spacetime and the vectorial field when the beams are going through the surface of the tori.

5.

The loops created on equators of the point masses define the weak interactions of particles. The loops created inside the torus of core of baryons define the strong interactions.

6.

The early Universe inside the torus of the object before big bang arose similarly as the loop in the baryons responsible for the strong interactions. The object before big bang exited from the state of black hole due to the object-before-big-bang \rightarrow neutrino transition. The lacking dark energy (not mass) hides itself inside the neutrinos the chaotic vectorial field consists of.

Table 1 Interactions

Name of source	States	Carriers of interaction	Name of interaction	Place of creation of the carriers
Tachyons	1	Tachyons	Fundamental	Eternal
Closed strings	2	Gradient of negative pressure in spacetime	Gravitational	Closed string
Neutrinos	4	Beams of tachyons	Gravitational Gravitational	Closed strings Torus/gravitational -charge
Cores of baryons	4	Beams of tachyons + polarized chaotic vectorial field composed of binary systems of neutrinos Photons carried by the chaotic vectorial field Small neutrino loops Large loops composed of binary systems of neutrinos	Electric and magnetic Electro-magnetic Weak Strong	Torus/electric-charge + polarized vectorial field Surface of torus Equator of point mass Circular axis of torus
Stable object before big bang	4	Gravitational field Large loops of nucleons (also the early Universe)	Gravitational Gravitational	The object Circular axis of torus

Table 2 New symbols of neutrinos

Neutrino	Spin helicity ¹⁾	Internal helicity	Gravitational charge	New symbol
$\nu_{e(\text{anti})}$	+	L (left)	+	$\nu_{e(\text{anti})L+}$
ν_e	-	R (right)	-	ν_{eR-}
$\nu_{\mu(\text{anti})}$	-	R	+	$\nu_{\mu(\text{anti})R+}$
ν_{μ}	+	L	-	$\nu_{\mu L-}$

¹⁾ The sign '+' is for the parallel senses of the velocity and spin, the sign '-' is for the antiparallel senses.

There are in existence following large loops

$$\gamma_{(\text{loop})L1} \equiv (\nu_{eR-} \nu_{e(\text{anti})L+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})L2} \equiv (\nu_{\mu L-} \nu_{\mu(\text{anti})R+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})L3} \equiv (\nu_{eR-} \nu_{\mu(\text{anti})R+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})L4} \equiv (\nu_{\mu L-} \nu_{e(\text{anti})L+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})R1} \equiv (\nu_{eR-} \nu_{e(\text{anti})L+})_{(\text{loop})R}$$

$$\gamma_{(\text{loop})R2} \equiv (\nu_{\mu L-} \nu_{\mu(\text{anti})R+})_{(\text{loop})R}$$

$$\gamma_{(\text{loop})R3} \equiv (\nu_{eR-} \nu_{\mu(\text{anti})R+})_{(\text{loop})R}$$

$$\gamma_{(\text{loop})R4} \equiv (\nu_{\mu L-} \nu_{e(\text{anti})L+})_{(\text{loop})R}$$

where $\gamma_{(\text{loop})L}$ denotes the large loop with the left helicity.

Then there are in existence the eight different large loops and it is some analogy to the eight gluons. It suggests that symmetric meson should be composed of the eight different large loops i.e. of four neutral pions. I identify this meson as the virtual eta meson. Symmetrical

decays of the virtual eta mesons lead to the Titius-Bode law for the strong interactions. The created virtual particles do not change the mean density of the chaotic vectorial field.

Table 3 Hidden 'dimensions'

Elementary object	Co-ordinates and quantities needed to describe position, shape and motions
Tachyon	6 (5 + time)
Closed string	10 (9 + time)
Closed string-antistring pair	11 (10 + time)
Neutrino	26 [9(large torus) + 7(small tori on the surface of the large torus) + 9(small tori on the surface of the point mass) + time]
Core of baryons Electron	58 (9 + 23 + 25 + time)
Object before the big bang suited to life	122 (9 + 55 + 57 + time)

We see that for the elementary objects we have

$$N = (d - 1) \cdot 8 + 2,$$

where N denotes the numbers of needed co-ordinates and quantities, $d = 2, 4, 8, 16$ then $N = 10, 26, 58, 122$.

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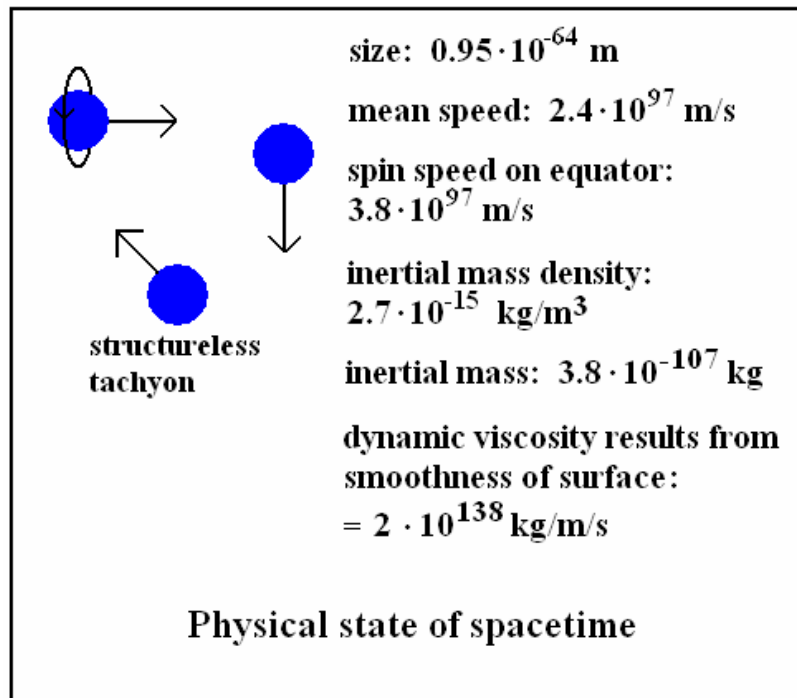
Phase Transitions of Spacetime and Nucleons

Sylwester Kornowski

Abstract: Ultimate theory starts from four succeeding phase transitions of granulated spacetime. Only seven parameters describe whole nature. It leads to the internal structure and other properties of the closed strings, neutrinos, cores of baryons, and objects before big bangs suited to life. Here is also described internal structure of nucleons. There are the mean fractional electric charges and eight electromagnetic loops leading to the symmetric eta meson and to the Titius-Bode law for the strong interactions.

Introduction

In [1] I set forth the experimental data suggesting how ultimate theory should look. I also formulated the program of ultimate theory. Here I described the possible phase transitions of granulated spacetime and internal structure of nucleons. The mass density of the chaotic vectorial field [1] is the seventh parameter of the ultimate theory because we cannot derive it from the six parameters defining spacetime. It is result of the spontaneous fluctuations in spacetime leading to the stable objects.



The six parameters listed in the figure titled ‘Physical state of spacetime’ plus the mass density of the chaotic vectorial field we can replace for new set of parameters listed below – then ultimate theory is mathematically simplest. Because we can derive the initial conditions from the new set of parameters so these sets of parameters are equivalent. The values of the G , $\hbar/2$, c , e , masses of electron and charged pion are in accord to the 2006 CODATA. The mass of neutral pion I matched to obtain the best results.

The parameters used in this theory:

Gravitational constant: $G = 6.674 \cdot 10^{-11}$ m³/(kg s²)

Half-integral spin: $\hbar/2 = 1.0545716 \cdot 10^{-34}/2$ Js

Speed of light in spacetime: $c = 2.99792458 \cdot 10^8$ m/s

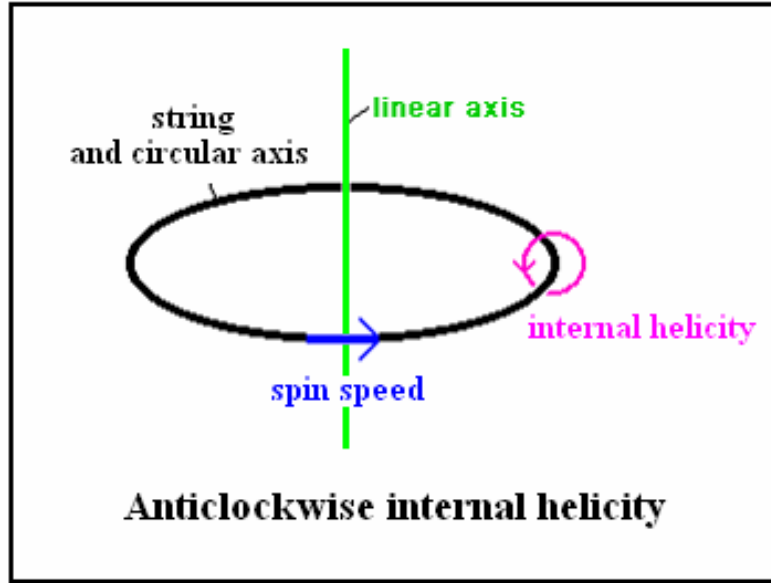
Electric charge of electron: $e = 1.6021765 \cdot 10^{-19}$ C

Mass of electron: $m_{\text{electron}} = 0.5109989$ MeV

Mass of neutral pion: $m_{\text{pion}(0)} = 134.9661$ MeV

Mass of charged pion: $m_{\text{pion}(+-)} = 139.57018$ MeV

Phase transitions of spacetime and new constant



Because the tachyons have eternal linear and rotational energies then there appear rotary whirls, i.e. the closed strings having internal helicity (see figure ‘Anticlockwise internal helicity’). Closed string is stable because the internal helicity and dynamic viscosity cause that spacetime near closed string thickens. Because of the shape of closed string, pressure is lowest on internal equator of it. It means that the thickened spacetime to become detached from the closed string on the internal equator of it. It leads to the negative pressure inside closed string. There appears collimated jet of spacetime. Similar phenomena lead to the collimated jets emitted by the active galaxies. Assume that closed string is composed of K^2 adjoining tachyons (the square of the K causes that calculations are simpler). To saturate the interactions of stable objects via spacetime, when some stable object contains x^2 elements then the next larger one must contain x^4 the elements. Then, the objects created in the phase transitions of spacetime should contain K^2 , K^4 , K^8 , K^{16} tachyons. Masses of the possible stable objects are directly proportional to number of the closed strings. It means that the stable objects contain following number of the closed strings: K^0 , K^2 , K^6 , and K^{14} . It means that masses of the stable objects are directly proportional to $K^{2(d-1)}$, where $d=1$ for closed strings, $d=2$ for neutrinos, $d=4$ for cores of baryons and $d=8$ for objects before big bangs suited to life.

Surface mass densities for all stable objects should have the same value. Then damages to the stable objects nature immediately repairs - so they are the stable objects. It means that the radii of the tori of the stable objects should be directly proportional to $K^{(d-1)}$.

Mean radii of the tori of the elementary objects are

$$r_d = r_1 K^{d-1} \quad (1)$$

where r_1 is for closed string.

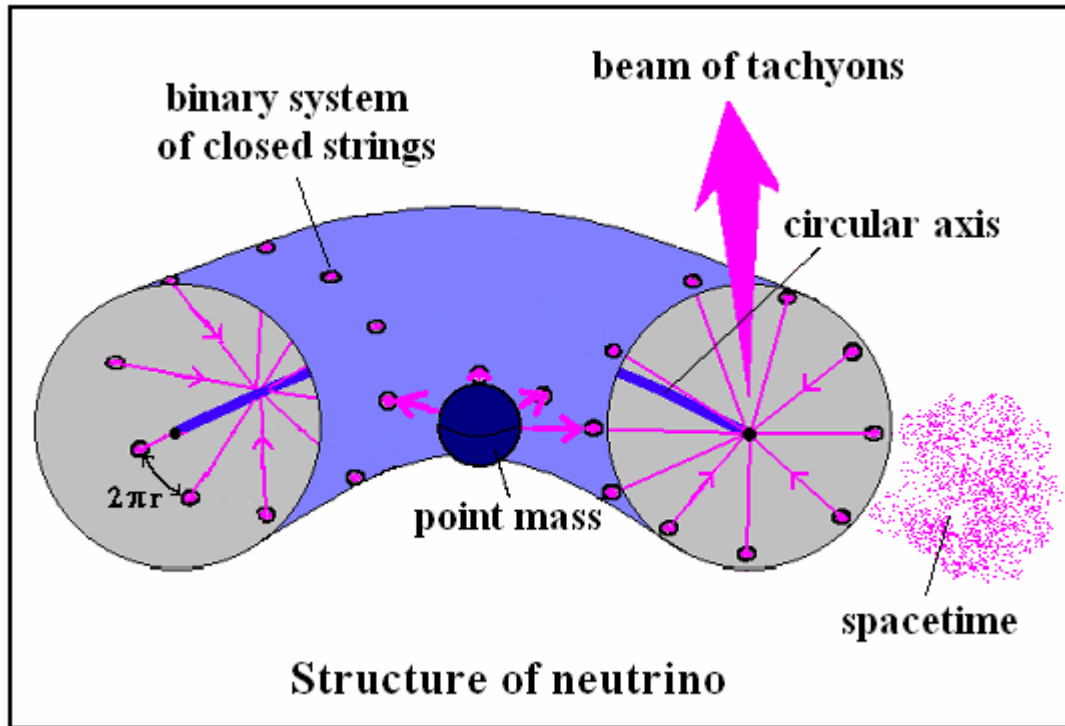
Rest masses of the tori of elementary objects are

$$m_d = m_1 K^{2(d-1)} \quad (2)$$

where m_1 is for the closed string.

The strings, neutrinos, cores of baryons and objects before big bang suited to life should have the same spin. Then time of an interaction depends only on involved energy. It causes that description of all interactions has the same origin. Because all elementary objects have the same spin then from the formula $mvr = \hbar/2$ we can calculate the natural speed of the elementary objects in spacetime (the spin speeds on equators of resting tori are equal to the natural speeds in the spacetime).

From these conditions, we obtain that range of the gravitational force is about $2 \cdot 10^{36}$ m. All closed strings have only one strictly determined frequency of internal helicity – it results from the law of conservation of energy (if we assume that mean linear kinetic energy and mean rotational kinetic energy of the tachyons have the same value then we obtain about $3 \cdot 10^{19}$ revolutions per spin period – it is about $1.3 \cdot 10^{161}$ Hz). To describe position, shape and motions of closed string we need 3 coordinates, 2 radii, 1 spin speed, 1 angular speed associated with the internal helicity and time associated with the linear speed. To describe the rotation of the spin vector we additionally need 2 angular speeds. It means that we need the 10 numbers (the 3 spatial dimensions plus time and plus the 6 false dimensions). To describe the string-antistring pair we need 11 ‘dimensions’.



Neutrinos are composed of the binary systems of closed strings. Cores of baryons and electrons are composed of neutrinos and binary systems of neutrinos. Objects before big bangs suited to life are composed of baryons whereas the torus of such object is composed of deuterium.

The exchanged particles the core of baryons and electrons consist of make the half-turns on the circular axis and in centre of torus. It causes that there appear the circular mass on the circular axis and the point mass in centre of torus. It also means that because of the half-turns the stable tori have internal helicity.

Baryons

Key points:

- *The core of baryons is the black hole for the strong interactions.
- *Outside of the core of baryons is obligatory the Titius-Bode law for the strong interactions. Between the core and pion, lying under the Schwarzschild surface for strong interactions, is exchanged electric charge. Pion in the strong field looks similarly as the two electrons in the ground state of atom.

*The neutral pion is binary system of two large loops composed of the binary systems of neutrinos. The large loops arise on the circular axis inside torus of the core.

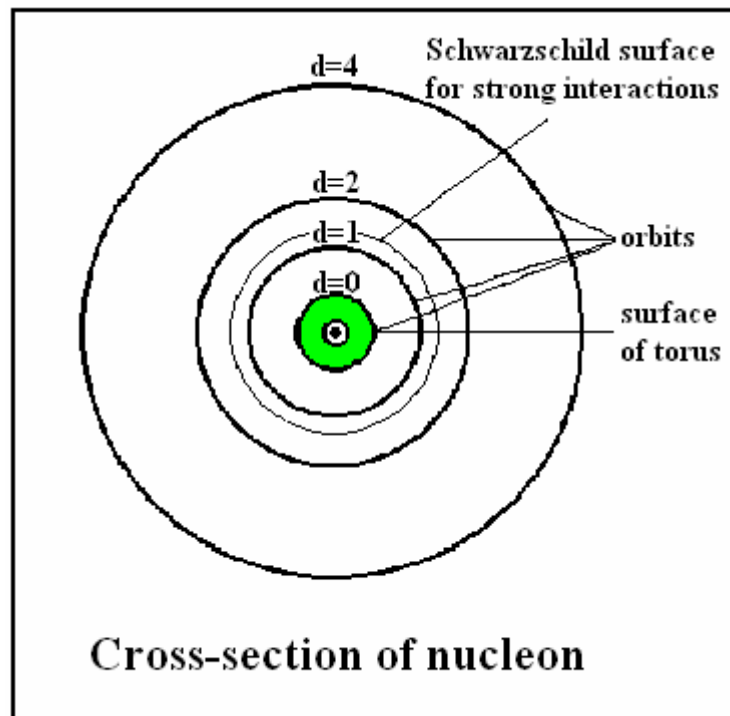
The Titius-Bode law for the strong interactions we can write in following form

$$R_d = A + dB \quad (3)$$

where R_d denotes the radii of the circular tunnels, the A denotes the external radius of the torus, $d=0,1,2,4$; the B denotes the distance between the second tunnel ($d=1$) and the first tunnel ($d=0$). The first tunnel is in contact with the equator of the torus.

The tunnels arise because of the symmetrical decays of the symmetric virtual eta mesons – in the place of a decay is created for some time a ‘niche’ in the chaotic vectorial field. For the physical properties of nucleon is responsible the pion in the $d=1$ tunnel lying under the Schwarzschild surface for the strong interactions. For the physical properties of the hyperons are responsible the pions in the $d=2$ state i.e. pions on the first orbit above the Schwarzschild surface. The unitary spin of the relativistic charged pion determines the radius of the $d=1$ tunnel. Virtual eta mesons decay to two identical mesons on this orbit. One of these components is moving towards the equator of torus whereas the other one is moving in opposite direction. When the first component reaches the equator of torus, the other one is stopping and decays to two identical particles, and so on. In the place of the decay appears ‘hole’ in the chaotic vectorial field. Set of such holes is some ‘tunnel’. The $d=4$ orbit is the last orbit for the strong interactions because on this orbit the neutral virtual pion decays to photons so the strong interactions disappear. Pion (two large loops) looks for the strong field similarly as the two electrons in the ground state of an atom. It causes that there appear the selection rules for the pions and loops created in baryons.

The hyperons arise very quickly because of the strong interactions. They decay slowly due to the tunnels.



Calculations

Description of the internal structure of nucleons leads to conclusion that the mass of neutral pion is two times greater than the mass of large loop minus the binding energy of these loops. The α -order correction for the radiation energy created in the interactions of the virtual or real electron-positron pairs (created by the virtual or real photons emitted by an electrically charged particle) is

$$m_{em}c^2 = ke^2/\lambda_C \quad (4)$$

where $k=c^2/10^7$, the λ_C it is the Compton wavelength of bare particle.

The Compton wavelength of electrically charged particle is

$$\lambda_C = 2\pi\hbar/c/m_{bare} \quad (5)$$

Then from Eq.(4) and Eq.(5) we obtain

$$m_{em} = Cm_{bare} \quad (6)$$

where $C=e^2c/(2\pi 10^7\hbar)$, $m_{bare}=m/(1+C)$.

Then

$$m_{em} = mC/(1+C) \quad (7)$$

When two electrically charged particles, for example real muon and virtual electron, are in distance equal to the Compton wavelength for the real bare muon then the binding energy of this binary system is equal to the radiation energy of the real particle.

Simplest neutral pion consists of four energetic neutrinos. The charged pion more often than not, decays to the muon and neutrino. If we assume that these two particles arise from the bare mass of charged pion and that the neutrino has energy equal to the one fourth of the mass of neutral pion then the calculated mass of muon is

$$m_{muon} = m_{pion(+)} - m_{em-pion(+)} - m_{pion(o)}/4 \quad (8)$$

To calculate the binding energy for neutral pion we may assume that this energy is equivalent to the electromagnetic energy for system composed of muon, virtual electron and exchanged real photons – such electromagnetic system can have mass equal to the mass of neutral pion. The binding energy for such system can be calculated from the Eq.(7). Knowing the mass of large loop m_{LL} and on base of the uncertainty principle, we can calculate the external radius of torus

$$A=3\hbar/(4\pi cm_{LL}) \quad (9)$$

For energy of rotating neutrino is very well defined volume (it is the sphere) and linear distribution of the energy (it is the diameter of the sphere) whereas it is very difficult to define the surface energy density.

If the L denotes the diameter of the equator of torus of neutrino then the Planck's critical linear energy density for neutrino is

$$m_n/L = m_n/(2r_{neutrino}) = c^2/G \quad (10)$$

where m_n it is the energy of rotating neutrino.

If the V denotes the volume inside sphere defined by rotating equator of the torus then the Planck's critical volumetric energy density for neutrino is

$$m_n/V = m_n/(4\pi r_{neutrino}^3/3) = c^5/(\hbar G^2) \quad (11)$$

From the Eq.(10-11) we obtain

$$r_{neutrino}^2 = 3\hbar G/(2\pi c^3) \quad (12)$$

On other hand the Eq.(2) leads to

$$r_{neutrino} = A/K^2 \quad (13)$$

Solving the set of equations Eq(12-13) we obtain the K .

Knowing the K , A , and the half-integral spin of torus of baryons, I calculated mean distance between the binary systems of neutrinos the torus is composed. Torus of electron and torus of the core of baryons must be composed of the same number of the binary systems of neutrinos because then their electric charges have the same value. Then from the Compton length for

electron, we can calculate the mean distance between the binary systems of neutrinos in the chaotic vectorial field and then the mean density of it. Because the constants of interactions are directly proportional to the mass densities of fields then we can calculate the inertial mass density of spacetime.

The pions in the tunnels circulate the torus. Such pions I call the W pions because they are associated with the strong-Weak interactions. Like this are behaving the pion in the nucleons and the pions in the hyperons. Their masses are denoted by $m_{W(+o),d}$.

The B we can calculate from condition that the charged W pion in the d=1 state, which is responsible for the properties of nucleon, should have the unitary orbital moment because this state is the ground state for the W pions, then

$$m_{W(+),d=1}(A + B)v_{d=1} = \hbar \quad (14)$$

where $v_{d=1}$ denotes the speed of the W pion in the d=1 state.

The relativistic masses of the W pions we can calculate from the Einstein's formula

$$m_{W(+o),d} = m_{\text{pion}(+o)} / (1 - v_d^2/c^2)^{1/2} \quad (15)$$

We know that the square of speed is inversely proportional to radius r_d so from Eq.(3) and Eq.(15) we have

$$m_{W(+o),d} = m_{\text{pion}(+o)}(1 + A/(dB))^{1/2} \quad (16)$$

Since we know the A then from Eq.(14-16) we obtain the B.

The d=1 tunnel lies under the Schwarzschild surface for the strong interactions so nucleons are stable. The second solution is $B' = 0.96930517$ fm but because for this solution $A+B' > 2A$ so it does not lead to creation of the nucleon since such orbit lies above the Schwarzschild surface. It means that such orbit does not lead to creation of additional tunnels.

Creation of a resonance is possible when the loops overlap with the tunnels. Such pions I call the S bosons because they are associated with the Strong interactions. Their masses are denoted by $m_{S(+o),d=0}$. The spin speeds of the S bosons (they are equal to the 'c') differ from the speeds calculated on base of the Titius-Bode law for the strong interactions – it is the reason why the lifetimes of the resonances are short.

The mass of the core of resting baryons is denoted by $m_{H(+o)}$. The maximal mass of virtual S boson cannot be greater than the mass of the core so I assume that the mass of the S boson, created in the d=0 'tunnel', is equal to the mass of core (it is equal to the mass of torus plus the circular mass plus the point mass). As we know, the ranges of virtual particles are inversely proportional to their masses. Then from Eq.(3) we obtain

$$m_{H(+o)}A = m_{S(+o),d}(A + dB) \quad (17)$$

From Eq.(16) results that the W pion in the d=1 state has mass equal to 208.64 MeV so the virtual S pion in the d=0 state should have the mass not greater than about 730 MeV ($939 \text{ MeV} - 209 \text{ MeV} = 730 \text{ MeV}$). On the equator of torus appear the virtual eta mesons. The eta meson has mass equal to about the mass of four neutral pions. It means that the virtual S pion in the d=0 state decays to the virtual eta meson and a remainder. Assume that this remainder reaches the last tunnel in the nucleon i.e. the d=4 state. The mass of such S pion is denoted by $m_{S(+),d=4}$, then

$$m_{S(+),d=4} = m_{H(+)} - 4m_{\text{pion}(o)} \quad (18)$$

From Eq.(17-18) we have

$$m_{H(+)} = m_{\text{pion}(o)}(A/B + 4) \quad (19)$$

The nucleons and pions they are respectively the lightest baryons and mesons interacting strongly so there should be some analogy between the carrier of electric charge interacting with the core of baryons (it is the distance of masses between the charged and neutral cores) and the carrier of electric charge interacting with the charged pion (it is the electron). Assume that

$$(m_{H(+)} - m_{H(o)})/m_{H(+)} = m_{\text{electron}}/m_{\text{pion}(+)} \quad (20)$$

The results obtained from Eq.(16-20), for value $A/B=1.3897995$, are collected in Table 4 (the masses are given in MeV).

Table 4 *Relativistic masses*

d	m_{S(+)}	m_{S(o)}	m_{W(+)}	m_{W(o)}
0	727.440	724.777		
1	423.046	421.498	215.761	208.644
2	298.247	297.155	181.704	175.710
4	187.576	186.889	162.013	156.668

There is the probability y that the proton is composed of H^+ and $W_{(o),d=1}$ and the probability $1-y$ that is composed of H^0 and $W_{(+),d=1}$. From the Heisenberg uncertainty principle follows that the probabilities y and $1-y$, which are associated with the lifetimes of proton in above-mentioned states, are inversely proportional to the relativistic masses of the W pions so from this condition and Eq.(16) we have

$$y = m_{\text{pion}(+)}/(m_{\text{pion}(+)} + m_{\text{pion}(o)}) = 0.508385 \quad (21)$$

$$1 - y = m_{\text{pion}(o)}/(m_{\text{pion}(+)} + m_{\text{pion}(o)}) = 0.491615 \quad (22)$$

There is the probability x that the neutron is composed of H^+ and $W_{(-),d=1}$ and the probability $1-x$ that is composed of H^0 , resting neutral pion and Z^0 . Mass of the last particle is $m_{Z(o)}=m_{W(o),d=1}-m_{\text{pion}(o)}$ (the pion $W_{(o),d=1}$ decays because in this state both particles, i.e. the torus and the $W_{(o),d=1}$ pion, are electrically neutral). Since in the $d=1$ state occurs only the $W_{(o),d=1}$ pion and because the mass of resting neutral pion is greater than the mass of Z^0 (so the neutral pion lives shorter) then

$$x = m_{\text{pion}(o)}/m_{W(-),d=1} = 0.625535 \quad (23)$$

$$1 - x = 0.374465 \quad (24)$$

The masses of baryons are equal to the sum of the masses of components because the binding energy associated with the strong interactions cannot abandon the strong field.

Mass of proton is

$$m_{\text{proton}}=(m_{H(+)}+m_{W(o),d=1})y+(m_{H(o)}+m_{W(+),d=1})(1-y) \quad (25)$$

Mass of neutron is

$$m_{\text{neutron}}=(m_{H(+)}+m_{W(-),d=1})x+(m_{H(o)}+m_{\text{pion}(o)}+m_{Z(o)})(1-x) \quad (26)$$

Ratio of the magnetic moment of proton to the nuclear magneton is

$$\mu_{\text{proton}}/\mu_o=m_{\text{proton}}y/m_{H(+)}+m_{\text{proton}}(1-y)/m_{W(+),d=1} \quad (27)$$

Ratio of the magnetic moment of neutron to the nuclear magneton is

$$\mu_{\text{neutron}}/\mu_o=m_{\text{proton}}x/m_{H(+)}-m_{\text{proton}}x/m_{W(-),d=1} \quad (28)$$

Mean square charge for proton is

$$\langle Q_{\text{proton}}^2 \rangle = e^2[y^2 + (1-y)^2]/2 = 0.25e^2 \text{ (the quark model gives value } 0.33e^2)$$

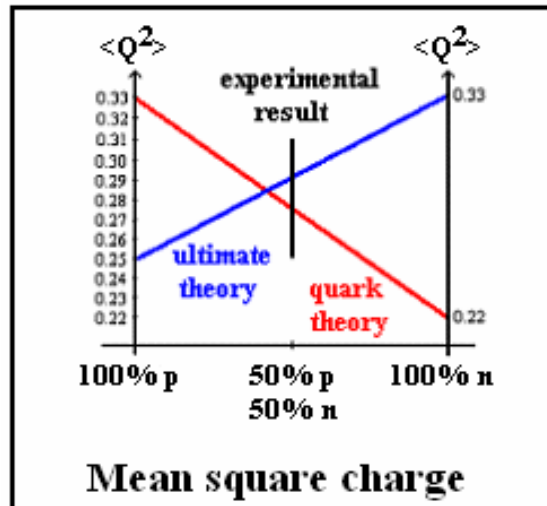
Mean square charge for neutron is

$$\langle Q_{\text{neutron}}^2 \rangle = e^2[x^2 + (-x)^2]/(2x + 3(1-x)) = 0.33e^2 \text{ (the quark model gives value } 0.22e^2), \text{ where } [2x + 3(1-x)] \text{ defines the mean number of particles in neutron.}$$

Mean square charge for nucleon is

$$\langle Q^2 \rangle = [\langle Q_{\text{proton}}^2 \rangle + \langle Q_{\text{neutron}}^2 \rangle]/2 = 0.29e^2 \text{ (the quark model gives value } 0.28e^2)$$

In the last case both results lie inside the interval determined by experiment (the measured values of the $\langle Q^2 \rangle$ are $(0.25, 0.31)e^2$)[2]. From the figure titled 'Mean square charge' results that my model and quark model give different results. Experiment carried into effect with higher accuracy should give the answer which one model is correct.



Summary

My theory is very simple because is based on only seven parameters and three formulae – two formulae are associated with the possible phase transitions and one formula is associated with the Titius-Bode law for the strong interactions.

This theory is the extension of the Einstein's theories of relativity and of the correct part of the quantum theory. Gravity needs identical and inflexible closed strings. Then, the G has the same value for all masses. Gravity is classical. It means that formulation of quantum gravity is impossible but the classical gravity leads to the correct part of the quantum theory. Quantum theory appears on higher level of nature and is associated with the field composed of the binary systems of neutrinos and spacetime composed of the superluminal granules.

Theory based on the four succeeding phase transitions of granulated spacetime, described by the new dimensionless constant K, and the Titius-Bode law for the strong interactions gives very good results. There are not in existence the gravitons, s-particles, other –inos, Higgs bosons, and tau neutrinos.

The ultimate theory contains only seven parameters. Five of them do not change with time: the mean radius of the tachyons, their mean inertial mass, their dynamic viscosity, their mean linear speed and their mean angular speed. These eternally constant parameters lead to the two fundamental laws of conservation: of energy and spin, and to the principle of relativity. The other three parameters change over time (in cosmic scale): the mean inertial mass density of spacetime, the mean mass density of the bound closed strings and the mean mass density of the binary systems of neutrinos. Today, of course in cosmic scale, almost all closed strings are inside the masses so there are only two predominant fields leading to the two long-distant interactions. Because values of the gravitational constant, speed of light in spacetime, half-integral spin and electric charge, depend on the listed mass densities so their values change very slow with time (in cosmic scale).

All particles greater than neutrino are built of the very stable neutrinos. The lacking dark energy is inside neutrinos because they are composed of the superluminal strings.

The infinite cosmos is eternal.

Three conditions must be satisfied to create life. First, the mass densities of the fields composed of the tachyons and binary systems of neutrinos should have strictly determined values the creations of the stable objects were possible. The laws of physics cannot vary because the eternal bare tachyons fill the infinite volume. Next, the object before big bang must have strictly determined mass the object-before-big-bang \rightarrow neutrino transition was possible. Because universes arise as the universe-antiuniverse pairs then the distance between

the constituents of a pair must be sufficiently distant. These three conditions solve the Goldilocks enigma.

Table 5 *Theoretical results*

Physical quantity	Theoretical value
Inertial mass density of spacetime	*2.72 E-15 kg/m/m/m
Mass density of the chaotic vectorial field	1.13 E+28 kg/m/m/m
Diameter of tachyon	0.951 E-64 m
Mean linear speed of tachyons and the speed of propagation of gravitational field	2.39 E+97 m/s
Inertial mass of tachyon	3.75 E-107 kg
Range of gravitational field	2 E+36 m
Radius of closed string	0.944 E-45 m
Linear speed of closed string	0.727 E+68 m/s
Mass of closed string	2.34 E-87 kg
Frequency associated with internal helicity of closed string	1.3 E+161 Hz
External radius of neutrino	1.117 E-35 m
Mass of neutrino	3.33 E-67 kg
Mass of object before big bang suited to life	1.96 E+52 kg
External radius of object before big bang suited to life	287 million light-years
Mass of the Universe	1.82 E+51 kg
Radius of the early Universe loop	191 million light-years
External radius of torus of nucleon	0.697442 fm
Constant K	0.790 E+10
Binding energy of two large loops	0.1227 MeV
Mass of large loop	67.54441 MeV
Mass of muon	105.667 MeV
The A/B in the Titius-Bode law for strong interactions	1.38980
Mass of proton	938.274 MeV
Mass of neutron	939.539 MeV
Magnetic moment of proton	+2.79360
Magnetic moment of neutron	-1.91341
Radius of last tunnel for strong interactions	2.70476 fm
Mean square charge for nucleon	0.29
Mean square charge for proton	0.25
Mean square charge for neutron	0.33

*2.72 E-15=2.72·10⁻¹⁵

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Unification of All Interactions

Sylwester Kornowski

Abstract: The fundamental force associated with the dynamic viscosity of the tachyons, resulting from the smoothness of their surfaces, and their eternal linear and rotational motions lead from gravity to the other interactions. The four-neutrino symmetry solves many problems. Here also the characteristic total cross sections for nucleon-nucleon and pion-nucleon scattering are calculated. New interpretation of the uncertainty principle leads to the entangled particles. In history of evolution of our part of cosmos, the symmetry of the field composed of the binary systems of neutrinos was broken three times.

Introduction

In [1] and [2] I described how the four possible phase transitions of granulated spacetime lead to the observed particles and fields. Here I show mathematical and physical relations between different interactions. Physical quantities denote the same symbols as in [1] and [2].

How weak interactions of baryons lead to the fundamental force and vice versa

Notice that the ratio of the distance of masses between the charged and neutral pions to the mass of electron is equal to the ratio of the masses of charged core of baryons H^+ and Z^+ , where $m_{Z(+)}=m_{W(+),d=1}-m_{\text{pion}(0)}$ [2]. It should have some deeper meaning. Assume that the increases of the masses of electron and the Z^+ are realized in the $d=0$ state because this tunnel has some width resulting from the diameter of the point mass of the virtual H^+ created on the equator of the torus of core of baryons. The width of the $d=1$ tunnel causes that the mentioned particles in this tunnel are not moving with the speed equal to the 'c'.

The relativistic masses of the W pions [2] we can calculate from the Einstein's formula

$$m_{W(+0),d} = m_{\text{pion}(+0)} / (1 - v_d^2/c^2)^{1/2} \quad (1)$$

From Eq.(1) we obtain

$$\alpha_{\text{sw}(Z(+),d=0)} = v_{d=0}/c = (1 - (m_{Z(+)}/m_{H(+)}))^2)^{1/2} = 0.99381284 \quad (2)$$

where α denotes the value of the coupling constant for the strong-weak interactions.

The $r_{p(\text{proton})}$ denotes the radius of the point mass of proton and the range of the weak interactions of the point mass of proton because the range of weak interactions of single neutrino is 2π times bigger than the external radius of its torus so this radius is much smaller than the radius of the point mass of proton. Because $v^2=G_{\text{sw}}m_{H(+)}/r$ (where G_{sw} denotes the strong constant) and because for the particle $Z_{(+0),d=0}$ we have $r=r_{p(\text{proton})}+A$ then from Eq.(2) we obtain

$$A/(r_{p(\text{proton})} + A) = (v_{d=0}/c)^2 = 1 - (m_{Z(+)}/m_{H(+)}))^2 \quad (3)$$

Then $r_{p(\text{proton})}=0.871113 \cdot 10^{-17}$ m

The spin of proton is half-integral so we can calculate the sum of the circular mass and the mass of torus: $X=m_{c(\text{proton})}=318.2955$ MeV. Notice that the mass of H^+ [2] is greater than the doubled value of X . It means that core of baryons behaves in different way than the bare electron [2]. Assume that the point mass of core of baryons Y is equal to the X plus mass of charged pion minus the one fourth of the mass of neutral pion ($Y=424.1242$ MeV) and next verify whether such assumption leads to the mass of core of baryons and to the stable closed strings. Positive verification of such assumption will show the origin of mass of the muon [2]. Because on the equator of the point mass the spin speed of the created small neutrino loop must be equal to the c then from following formula we can calculate the constant for the weak interactions

$$G_w=c^2 r_p/Y=1.03551 \cdot 10^{27} \text{ m}^3 \text{ s}^{-2} \text{ kg}^{-1} \quad (4)$$

The coupling constant for weak interactions of protons $\alpha_{w(\text{proton})}$ we can calculate from the definition

$$\alpha_{w(\text{proton})}= G_w Y^2/(\hbar c)=0.018723256 \quad (5)$$

The distance of masses between $X+Y$ and H^+ is equal to the binding energy resulting from the weak interactions of the point mass of core of baryons with the virtual large loops arising in distance $2A/3$ from the point mass and with the virtual particles arising on the surface of the torus. The pairs are the virtual H^+H^- pairs and the particles having masses equal to the distance of masses between charged and neutral pions. The axes of these dipoles converge on the circular axis of the torus so they behave as if they also were in distance $2A/3$ from the point mass. This energy is equal to the masses multiplied by the coupling constant for weak

interactions and is equal to 14.9709 MeV. It leads to the mass of core of baryons equal to 727.449 MeV and this result is consistent with the origin value 727.440 MeV.

Now, verify whether the mass Y leads to the stable closed strings. Gravitational mass is directly proportional to the number of the closed strings a mass is composed of. Then from following formula we can calculate the number of the closed strings N_{cs} the point mass of core of baryons is composed of

$$N_{cs}=Y/m_1 \quad (6)$$

where m_1 denotes mass of closed string.

Assume that the radius of the point mass has strictly determined value because the closed strings suck up spacetime from interior of it. Calculate volume of spacetime V_s a closed string sucks up it

$$V_s=4\pi r_{p(\text{proton})}^3/(3N_{cs}) \quad (7)$$

Such volume of spacetime thickens in following volume near one tachyon

$$V_{cs}=2\pi r_t \pi r_t^2 \quad (8)$$

where r_t denotes mean radius of tachyons. Knowing inertial mass density of spacetime ρ_s [2], calculate the mass density of the thickened spacetime ρ_{ts}

$$\rho_{ts}=\rho_s V_s/V_{cs} \quad (9)$$

Centripetal force acting on one tachyon results from the pressure difference between the interior and exterior of the closed string. Because $\rho_{ts} \gg \rho_s$ then the centripetal force F_{cpt} is

$$F_{cpt}=\pi r_t^2 \rho_{ts} v_t^2/2 \quad (10)$$

where v_t denotes mean linear speed of tachyons.

Next compare the obtained centripetal force with the centrifugal force F_{cft} acting on the tachyons a closed string is composed of

$$F_{cft}=m_t v_t^2/r_t \quad (11)$$

where m_t denotes inertial mass of tachyon. For both forces we obtain about $2.2 \cdot 10^{133}$ N. It causes that the closed strings are the stable particles.

Due to the internal helicity of closed string and the dynamic viscosity, the closed string transforms the chaotic motions of the tachyons into the divergently moving tachyons. It is the mechanism responsible for how closed string acquires its own gravitational field by interacting with spacetime. Because of the direct collisions of the divergently moving tachyons with spacetime the gravitational field has finite range $2 \cdot 10^{36}$ m. The closed strings arise as the closed string/antistring pairs because resultant spin angular velocity and resultant internal helicity of spacetime must be equal to zero. Such closed strings are not flexible so it cannot vibrate. All closed strings have only one strictly determined frequency of internal helicity – it results from the law of conservation of energy (if we assume that mean linear kinetic energy and mean rotational kinetic energy of the tachyons have the same value then we obtain about $3 \cdot 10^{19}$ revolutions per spin period i.e. about $1.3 \cdot 10^{161}$ Hz).

Homogeneous description of the lifetimes

Suppose that the neutrinos inside the point masses of particles behave similarly as ionized gas (at assumption the gas) in stars. Theory of such stars says that the radiation pressure is directly proportional to the fourth power of the absolute temperature. The analogous relation ties the total energy emitted by the black body with temperature of it. This theory also says that the absolute temperature of a star is directly proportional to its mass. From it results that total energy emitted by star is directly proportional to the fourth power of mass. On the other hand, the maximal energy of created virtual particle, in surrounding of a point mass, is equal to the point mass. Because from the Heisenberg uncertainty principle results that lifetime of a particle is inversely proportional to energy of it so we obtain that lifetime of a point mass is inversely proportional to the fourth power of its mass

$$t \sim 1/m^4 \quad (12)$$

The same relation relates to the circular masses.

The coupling constant is directly proportional to the emitted maximal virtual energy equal to the mass of the emitter. On base of the uncertainty principle, we know that the lifetime of this energy is inversely proportional to this energy. From these relations we obtain

$$t \sim 1/\alpha \quad (13)$$

On the base of the Eq.(12-13) we can calculate the lifetimes of particles.

The time needed the large loop appeared on the surface of torus is

$$t_{\text{strong-minimal}} = t_{\text{em-minimal(proton)}} = (A/3)/c = 0.7755 \cdot 10^{-24} \text{ s}$$

It is the minimal time of the strong interactions and is equal to the time needed to a photon covered the distance between the 'electric charge', placed on the circular axis, and the surface of torus.

The tau in weak interaction behaves as the electron in the electromagnetic interaction so we have

$$t_{w(\text{tau})}/t_{\text{em-minimal(proton)}} = (m_{c(\text{proton})}/m_{c(\text{electron})})^4 = 2.4 \cdot 10^{12}$$

then the lifetime of tau is

$$t_{w(\text{tau})} = 1.9 \cdot 10^{-12} \text{ s.}$$

The weak interactions are responsible for the decay of the muon and $m_{p(\text{muon})} = m_{\text{muon}}/2$ so the lifetime of muon is

$$t_{w(\text{muon})} = t_{w(\text{tau})} (m_{p(\text{tau})}/m_{p(\text{muon})})^4 = 2.4 \cdot 10^{-6} \text{ s.}$$

The weak interactions are responsible for decays of hyperons and because in these interactions they behave as a nucleon, whereas the muon behaves as a electron, so the lifetime of hyperons is equal to

$$t_{w(\text{hyperons})} = t_{w(\text{muon})} / (\alpha_{w(\text{proton})} / \alpha_{w(\text{electron})}) = 1.2 \cdot 10^{-10} \text{ s.}$$

The weak interactions are responsible for the beta decay of neutron but in such decay the neutron behaves as the electron (the electron appears in this decay), whereas the decay of proton is impossible, so the lifetime of neutron is

$$t_{w(\text{neutron})} = t_{w(\text{hyperons})} (m_{p(\text{proton})} / m_{p(\text{electron})})^4 = 937 \text{ s.}$$

The lifetime of the charm hyperon $\Lambda_c^+(2260)$ is

$$t_{w(\Lambda(2260))} = t_{w(\text{hyperons})} (m_{p(\text{proton})} / m_{p(\Lambda(2260))})^4 = 6.5 \cdot 10^{-13} \text{ s}$$

where $m_{p(\Lambda(2260))} = m_{\Lambda(2260)} - m_{\Lambda(1115)} + Y = 1573 \text{ MeV.}$

The lifetime of the large loop created on the circular axis of the torus of nucleon can be calculated from the uncertainty principle $E_{pl} \cdot t_{pl} = \hbar$ where $E_{pl} = 67.5444 \text{ MeV}$ [2]. The neutral pion decays in respect of the weak interaction. The weak mass of the large loop we can calculate from formula $E_{pl(\text{weak})} = E_{pl} \cdot \alpha_{w(\text{proton})} = 1.26457 \text{ MeV}$ and it is the distance of masses between the neutron and proton.

Then the lifetime of the neutral pion is

$$t_{\text{pion}} = t_{pl} (E_{pl} / E_{pl(\text{weak})})^4 = 0.793 \cdot 10^{-16} \text{ s}$$

Charged pion decays because of the electromagnetic interaction of the weak mass then

$$t_{\text{pion}(+-)} = t_{\text{pion}} (1/\alpha_{\text{em}})^4 = 2.78 \cdot 10^{-8} \text{ s}$$

Homogeneous description of all interactions

Constants of interactions are directly proportional to inertial mass densities of fields carrying the interactions. Following formula defines the coupling constants of all interactions

$$\alpha_i = G_i M_i m_i / (c\hbar) \quad (14)$$

where M_i defines sum of mass of interacting particles plus mass of carrier of interactions inside the particles whereas m_i defines mass of carrier of interactions outside the interacting particles.

We know that neutral pion is binary system of large loops composed of the binary systems of neutrinos. It means that inside neutral pion are exchanged the binary systems of neutrinos whereas between the neutral pions are exchanged the large loops. We can neglect the mass of binary system of neutrinos in comparison to the mass of neutral pion. On other hand, from the Eq.(2) results that coupling constant for the large loops is unitary because their spin speed is equal to the 'c'. Then for the two strongly interacting neutral pions is

$$\alpha_S^{\pi\pi\gamma} = G_S(2m_{\text{pion}(0)})(m_{\text{pion}(0)}/2)/(c\hbar) = v/c = 1 \quad (15)$$

where v denotes the spin speed of the large loop. Then the constant of the strong interactions of pions is $G_S=5.46147 \cdot 10^{29} \text{ m}^3 \text{ s}^{-2} \text{ kg}^{-1}$.

Coupling constant for two strongly interacting protons is

$$\alpha_S^{\text{pp}\pi} = G_S(2m_{\text{proton}} + m_{\text{pion}(0)}/2)m_{\text{pion}(0)}/(c\hbar) = 14.4038 \quad (16)$$

In the plane perpendicular to the relativistic velocity, for relativistic nucleons is $\alpha_S^{\text{pp}\pi}(\text{relativistic})=13.9$. It results from fact that the G_S is directly proportional to the mass density of the strong field. When relativistic speed increases then the mass density decreases because decreases the spin speed of the loop so also the mass of the large loop must decrease: $E(\text{loop})2\pi r(\text{loop})/v(\text{spin-speed-of-loop})=\hbar$. In the relativistic version, we also must stand the c in the denominator for the spin speed of the loop.

From formula $ke^2=G_{\text{em}}m^2$ we can calculate the constant for the electromagnetic interactions of two electrons $G_{\text{em}}^{ee}=ke^2/m_{\text{electron}}^2$. This formula results from fact that the mass density of the electric charge of electron is the same as the density of the chaotic vectorial field [2].

Weak constant I calculated before – see Eq.(4). Inside the point mass, the neutrinos exchange tachyons. Near point mass of baryons are created virtual objects having mass equal to the point mass so between the point masses of baryons are exchanged particles having mass equal to the Y .

Remember that the gravitational constant is the parameter: $G=6.674 \cdot 10^{-11} \text{ m}^3 \text{ s}^{-2} \text{ kg}^{-1}$. Gravitational constant depends on the inertial mass density of spacetime, the internal structure of the stable closed strings, and the dynamic viscosity. Because the closed strings are stable and identical objects (they can differ only by the internal helicity), and because the dynamic viscosity has only one value so the ratio of the gravitational constant to the inertial mass density has strictly determined value.

Now I calculate the coupling constant of weak interactions of electron and magnetic moment of it.

The external radius of the torus of electron is equal to the Compton wavelength for the bare electron (the needed in the calculations the bare mass of electron I calculated below because to do it is needed the iteration) is $r_{z(\text{electron})}=3.86607 \cdot 10^{-13} \text{ m}$.

From Eq.(4) for a point mass M_p we have

$$G_w M_p = r_p c^2 \quad (17)$$

where r_p denotes the range of weak interactions.

Since

$$\alpha_w = G_w M_p m_p / (c\hbar) \quad (18)$$

where m_p denotes a mass interacting weakly with the M_p , so

$$\alpha_w = m_p r_p c / \hbar \quad (19)$$

To calculate the radius of the point mass of electron we should divide the point mass of electron by the mass Y and extract the cube root of the obtained result and next multiply it by the radius of the point mass of proton. The radius of the point mass of electron $r_{p(\text{electron})}$ is

$$r_{p(\text{electron})} = 0.735426 \cdot 10^{-18} \text{ m} \quad (20)$$

From Eq.(19) we obtain

$$\alpha_{w(\text{electron})} = 9.51129 \cdot 10^{-7} \quad (21)$$

Then

$$\alpha_{w(\text{proton})} / \alpha_{w(\text{electron})} = 19,685.3 \quad (22)$$

Mass of resting electron is equal to the sum of the mass of the bare electron and the electromagnetic and weak masses resulting from the interaction of the components of the virtual electron-positron pairs and the weak mass resulting from the interaction of the point mass with the electromagnetic and weak masses of the virtual pairs. The virtual pairs behave as if they were in distance equal to $2A/3$ from the point mass.

The formula for the coupling constants of the gravitational, weak and strong interactions is as follows

$$\alpha_i = G_i M m / (c \hbar) \quad (23)$$

The energy of the interaction defines formula

$$\Delta E_i = G_i M m / r \quad (24)$$

then from Eq.(23-24) we obtain

$$\Delta E_i = \alpha_i c \hbar / r = m_i c^2 \quad (25)$$

On the other hand the Compton wavelength of the bare particle is equal to the external radius of the torus and is defined by formula

$$\lambda_c = r_{z(\text{torus})} = \hbar / (m_{\text{bare}} c) \quad (26)$$

then from Eq.(25-26) we obtain

$$m_i = \alpha_i m_{\text{bare}} / (r / r_{z(\text{torus})}) \quad (27)$$

From Eq.(19) we have

$$\alpha_{w(\text{electron})} = m_{p(\text{electron})} r_{p(\text{electron})} c / \hbar \quad (28)$$

where $m_{p(\text{electron})}$ denotes the mass of the point mass of electron.

Because state of electron describes the wave function filling the whole Universe and because the torus of electron is a part of the chaotic vectorial field then we must take into account the dark energy in our Universe. The dark energy is the sphere filled with the binary systems of neutrinos created from the object before big bang suited to life. The mass of the dark energy is so many times greater than the baryonic mass of our Universe how many times the bare mass of the proton (it is the core of proton) is greater than the mass of the large loop created on the circular axis of the torus of proton. The ratio of these values is $\beta = 10.769806$.

The coupling constant of the weak interactions of the electron sunk in the dark energy we can calculate from formula

$$\alpha'_{w(\text{electron})} = (\beta + 1) \alpha_{w(\text{electron})} \quad (29)$$

Introduce the symbol

$$\gamma = \alpha_{em} / (\alpha'_{w(\text{electron})} + \alpha_{em}) \quad (30)$$

where γ denotes the mass fraction of the electromagnetic mass in the bare mass of the electron, whereas $1 - \gamma$ denotes the mass fraction of the weak mass in the bare mass of the electron.

Since distance between the constituents of a virtual pair is equal to the length of the equator of torus (it is because such is length of the virtual photons) so the ratio of the radiation mass (created by the virtual pairs) to the bare mass of electron is

$$\delta = \gamma \alpha_{em} / 2\pi + (1 - \gamma) \alpha'_{w(\text{electron})} / 2\pi \quad (31)$$

The ratio of the total mass of electron to its bare mass, which is equal to the ratio of the magnetic moment of the bare electron to the Bohr magneton for the electron, describes formula

$$\varepsilon = 1 + \delta + \delta \alpha'_{w(\text{electron})} / (2/3) \quad (32)$$

The first approximation ε_1 we obtain substituting the half of the measured mass of the electron for the point mass of the electron. Next we can substitute for the point mass of the electron the total mass of the electron divided by $2\varepsilon_1$ – it is the second approximation ε_2 , and so on. On base of such iteration we can calculate the point mass and bare mass of electron.

How great is the inaccuracy of the obtained result resulting from the spontaneous fluctuations in the chaotic vectorial field? The spontaneous fluctuations of the field composed

of the binary systems of neutrinos caused by the creations of the virtual electron-positron pairs inside the bare electron cause that the density of the chaotic vectorial field inside bare electron can differ from the mean density of this field by $\alpha_{w(\text{electron})}$ (see Eq.(27)). It means that the experimental result can differ from the calculated one by the value

$$(\varepsilon_2 - 1)\alpha_{w(\text{electron})} = 1.1 \cdot 10^{-9} \quad (33)$$

Then we obtain following value

$$\varepsilon_3 = 1.0011596531 \pm 0.0000000011 \quad (34)$$

Four-neutrino symmetry

Particle composed of the 4 different neutrinos has the resultant gravitational charge equal to zero, also the resultant internal helicity and spin is equal to zero. From it results that neutral object should be built of the $4n$ different neutrinos where the n denotes the integers. In order the interactions of elements an object is composed of were saturated the number of the elements in this object must be equal to the number of the neutrinos in each element. It causes that if the smaller object contains x neutrinos then the larger object must contain x^2 neutrinos. So the neutral pions should contain 4, 16, 256, etc. neutrinos. In the surroundings of the torus of a particle appear the virtual particles and the total mass of them cannot be greater than the mass of the real particle. It is easy to notice that in nucleon can be created at the same time at most 6 virtual neutral pions. These pions must differ by the number of the neutrinos because the neutrinos are the fermions. It means that for example the typical gravitational black hole built of the neutrons (i.e. photons on the equator of the typical black hole are moving with the speed 'c') can interact with about 4^{32} other typical black holes because at most such number of the neutrinos, having gravitational charges, contains virtual pion created inside the neutron. In fact, the early Universe contained two times more such typical black holes because the neutrons have two different states [2]. So in our early Universe was about $3.69 \cdot 10^{19}$ typical black holes. It is easy to calculate that the typical black hole built of neutrons had to have mass equal to about 25 times greater than the sun. The total mass of all these biggest neutron stars was equal to about $1.821 \cdot 10^{51}$ kg. Such mass has the baryonic matter (visible and dark) in our Universe. The typical early massive galaxy, which I call the protogalaxy, contained $2 \cdot 4^{16}$ typical black holes. Associations containing 4, 16, 256, etc. massive galaxies look as flattened spheroids. Notice that described above rules lead to the four-neutrino symmetry. This symmetry is obligatory also for following sequence of numbers: 64 (for example a meson built of four groups, each group built of four pions and each pion built of 4 neutrinos), 64^2 , 64^4 , etc. Such associations look as serpents.

Our Universe appeared analogically as the large loop inside the torus of baryons but the neutrinos in binary systems of neutrinos we must replace with the biggest neutron stars. Such model leads to the correct mass of our Universe. Also such model leads to the correct value of the anisotropy power of the quadrupole associated with the object-before-big-bang \rightarrow neutrino transition.

The objects which contained most the binary systems of neutrinos (they are an analogs to our early Universe), created in the nuclear transformations, decayed to 'galaxies' (which carries energy of photons) similarly as our early Universe decayed to the massive galaxies. Each such object decayed to the 4^{16} photonic galaxies. It leads to the 372 million photons in cubic meter in our Universe – it is the upper limit.

Some results associated with the constant K

Calculate the mass of typical gravitational neutron black hole. On the equator of such black hole the neutrons are moving with speed equal to the 'c' but such object is does not flatten out

because inside it the field composed of the binary systems of neutrinos rotates with the same angular speed – it means that the black hole is in rest in relation to the chaotic vectorial field. The nucleons in such object are placed in vertices of cubes and the lattice constant is equal to $a_c=(A+4B)/2^{1/2}$.

The radius of such black hole r_{bh} and the mass m_{bh} satisfy following equation

$$r_{bh} = Gm_{bh}/c^2 \quad (35)$$

If N_1 denotes the number of neutrons in such black hole then

$$4\pi r_{bh}^3/3 = N_1 a_c^3 \quad (36)$$

and

$$m_{bh} = N_1 m_{neutron} \quad (37)$$

Solving the set of equations Eq.(35-37) we get

$$N_1 = 2.946 \cdot 10^{58}$$

$$m_{bh} = 4.935 \cdot 10^{31} \text{ kg i.e. about 25 masses of the sun}$$

$$r_{bh} = 3.664 \cdot 10^4 \text{ m i.e. about 37 km}$$

On other hand from the four-neutrino symmetry results that the early our Universe was built of the $2 \cdot 4^{32}$ gravitational neutron black holes. It means that the baryonic mass of the Universe is $1.821 \cdot 10^{51}$ kg. The baryonic mass in our Universe should be the K^8 times greater than the rest mass of the large loop ($m_{LL} = 67.5444$ MeV) [2]. It means that is satisfied following relation

$$m_{LL} K^8 = 2 \cdot 4^{32} N_1 m_{neutron} \quad (38)$$

From it we obtain the value of the constant $K = 0.790 \cdot 10^{10}$.

Why value of the dark energy mass density calculated within the quantum theory is about 10^{120} times greater than the measured? We know that spin defines expression ‘mvr’. Knowing the natural speed of the closed strings [2] we can calculate the internal energy of neutrino. The ‘ $m_{neutrino} v^2$ ’ plus the calculated rest energy ‘ $m_{neutrino} c^2$ ’ is equal to the calculated rest mass of the object before big bang suited to life (it is equal to the ‘ $m_s c^2$ ’ where $m_s = 1.961 \cdot 10^{52}$ kg). It means that there is possible the object-before-big-bang \rightarrow neutrino transition and it was the reason why our Universe exited from the black hole state. It means that the measured energy of non-rotating neutrino should be $K^{12} = 0.59 \cdot 10^{119}$ times smaller than the energy (not mass) frozen inside the neutrino. The object-before-big-bang \rightarrow neutrino transition leads to creation of the sphere filled with binary systems of neutrinos. It is the dark energy.

The gravitational field propagates with speed equal to $2K^9/3$ i.e. $8 \cdot 10^{88}$ times higher than the ‘c’. The gravitons and gravitational waves are not in existence.

Properties of spacetime and the chaotic vectorial field lead to relativistic mass

Inertial and gravitational mass of a particle I define as directly proportional to number of all closed strings (or to total volume of all closed strings) the particle is built of. It also concerns the relativistic mass. The eternal mean speed of bound and free tachyons cannot change so spin speed of an accelerated particle decreases. It causes that pressure inside the particle also decreases and the particle absorbs the free binary systems of neutrinos, composed of the closed strings, from the chaotic vectorial field. Such mechanism causes that for particles composed of the binary systems of neutrinos is obligatory the Einstein formula $E=mc^2$. Generally, the mass and energy have not the same origin.

Not solved basic problems associated with spin are as follows:

What spontaneous phenomena lead to the law of conservation of spin?

Why spin of the particles cannot change in the interactions?

Fluctuations of spacetime and fields cause that there arise compressions and rarefactions. To extend lifetime of a compression the pressure inside it must decrease. Because mean speed of particles inside the compression cannot change then only creation of a vortex causes reduction

of the pressure. When we accelerate a vortex then spin speed of it decreases what causes that pressure also decreases. It means that to increase the pressure, the density of chaotic vectorial field inside vortex must increase. When we accelerate for example proton, then spin speed of it must decrease because the resultant speeds of the components the proton is composed of cannot change. It causes that pressure inside the proton decreases and additional energy accumulated in the chaotic vectorial field flows into the proton and transforms into vortex in such way that the spin is always half-integral.

When we accelerate some particle then the spin of torus must be parallel or antiparallel to the linear velocity. Then spin of particle does not change value. It means that the spin angular velocity is always parallel or antiparallel to the relativistic velocity – it is the reason why, for example, the spins of the all particles appearing in the muon decay overlap with the direction of motion of the muon. When we accelerate some particle, for example proton (the spin speed of the binary systems of neutrinos on the equator of the resting torus is equal to the ‘c’), then the spin angular speed of the torus decreases. It is because in the infinite cosmos and inside particles is obligatory the law of conservation of energy - in this case is conserved the total energy of the binary systems of neutrinos the torus is composed of. Rotations of the spin vectors of the binary systems of neutrinos, the torus is built of, are impossible because also electric charge must be conserved (all spins of the binary systems of neutrinos the torus is built of must be perpendicular to the surface of it).

Because the mean spin velocity of proton $v(\text{spin})$ is perpendicular to the relativistic velocity of proton $v(\text{relativistic})$ so for the binary systems of neutrinos placed on the equator we have

$$nv^2(\text{spin}) + nv^2(\text{relativistic}) = nc^2 \quad (39)$$

where the letter n denotes number of neutrinos in a relativistic proton.

Because there is obligatory the law of conservation of spin then for the binary systems of neutrinos placed on equator (similarly is for all other binary systems of neutrinos) we have

$$N_n c = nv(\text{spin}) \quad (40)$$

where ‘ N_n ’ denotes number of neutrinos in resting proton. The size of torus also cannot change because then the spin is changing.

Very simple transformations lead to following formula

$$n = N_n / (1 - v^2/c^2)^{1/2} \quad (41)$$

Because relativistic mass is directly proportional to the ‘ n ’ whereas the rest mass to the ‘ N_n ’ so we obtained the very well known Einstein’s formula. We see that this formula is correct only when:

-the half-integral spin is associated with the torus having surface similar to the Ketterle surface for a strongly interacting Fermi gas

-there is obligatory the laws of conservation of spin and energy

It means that relativistic proton is built of more binary systems of neutrinos i.e. the thickness of the surface of torus is greater – there are created next layers built of the same number of binary systems of neutrinos because number of the lines of electric forces, created by the torus, cannot change over time. Because the point mass must be about 4/3 greater than the mass of torus so also this mass increases when we accelerate a proton.

The neutrinos have not relativistic mass because the density of the field composed of the free closed strings is practically equal to zero - we do not observe some interactions associated with such field.

Characteristic total cross sections for N-N and π –N scattering

Knowing internal structure of particles, we can calculate the coupling constants for interactions and define needed in the calculations scattering potentials. Sometime the calculations are very simple as, for example, for proton-proton total cross sections. The

resting torus is composed of one layer of the binary systems of neutrinos and they are in distance about $2\pi r_{\text{neutrino}}$. It means that penetration of the tori of the protons the target consists of by moving protons is possible. Range of strong interactions for resting proton is a little greater than the radius of the last tunnel ($A+4B=2.70476$ fm) and is equal to the circumference of the large loop ($4\pi A/3=2.9215$ fm). In fact, the range is a little greater because the opened loop is tangential to the circular axis – the correct value is $d_{\text{range-strong}}=2.958$ fm. To neglect the cross section resulting from the electromagnetic interactions of nucleons they should be in distance smaller than $A+4B$. The nucleons in a beam and target have tendency to collect in vertices of squares having the diagonal equal to $A+4B$. The exchanged pions are most often in centres of the squares. The volumetric binding energy for such nucleons is 14.952 MeV. It means that we can neglect the electromagnetic interactions of nucleons in comparison with the strong interactions when the nucleons in a beam have energy about 15 MeV. For kinetic energy of proton about 15 MeV, due to the possible turns of the spins (thermal motions), the strong field fills the sphere having radius equal to the range of the strong interactions. A proton is scattered on a circular axis of resting torus of proton the target consists of (i.e. on the large loop having highest mass density in resting nucleon) when distance between them is less than the sum of range of the strong interactions and radius of the large loop $2A/3$. In this case the p-p cross section is

$$\sigma_{15\text{MeV}}(\text{p-p})=\pi(d_{\text{range-strong}}+2A/3)^2=368 \text{ mb} \quad (42)$$

For medium kinetic energies (it is a few hundred MeV) the total cross section very quickly decreases due to following reasons:

1 Spin of proton must be parallel or antiparallel to the relativistic velocity.

2 Spin speed of proton decreases when relativistic speed increases - it causes that the spin period of the large loops increases whereas mass of it decreases. It causes that the strong interactions outside torus of proton are vanishing.

Then, the colliding protons are scattered on their circular axes. It means that in this case the total cross section is

$$\sigma_{\text{medium}}(\text{p-p})=\pi(2A/3+2A/3)^2=27 \text{ mb} \quad (43)$$

For kinetic energies a few times higher than the rest mass of proton, on the surface of torus of proton appear a few new layers and the torus becomes non-transparent. For collisions of such protons with resting target the cross section is (tori of protons the target is composed of are transparent)

$$\sigma_{\text{high}}(\text{p-p})=\pi(A+2A/3)^2=42 \text{ mb} \quad (44)$$

For kinetic energies a few times higher than the rest mass of proton for antiparallel beams of nucleons is

$$\sigma_{\text{high-antiparallel}}(\text{p-p})=\pi(2A)^2=61 \text{ mb} \quad (45)$$

For n-p scattering total cross sections differ from the p-p scattering. The negative pion in neutron due to the electric attraction looks for the electric charge of proton. It means that proton sees the mass of negative pion. Because the large loops the negative pion is composed of are in the $d=1$ tunnel ($r=A+B$) and because the radius of the large loop is $2A/3$ so for energy about 15 MeV for the n-p scattering we obtain

$$\sigma_{15\text{MeV}}(\text{p-n})=\pi(d_{\text{range-strong}}+A+B+2A/3)^2=671 \text{ mb} \quad (46)$$

For very energetic p-n scattering mass of the negative pion is very small so the both total cross sections, i.e. for p-p and p-n, should have the same value.

It is easy to calculate that for very energetic π -p scattering the total cross section is about 27 mb – see Eq.(43). There should be significant reduction of the cross section for the negative pion-proton scattering for energies of the pion equal to the energies of the S pions [2] in the $d=0$ and $d=1$ tunnels i.e. in the tunnels lying under the Schwarzschild surface for the strong interactions. These energies are equal to about 423 MeV and 727 MeV [2]. These reductions are associated with the productions of the resonances.

New interpretation of the uncertainty principle

$$\frac{\sum_i E_i}{\sum_i \nu_i} = n |\hbar|$$

The uncertainty principle
for state-lifetime

$$\frac{\sum_i E_i}{2\pi \sum_i \nu_i} = n |\hbar|$$

The uncertainty principle
for vanishing

I will call the real and virtual photons, electrons and the electron-positron pairs in the chaotic vectorial field the renewable particles i.e. particles which disappear in one place of this field and appear in another one, and so on. It leads to the wave function. The same we can say about the real and virtual loops composed of the binary systems of neutrinos in the strongly interacting field i.e. field composed of the virtual and real large loops, created on the circular axis of the torus of the core of baryons, and bound states of the large loops such as pions and the eta mesons. Recapitulate: the photons and electrons in the chaotic vectorial field and the free and bound large loops in the strongly interacting field behave as the quantum particles. We observe some distribution of energy, mass or mass/energy of the renewable/quantum particles in the adequate field. Such distribution we can describe by means of the wave function. Value of the 'n' (see the figures titled 'The uncertainty principle for state lifetime' and 'The uncertainty principle for vanishing') depends on the spins of the objects a field is composed of. For photons, the electron-positron pairs and the large loops created in the chaotic vectorial field is $n=1$. It means that for electrons is $n=\hbar/2$ but new free electrons cannot be created in the chaotic vectorial field (only the electron-positron pairs can be) because for the chaotic vectorial field is $n=1$. The observed today electrons were created during the era when the first time was broken symmetry of field - it is described below. Now I only emphasize that there were the three different types of broken symmetry in history of the Universe. Because the strong field is also composed of the pions i.e. of the binary systems of the large loops then for such field we have $n=2$. It means that in such field arise loops having spin equal to $2\hbar$. Such loops are in the resonances.

Two entangled neutrinos have different gravitational charges and during the period of rotation, at least two times the same direction and senses of the spins.

From the uncertainty principle written in the new shapes results that for example photons can be the rotational energy of only one binary system of neutrinos ($i=1$) or of the ' $i>1$ ' binary systems of neutrinos. For a photon, the ' i ' has strictly determined value – it is the number of the entangled photons the photon consists of. A photon behaves as follows: the ' i ' entangled photons disappear in some places of the chaotic vectorial field and appear in other ' i ' places of it, and so on. It leads to conclusion that photons sometimes behaves as particles ($i=1$) or as wave composed of entangled photons ($i>>1$). We see that the uncertainty principle and the quantum physics are associated with the appearing/disappearing mechanism i.e. with the changing distribution of the ' i ' entangled photons.

There are two different times for the renewable/quantum particles. A renewable particle arises as an energy loop. Lifetime of such loop is equal to the period of spinning of it (such period I will call the state-lifetime). After the state-lifetime, the loop collapses to the centre of it and the time of such process is the time of vanishing of the loop. We see that state-lifetime of a renewable particle is associated with the length of the circumference of the loop whereas the time of vanishing is associated with the radius of the loop. It means that the state-lifetime is 2π times longer than the time of vanishing. Length of wave is associated with the time of vanishing so to obtain the state-lifetime of a photon we must multiple the time resulting from the length of wave by the 2π .

The inverse of the resultant frequency in the uncertainty principle is not a lifetime of a renewable particle – it is the state-lifetime in one state with determined value of the ' i '. There are two different lifetimes for a photon. State-lifetime is the time of some distribution of the entangled photons a photon is composed of ($i=\text{const}$) whereas the lifetime of a photon is the time after which the photon decays to more non-entangled photons composed of entangled photons i.e. the ' i ' changes value. Strictly determined photon, after its lifetime, decays to smaller groups of entangled photons determined by the four-neutrino symmetry. The sum of the energies of the entangled photons does not define the uncertainty of energy – it is uncertainty of distribution of the ' i ' entangled photons a photon consists of. After the state-time resulting from the sum of the frequencies of the entangled photons, the distribution of the entangled photons is changing.

Emission of photon composed of greater number of associated photons are more probable because then the amplitude of the wave function has smaller value. It means that also lifetime of the photon should be longer. Describing the four-neutrino symmetry, I wrote that maximal number of entangled photons in photons emitted in the nuclear transformations is $i=4^{32}$ and such states of the emitted photons are most probable. Such photons, after its lifetime, decay to not entangled photons composed of entangled photons, i.e. to the photon galaxies ($i=4^{16}$), similarly as our early Universe decayed to the massive protogalaxies. We see that today dominate the massive galaxies so we can assume that there dominate the photon galaxies i.e. that lifetime of the photon galaxies is to approximate the lifetime of the massive galaxies. When the massive galaxies will start to decay to smaller objects then also the photon galaxies should make the same. The lifetime of the photon galaxies should be 4^{16} times longer than the lifetime of the original photons.

Assume that for $i=1$ the state-lifetime of a photon is equal to the lifetime of photon. Today, the mean length of the photons the CMB radiation composes of is about 1.9 mm. From it we can calculate the time of vanishing for $i=1$ and next the state-lifetime (it is the time of vanishing multiplied by the 2π) for $i=1$ which is equal to the lifetime. Lifetime of photon containing $i=4^{32}$ entangled photons is the ' i ' times longer – it is equal to about 23 years. Lifetime of the photon galaxies should be $i=4^{16}$ times longer because the photon galaxies are not entangled so their energy is smaller than the original photon. It means that lifetime of the

photon galaxies is about 100 billion years. It leads to conclusion that today the CMB radiation is composed of the photon galaxies. It leads to about 372 million photons per cubic meter what very well corresponds with the observational facts. Because the Universe is expanding then, over time, the length of the photons increases.

Broken Symmetry

We can derive whole nature from physical properties of spacetime and the mass density of the chaotic vectorial field composed of the binary systems of neutrinos.

In the chaotic vectorial field appear spontaneous fluctuations. Because the fundamental field, i.e. spacetime, is composed of tachyons having the eternal linear and rotational energy, then thickened fluctuation transforms into vortex having internal helicity. Resultant helicity and angular velocity associated with spinning of vortices must be equal to zero. It means that the rotary vortices arise as the vortex-antivortex pairs. It was the first era of the broken symmetry of the chaotic vectorial field. This broken symmetry is associated with production of the rotary vortices having spin and internal helicity. Distance between the vortex and antivortex should be shorter than the range of the gravitational forces (about $2 \cdot 10^{36}$ m – it is about 10 billions times greater distance than the present radius of the Universe) and sufficiently bigger than the radii of the vortices to not annihilate too quickly. In both components of the vortex-antivortex pair, the creations of the electron-positron pairs were possible. When mass density inside vortex was sufficiently high, in the left-handed vortex appeared the positron-proton transitions whereas in the right-handed one the electron-antiproton transitions. It was the second era of the broken symmetry of the field composed of the binary systems of neutrinos. When mass of a vortex is strictly determined then there is possible the vortex \rightarrow object-before-big-bang-suited-to-life transition. As I wrote, our rotary vortex was left-handed and there were created the left-handed protons and next the left-handed neutrons. From the neutrons where created the torus, the point mass in the centre of torus and the loop inside torus composed of the protogalaxies – they consisted of the greatest neutron stars. Because of the four-neutrino symmetry and the gravitational charges of the neutrinos, the protogalaxies grouped in larger structures already before big bang. Because the internal energy of neutrino is equal to the mass of the object before big bang suited to life, one ‘day’, there was the object-before-big-bang-suited-to-life \rightarrow neutrino transition. It caused that the early Universe (i.e. the loop) started the intensive evaporation caused by the beta decays of the neutrons and next the electric repulsion of the protons. The appearing in the beta decays the electron-antineutrinos the third time in history of evolution of the left-handed rotary vortex broken symmetry of the chaotic vectorial field. It means that present symmetry of the Universe is broken due to the senses of the angular velocities of the massive spiral galaxies in relation to the senses of their magnetic axes (most often the helicity should be the same), because of the electron-proton asymmetry, and due to the chaotic vectorial field contains more the electron-antineutrinos.

Summary

Weak interactions of baryons lead to the stable inflexible closed strings having the same radii.

Point and circular masses behave as ionized gas in stars. Such model leads to lifetimes of particles consistent with the experimental data.

Constants of interactions are directly proportional to the mass densities of the fields carrying the interactions. The factors of proportionality have the same value.

Properties of spacetime and the chaotic vectorial field lead to the relativistic mass.

The four-neutrino symmetry solves many problems associated with the particle physics and cosmology.

The obtained characteristic total cross sections for N-N and pion-N scattering are consistent with the experimental data.

New interpretation of the uncertainty principle leads to about 372 million photons per cubic meter in our Universe. Photons entangle due to the interactions of the gravitational dipoles – they are the binary systems of neutrinos. It is the new element of gravity.

In history of the Universe, symmetry was broken three times.

Table 1 *Theoretical results*

Physical quantity	Theoretical value
Point mass of nucleon	424.124 MeV
Centripetal force acting on the closed string	2.2 E+133 N
Frequency associated with internal helicity of closed string	1.3 E+161 Hz
Range of gravitational field	2 E+36 m
Circular mass plus mass of torus of nucleon	318.296 MeV
External radius of torus of electron	386.607 fm
Range of weak interactions of proton	8.71113 E-18 m
Range of weak interactions of electron	0.735426 E-18 m
Lifetime of proton	Stable
Lifetime of neutron	937 s
Lifetime of muon	2.4 E-6 s
Lifetime of tau	1.9 E-12 s
Lifetime of hyperon	1.2 E-10 s
Lifetime of charm baryon λ_c^+ (2260)	6.5 E-13 s
Lifetime of neutral pion	0.79 E-16 s
Lifetime of charged pion	2.8 E-8 s

*2.2 E+133=2.2·10¹³³

Table 2 *Theoretical results*

Physical quantity	Theoretical value
Coupling constant for weak interactions of proton	0.0187233
Coupling constant for weak interaction of electron when we take into account the dark energy	1.11946 E-5
Coupling constant for weak interaction of electron when we do not take into account the dark energy	0.951129 E-6
Coupling constant for strong-weak interactions inside nucleon	d=0: 0.993813
	d=1: 0.762597
	d=2: 0.640308
Coupling constant for strong interactions of non-relativistic protons	14.4038
Coupling constant for strong interactions of relativistic protons in plane perpendicular to the relativistic velocity	13.9
Coupling constant for strong interactions of pions	1
Magnetic moment of electron	1.0011596531± ±0.0000000011
Mass of typical neutron black hole	~ 25 masses of the sun
Radius of typical neutron black hole	~ 37 km
Total mass of the dark energy	1.961 E+52 kg
Mass of the baryonic matter	1.821 E+51 kg
Ratio of the hidden dark energy to mass of neutrino	0.59 E+119
Ratio of the total mass of the dark energy to the mass of baryonic matter (inside sphere filled with baryons the ratio has different value)	10.7698
Volumetric binding energy	14.952 MeV
p-p total cross section for kinetic energy about 15 MeV	368 mb
p-p total cross section for kinetic energies about a few hundred MeV	27 mb
p-p total cross section for kinetic energies equal to about a few rest masses of protons	42 mb
N-N total cross section for kinetic energies equal to about a few rest masses of proton for antiparallel beams	61 mb
p-n total cross section for kinetic energy about 15 MeV	671 mb
p-n total cross section for kinetic energies equal to about a few rest masses of proton	42 mb
π -p total cross section for very high energies	27 mb
Significant reduction of the cross sections for negative pion-proton scattering	423 MeV
	727 MeV

Table 3 *Values of the G(i)*

Interaction	Relative value of the G(i)
Strong interaction of pions	1 (for $G_S=5.46147 \cdot 10^{29} \text{ m}^3 \text{ s}^{-2} \text{ kg}^{-1}$)
Weak interaction	$1.9 \cdot 10^{-3}$
Electromagnetic interaction of electrons	$5.1 \cdot 10^2$ (it is not a mistake)
Gravitational interaction	$1.2 \cdot 10^{-40}$

References

- [1] S Kornowski; *Experimental Data and Program of Ultimate Theory*
 [2] S Kornowski; *Phase Transitions of Spacetime and Nucleons*

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New Cosmology

Sylwester Kornowski

Abstract: On base of the four possible phase transitions of granulated spacetime and the Titius-Bode laws for strong and gravitational interactions is described evolution of the object before big bang suited to life, cosmogony of the Solar System, and cosmogony of the massive spiral galaxies. The anisotropy power for the quadrupole is calculated.

Introduction

The six parameters describing physical state of granulated spacetime and the mass density of the chaotic vectorial field lead to the object before big bang suited to life [1], [2]. Our early Universe arose similarly as the large loop responsible for the strong interactions in the baryons but we must replace the binary systems of neutrinos the large loops are composed of for binary systems of the greatest neutron stars – they are the typical neutron black holes [2].

The object before big bang suited to life was the big torus around spherical mass. The surface of torus was composed of deuterium (i.e. of electrons and binary systems of nucleons) and looked similarly as the Ketterle surface for Fermi gas [4]. In centre of the torus was mass composed of the typical neutron black holes. Calculated mass of whole object is $M=1.961 \cdot 10^{52}$ kg. Radius of the equator of the big torus was equal to 286.7 million light-years. Our Universe appeared similarly as the large loops inside torus of baryons. It means that our Universe appeared on the circular axis inside the big torus as the loop composed of the protogalaxies built of the typical neutron black holes. These protogalaxies assembled into larger structures, visible today, already before big bang due to the four-neutrino symmetry resulting from the gravitational charges of neutrinos and their internal helicities [1], [2]. The anticlockwise internal helicity of our Universe was defined by the rotation of the protogalaxies (the axes of rotation of the protogalaxies, also the magnetic axes, before big bang were tangential to the circular axis of the big torus) and the spin speed which was practically equal to zero (it was because the loop had integral spin). Calculated mass of the Universe (without the dark energy which is the remainder of the big torus and the big central mass) is $m=1.821 \cdot 10^{51}$ kg. Ratio of the mass of the object before big bang suited to life to the mass of the Universe was $\beta=10.769806$. Radius of the Universe loop was equal to 191.1 million light-years.

Because neutrino is built of the closed strings moving with speed $2.4248 \cdot 10^{59}$ times higher than the 'c' so the energy (not mass) frozen inside neutrino (then not measured by external observer) is equal to the M

$$M=m_{\text{neutrino}}(2.4248 \cdot 10^{59})^2 \quad (1)$$

where $m_{\text{neutrino}}=3.33493 \cdot 10^{-67}$ kg. It means that there is possible the object-before-big-bang \rightarrow neutrino transition. During such transition, the nucleons, the big torus and the central mass consisted of, decayed to free non-rotating binary systems of neutrinos. We see that there was created sphere filled with the additional binary systems of neutrinos. It is the dark energy having mass/energy equal to the M. The mixing of the dark energy and the early Universe started about 48 million years after creation of the new neutrino. Relativistic speed is the speed in relation to the chaotic vectorial field composed of the binary systems of neutrinos. In the nucleons can appear relativistic neutral pions having mass equal to 208.644 MeV. During the mixing were emitted the relativistic neutral pions having energy equal to the 208.644 MeV. Such processes appeared when the relativistic masses of cores of baryons were the 208.644 MeV greater than the rest masses and when the baryons were in rest in relation to the chaotic vectorial field. It means that expansion of the baryonic matter decelerated. Knowing the rest mass of core of baryons [2] we can calculate the maximal speed of the baryonic matter $v(\text{maximal})=0.6293648c$. It means that radial speed of the most distant galaxies cannot exceed the $v(\text{maximal})$. It also means that today the radius of the sphere filled with baryons is $v(\text{maximal})/c$ times smaller than the radius of the sphere filled with the dark energy. Because the dark energy is the β times greater than the baryonic matter then inside the sphere filled with baryons we should observe 1 part of the baryonic matter (visible and dark) per $\beta v(\text{maximal})^3=2.6848203$ parts of the dark energy. It leads to conclusion that inside the sphere filled with baryons there is about 27% of the baryonic matter and about 73% of the dark energy. We see that such abundance is consistent with the observational facts.

Why there was big bang of the baryonic loop (i.e. of the early Universe) after the object-before-big-bang → neutrino transition? When the gravitational field of the big torus squeezing the early Universe disappeared, there started intensive evaporation of the typical neutron black holes the baryonic loop was composed of. The neutrons placed on the surface of the stars, in respect of the weak decays, emitted the electrons and electron-antineutrinos in directions parallel to the magnetic axes. Owing to the electric repulsion of electrons, the strongly collimated jets were composed of, the electrons and electron-antineutrinos could overcome the gravitational field of the neutron black holes. Such electrons had speeds almost equal to the 'c'. Due to the beta decays, the surface of neutron black hole charged positively. The electric repulsion of protons caused that the protons assembled on the equator of neutron black hole. Ultimately, the electric repulsion exceeded the gravitational attraction and there took place the proton explosions in the plane of the equator. The proton beams carried forward some neutrons - it caused the additional emissions of electrons and electron antineutrinos in directions perpendicular to the plane of disc. The emitted protons captured the electrons and created the protonuclei. From them were formed the big stars i.e. the first generation of stars. Electric repulsion and the energy released in the first nuclear transformations before the era of the big stars and the energy released in the second nuclear transformations inside the big stars caused the big bang.

Cosmic structures in the Universe

The four-neutrino symmetry leads to following formula describing the number of objects in the structures of the Universe

$$D = 4^d \quad (2)$$

where $d=0,1,2,4,8,16$ for the structures having shape of flattened spheroid, and $d=3,6,12$ for the structures having shape of serpent.

The four-neutrino symmetry law concerns the neutrinos in the pions, the binary systems of neutrinos, the neutrons in protonuclei (at the beginning they contained only the neutrons), the typical neutron black holes in protogalaxies, the protogalaxies (the protogalaxies I call also the massive galaxies) in the Universe.

The structures I call as follows

$d=0$ single object

$d=1$ group

$d=2$ supergroup

$d=4$ cluster

$d=8$ supercluster

$d=16$ megacluster (the early Universe was the megacluster of the protogalaxies)

$d=3$ chain

$d=6$ superchain

$d=12$ megachain

Abundance of the chemical elements before the era of big stars

Due to the four-neutrino symmetry and the weight equilibrium before the era of big stars, per each free 256 neutrons there were 64 groups each containing 4 neutrons, 16 supergroups each containing 16 neutrons, 4 chains each containing 64 neutrons, and 1 cluster containing 256 neutrons. Then the abundance was as follows (total number of the protonuclei is 341)

Free neutrons	75.07 % (from them was created hydrogen)
Groups	18.77 % (from them was created helium)
Supergroups	4.69 % (from them were created oxygen)
Chains	1.17 % (from them were created first of all iron)
Clusters	0.29 % (from them were created first of all Pu-244 and then lead)

Abundance of the chemical elements just after the era of big stars

The observed 'oscillations' of the neutrinos are only the exchanges of the free neutrinos for the neutrinos the chaotic vectorial field is composed of. It means that on base of such 'oscillations' we cannot calculate mass of neutrinos. To explain the solar neutrino problem without the neutrino 'oscillations' (they are impossible because of the tremendous energy frozen inside them) we must assume that inside the sun and other stars, on surfaces separating the layers of the chemical elements, works the GASER (Gamma Amplification by Stimulated Emission of Radiation).

Energy of emitted quanta in the nucleons-helium transformations is 7.06 MeV. These quanta group because of the four-neutrino symmetry. It means that associations of them contain 1, 4, 16, 64, 256... quanta. The total energies of the possible associations are about 7 MeV, 28 MeV, 113 MeV, 452 MeV.... The association having energy about 28 MeV disturbs 4 nucleons and it causes that these nucleons transform into helium (in such transformation there is emitted next association having energy equal to about 28 MeV). The association having energy equal to about 113 MeV disturbs the 14 nuclei of helium and it causes that these nuclei transform into iron or nickel (in such transformation there is emitted next association having energy equal to about 97 MeV). The other associations are useless. It means that in the core of star are amplified the associations containing 4 and 16 quanta. We see that there are two basic channels of nuclear transformations in the core of star: hydrogen into helium, and helium into iron (with impurity of nickel).

The GASER and the four-neutrino symmetry lead to conclusion that the abundance of chemical elements (in the Universe) should have big 'peaks' for 1, 4, (16), 56, (208) nucleons. It is consistent with the observational facts.

Assume that the released energy in the centre of the sun is only the result of the neutrons-helium transformations. For example, the transformation of 112 neutrons into 28 nuclei of helium releases energy equal to 791 MeV and are emitted **56 electron-antineutrinos**.

Assume now that there works the GASER. To release energy about 791 MeV there should appear 4 nuclei of iron-56 as the result of helium-iron transformations (about 388 MeV) and 14 nuclei of helium as the result of neutrons-helium transformations (about 395 MeV). In these two main channels of nuclear transformations should be released the same energy. In the first channel are absorbed 8 electron-antineutrinos (because of the 8 processes inverse to the beta decay), whereas in the second are emitted 28 electron-antineutrinos (because of the 28 beta decays), so in these two transformations are emitted **20 electron-antineutrinos**.

We see that if there works GASER then star emits about **3 times less** the electron-antineutrinos and it solves the solar neutrino problem without the neutrino 'oscillations'.

The electron-antineutrino can transform neutron into proton because of the neutrino amplification by stimulated emission of neutrinos:

Neutron plus electron-antineutrino = proton plus electron plus 2electron-antineutrinos.

We can assume that in stable stars there is the energy equilibrium for the dominant processes of the nuclear transformations. Because the nuclear binding energy per nucleon has for the iron-56 value 8.79 MeV, however for the helium-4 it is 7.06 MeV then in the hydrogen layer should be about $100\% \cdot (8.79 - 7.06) / 7.06 = 24.5\%$ of helium and 75.5% of hydrogen if we do not take into account the more massive nuclei. Just after the era of the big stars, abundance of the helium and hydrogen was different because the gravitational field faster squeezed the iron nuclei placed in centre of the big stars so the binding energy per nucleon had for the iron-56 a little greater value (about 3.6% greater). How we can calculate the abundance of helium and hydrogen just after the era of big stars? We know that luminosity is almost directly proportional to four powers of mass of star. Whereas this theory leads to conclusion that lifetime of star is inversely proportional to four powers of mass [2]. It means that lifetime of

star is inversely proportional to its luminosity. A brief history of the solar system is as follows. First, there was big star - the Oort's cloud is remnant of the era of big stars. Next, there was the supernova of Ia type - the Kuiper's belt is remnant of the supernova. Now, there is the sun. If we assume that mass of the Ia supernova is about 1.44 times greater than the mass of the sun then its lifetime should be about 4.3 times shorter than the sun (I assume that the lifetime of the sun will be equal to about 15 billion years). The luminosity of such supernova is about 4.3 times greater than for the sun. Knowing the solar luminosity (I assume that it does not change with time – I know that it is only some approximation) and knowing the age of the sun (about 5 billion years) we can calculate that total energy emitted by the sun per nucleon – it is about 0.317 MeV. It means that the total energy emitted in our region of Galaxy, after the era of big stars, is about 1.27 MeV per nucleon because the supernova emitted about 3.0 times more energy than the sun to the present day. Assume that in other regions of massive galaxies was similarly. Today is about 3 times more the hydrogen than helium and in the nuclear transformations of visible matter into iron, is released about 3.5 MeV per each new nucleon in the dark matter. It is because there works the GASER – when about 14 nuclei of He-4 are transformed into Fe then there is released energy about $14 \cdot 7.06 + 56 \cdot 1.73 = 195.7$ MeV; it is about $195.7/56 = 3.5$ MeV per each new nucleon transformed into the dark matter. It leads to conclusion that since the era of big stars about 36% of the visible matter transformed into the dark matter. The dark matter is composed of the Fe+Ni lumps produced in the era of big stars. Temperature of these lumps is equal to the CMB radiation so their detection is very difficult. The dark matter is composed also of the stone+iron lumps produced by the supernovae. From it results that just after the era of big stars was about 29% of helium and 71% of hydrogen. It also leads to conclusion that the mean nuclear binding energy per nucleon in iron was about 3.6% greater (about 9.11 MeV) than in free nucleus. What were the causes of creation of such composition of matter? The first reason is the initial abundance of the chemical elements, the second cause is associated with the values of the nuclear binding energy per nucleon, and the third is the law saying that the released binding energy for the dominant types of nuclear transformations should have the same value. Assume that the big stars exploded when all the heaviest nuclei were transformed into iron (with impurity of nickel) and that the heaviest nuclei containing 256 nucleons (i.e. Nobel-256 and Lorens-256) have the binding energy equal to 7.06 MeV per nucleon (they are very unstable so we can treat them as set of almost free alpha-particles).

Table 1 *Big stars just after the beginning of big bang*

Composition at the beginning	Composition at the end	Released binding energy per nucleon
20% H-1	71% H; $100\% \cdot 2.05/7.06 = 29\%$ He	7.06 MeV
20% He-4	20% Fe-56	2.05 MeV
20% O-16	20% Fe-56	1.11 MeV
20% ^{64}X	20% Fe-56	0.00 MeV
20% ^{256}Y	20% Fe-56	2.05 MeV

During the explosions of the big stars, there arose the iron droplets and iron lumps similarly as the water droplets and hails in the Earth atmosphere. Today the iron droplets and lumps have temperature the same as the CMB – it is because this dark baryonic matter arose in the halos of the galaxies and larger structures during the first a few tens million years. It means that detection of the dark matter is very difficult.

Table 2 Stars of second generation with working the GASER

Composition at the beginning	Nuclear transformations	Released binding energy per nucleon
71% H-1	H-1 \rightarrow He-4	7.06 MeV
29% He-4	He-4 \rightarrow Fe For 1 part of the H-1 \rightarrow He-4 is 7.06/1.73=4.081 parts of the He \rightarrow Fe Over time amount of He decreases	8.79-7.06=1.73 MeV
about 0% Fe-56	Over time amount of Fe increases	

Above I calculated that inside the sphere filled with baryons is about 73% of the dark energy composed of the non-rotating binary systems of neutrinos. Rest, i.e. the 27%, it is the visible and dark baryonic matter. From Table 7 results that just after the era of big stars, there was 4 times more the dark matter than the visible matter but inside the stars of second and third generation about 36% of the visible baryonic matter transformed into the dark baryonic matter. During the explosions of supernovae first is produced the proton-neutron symmetrical nickel and then Fe-56, Si-28, N-14, Li-7, because in very high temperatures the decays should be symmetrical – we see the series: 56, 28=56/2, 14=28/2=56/4, 7=56/8; also similarly is for Ni-64, S-32, O-16. It means that today there should be about 3.5% of the visible matter, 23.5% of the dark matter, and 73% of the dark energy. It is consistent with the observational facts.

Radius of the Universe and Hubble constants

During the era of neutron stars and the era of big stars 80% of free neutrons were transformed into iron (about 92%) with impurity of nickel (about 8%) and 5.81% into helium - it means that about 40% of neutrons were transformed into protons. In the decay of neutron is released energy equal to about 0.77 MeV – it is about 0.31 MeV per each nucleon in the Universe. There was also released the nuclear binding energy. Because the binding energy per nucleon inside iron is 8.79 MeV, whereas inside helium is 7.06 MeV then there was released energy 7.4 MeV per each nucleon in our Universe. The sum is equal to $L_0=7.71$ MeV per each nucleon. It means that energy of the CMB (without the ripples) is

$$E_{\text{background}} = mL_0c^2/m_{\text{neutron}} = 1.32 \cdot 10^{66} \text{ J} \quad (3)$$

We know that the today density of the energy of the microwave background radiation is equal to $\rho_{\text{background}}=4.17 \cdot 10^{-14} \text{ J/m}^3$, then from formula

$$4\pi R_{\text{CMB}}^3/3 = E_{\text{background}}/\rho_{\text{background}} \quad (4)$$

results that the smallest radius of the sphere filled with CMB is

$R_{\text{CMB}}=1.96 \cdot 10^{26} \text{ m}$, i.e. 20.7 billion light-years.

The greatest radius of the sphere filled with the CMB is 20.9 billion light-years because the initial radius of the loop of the Universe was about 0.2 billion light-years.

The smallest radius of the sphere filled with dark energy is 20.8 billion light-years.

The greatest radius of the sphere filled with dark energy is 21.1 billion light-years.

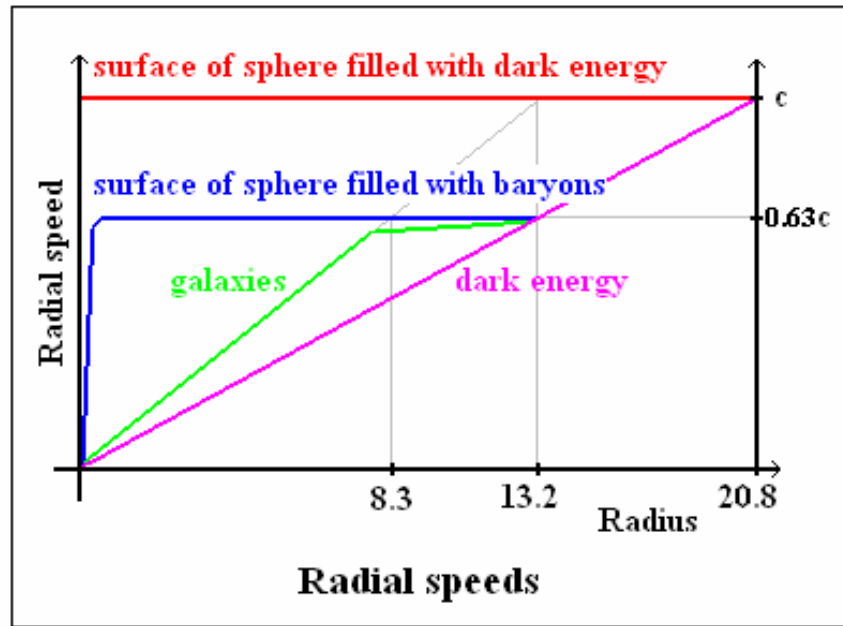
The smallest radius of the sphere filled with baryons (also the baryonic dark matter) is

$R_{\text{dark-matter}}=v(\text{maximal})R_{\text{CMB/dark-energy}}=13.1$ billion light-years.

The greatest radius of the sphere filled with baryons (also the baryonic dark matter) is 13.3 billion light-years.

Approximately the radius of the sphere filled with the CMB and the dark energy, is about 20.8 billion light-years, whereas the radius of the sphere filled with baryons (also the baryonic dark matter) is 13.2 light-years.

The Hubble constant H is defined as $H=c/R_{\text{sphere}}$, dimensionality is $\text{km}\cdot\text{s}^{-1}\cdot\text{Mps}^{-1}$. We can distinguish the three regions.



First region stretches from the centre of the Universe (i.e. from the centre of the biggest void) to distance $v(\text{maximal})R_{\text{dark-matter}}=8.3$ billion light-years. For this region the Hubble constant for the galaxies is $H_1=74$. Second region stretches from the distance 8.3 billion light-years to distance 13.2 billion light-years. In this region the Hubble constant for the galaxies decreases from $H_1=74$ to $H_3=47$. Third region stretches from the distance 13.2 billion light-years to distance 20.8 billion light-years. For this region the Hubble constant for the dark energy is $H_3=47$. The decreasing value of the Hubble constant inside the second region suggests the acceleration of the expansion of the Universe but we see that it is only an illusion.

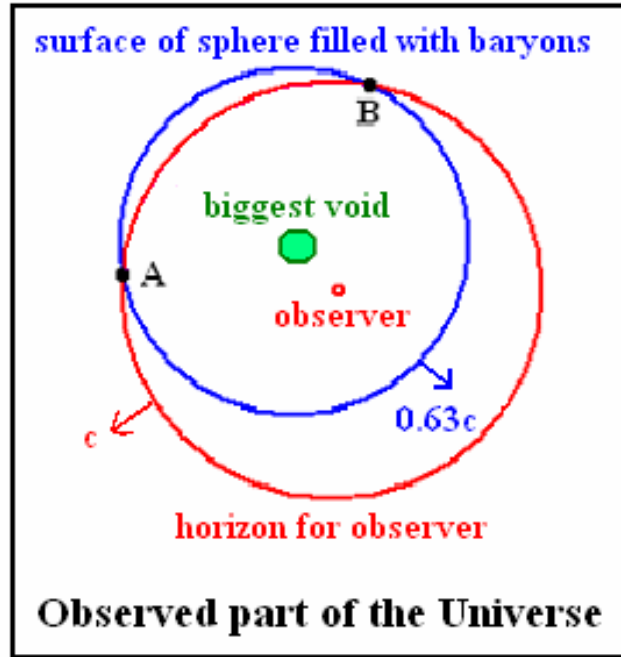
From the figure ‘Observed part of the Universe’ results that we can see the objects as they looked just after the object-before-big-bang \rightarrow neutrino transition only if our galaxy is placed in distance greater than 7.6 billion light-years from centre of the Universe. Such objects are on circle perpendicular to the figure and going through the points A and B. The Doppler red shift cannot be greater than 1. Greater value of the red shift than 1 suggests that the photons were moving in strong gravitational field

$$z = z_{\text{Doppler}} + z_{\text{gravity}} \quad (5)$$

The formula

$$v_r/c = [(1+z)^2 - 1] / [(1+z)^2 + 1] \quad (6)$$

where $z = \Delta\lambda/\lambda$, is incorrect. Notice that this formula leads to conclusion that the Doppler shift for observer placed in the centre of the baryonic matter and for the objects in distance 13.2 billion light-years from the centre of the Universe, is 0.6 (at the assumption that these objects are moving with the radial speed equal to the ‘c’). My theory leads to conclusion that this red shift is equal to 0.63 because these objects are moving with the radial speed equal to 0.63c. We see that my interpretation differs very much from the applied in the Cosmological Standard Model.



The Ω constant and number of photons in cubic meter

In the Einstein-de Sitter model the critical density is

$$\rho_{E-S} = 1.9 \cdot 10^{-26} h^2 \text{ kg/m}^3$$

where h is associated with the Hubble constant H by relation $H = h \cdot 100 \text{ (km/s)/Mps}$.

We know that the Hubble constant for the CMB has value equal to $H_1=47$ so the critical density for the CMB is

$$\rho_{E-S}(\text{CMB}) = 4.2 \cdot 10^{-27} \text{ kg/m}^3$$

The ratio of the radius of sphere filled with baryons to the radius of sphere filled with CMB is equal to $v(\text{maximal})/c=0.6293648$ then the Hubble constant for the baryonic matter inside sphere of radius equal to 8.3 billion light-years has value equal to $H_3=74$. It means that the critical density for the baryonic matter is

$$\rho_{E-S}(\text{baryonic matter}) = 1.04 \cdot 10^{-26} \text{ kg/m}^3$$

The mass density inside the sphere filled with baryons is (baryonic matter plus dark energy)

$$\rho = m(1 + \beta(v(\text{maximal})/c)^3) / (V(v(\text{maximal})/c)^3) = 8.41 \cdot 10^{-28} \text{ kg/m}^3 \quad (7)$$

where $V=3.2 \cdot 10^{79} \text{ m}^3$.

The ratio of the mass density inside the sphere filled with baryons to the critical density is

$$\Omega = \rho / \rho_{E-S}(\text{baryonic matter}) = 0.08$$

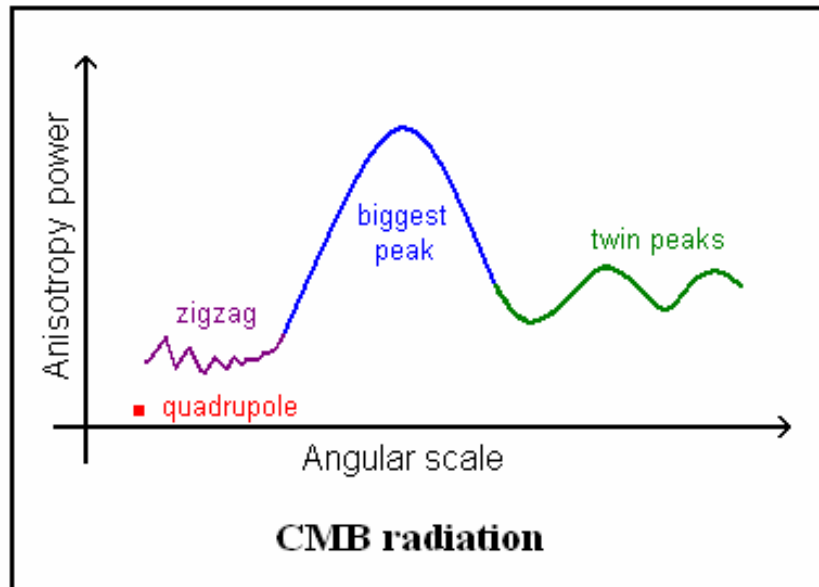
How many photons are in cubic meter? We have four dominant sources of creation of photons:

- about 52% of neutrons decayed to protons
- about 90% of nucleons are in the not free states inside the nuclei
- about 73% of nucleons repeated nuclear transformations inside the big stars and next in the visible matter
- today about 87% of the baryonic matter is the cold matter. It means that about 40% of all electrons are in atoms

The photon 'galaxies' composed of the binary systems of neutrinos are the carriers of the energies of photons. Maximal number of photons carried by greatest photon 'galaxy' emitted in the nuclear transformations is 4^{32} – it results from the four-neutrino symmetry. We know that our early Universe had broken up into 4^{16} protogalaxies. Similarly, each the greatest photon 'galaxies' had broken up into the same number of the photon 'galaxies' [2]. Because

probability of creations of smaller quanta of energies is higher than most of created in the nuclear transformations the photon ‘galaxies’ are the greatest photon ‘galaxies’. Knowing the mass of our Universe and knowing the mass of nucleon, we can calculate the total number of the nucleons. It is equal to $1.09 \cdot 10^{78}$ so the total number of photons inside the sphere filled with dark energy is equal to $(0.52+0.90+0.73+0.40) \cdot 1.07 \cdot 10^{78} \cdot 4^{16} = 1.19 \cdot 10^{88}$. The volume of our Universe is $3.20 \cdot 10^{79} \text{ m}^3$ so in the cubic meter should be about 372 million photons.

The CMB Angular Spectrum and the anisotropy power of quadrupole



The anisotropy power of quadrupole is associated with the energy emitted during the object-before-big-bang \rightarrow neutrino transition. Because our early Universe, it was the loop composed of the typical neutron black holes so the intensive evaporation of them started from the same initial conditions. It means that there was correlation of a few initial explosions of them. The correlated explosions ionized the matter so we see the zigzag. The biggest peak is associated with creations of the chemical elements from the protonuclei composed of the neutrons. Because of the four-neutrino symmetry appeared the protonuclei contained following numbers of neutrons: 1, 4, 16, 64, and 256. The twin peaks are associated with the era of big stars. First maximum is associated with the nuclear ignitions of the big stars what caused the ionization of matter, whereas the second maximum is associated with the explosions of the big stars what also caused ionization of matter. This new theory leads to conclusion that lifetime of stars is inversely proportional to the four powers of their mass. Assume that the lifetime of the sun should be about 15 billion years and that from each the typical neutron black holes were created 4 big stars (from the four-neutrino symmetry results that probability of creation of such associations of big stars was highest) then the time distance between the twin peaks is about only 10 million years. The twin peaks have almost the same maximal values because during explosions was emitted more energy than during the nuclear ignitions but in the first case the mean distance between the big stars was greater (it was due to the expansion of the Universe). There should be the fourth small peak associated with the nuclear ignitions of the stars of second generation.

Near the torus and central mass of the object before big bang suited to life, there arose the virtual electron-positron pairs. Distribution of energy of the photons per neutron associated with the radiation mass of the virtual pairs we can calculate from following formula

$$X_L = a m_{\text{neutron}} \alpha'_{\text{weak(electron)}} = 12.197 \text{ eV/neutron} \quad (8)$$

where $a=0.001159653$, $m_{\text{neutron}}=939.54 \cdot 10^6 \text{ eV}$, $\alpha'_{\text{weak(electron)}}=1.11946 \cdot 10^{-5}$ [2] and [3].

This energy is inside the sphere filled with the CMB so the energy inside the sphere filled with baryons is

$$Y_L = v(\text{maximal})^3 X_L / c^3 = 3.0406 \text{ eV/neutron} \quad (9)$$

Because there is $\beta=10.769806$ less nucleons in the Universe than was in the object before big bang suited to life so released energy per nucleon in the Universe was

$$Z_L = \beta Y_L = 32.747 \text{ eV/nucleon} \quad (10)$$

The nuclear energy released before the era of big stars was $L_0=7.71 \text{ MeV/nucleon}$ and today temperature is $T=2.725 \text{ K}$ so the energy Z_L leads to following temperature associated with the object-before-big-bang \rightarrow neutrino transition

$$T_L = T Z_L / L_0 = 1.1574 \cdot 10^{-5} \text{ K} \quad (11)$$

Because the anisotropy power is equal to T_L^2 then the anisotropy power of the quadrupole is equal to $1.34 \cdot 10^{-10} \text{ K}^2 = 134 \mu\text{K}^2$. We see that indeed the anisotropy power of the quadrupole is associated with energetic disorder in the background of the Universe caused by creation of the virtual electron-positron pairs near the masses of the torus and central ball of the object before big bang suited to life.

Cosmogony of the Solar System and Massive Spiral Galaxies

From the four-neutrino symmetry results, that virtual pion can interact maximally with $2 \cdot 4^{32}$ neutrinos (it is because of the long-distance interactions of the gravitational charges of the neutrinos) each placed in other the typical neutron black hole (the TNBH). Then our early Universe contained $2 \cdot 4^{32}$ the TNBH. Next smaller structures were the protogalaxies each composed of $2 \cdot 4^{16}$ the TNBH and having two cores (it is because of two states of neutron) - each core contained 4^{16} the TNBH (for example M31 was created in such manner) or one core when contained 4^{16} the TNBH (for example our galaxy was created in such manner). The succeeding smaller structure i.e. the binary protosupercluster contained $2 \cdot 4^8$ the TNBH and had two cores (some of the globular clusters are oval-shaped) - such structure has mass about 3.3 million times greater than the sun or had one core (some of the globular clusters are spherical-shaped) - such structure has mass about 1.6 million times greater than the sun. The next smaller structures were the binary protoclusters each containing $2 \cdot 4^4$ the TNBH and having two cores, and so on. Such binary protocluster I call the solar cluster. The cores of the solar cluster intensively evaporated and there arose chemical elements: H, He, O, X-64 (at first it transformed into iron), Y-256 (at first it transformed into plutonium Pu-244 and next into lead). From them arose gaseous rings. The radii of the rings defined the Titius-Bode law. The A/B for strong gravitational field has almost the same value as for the strong interactions. If we assume, that at the beginning of the evaporation of the solar cluster the constituents of this binary system were in distance equal to the radius of the Pluto ring then the centre of mass was the point of tangency of the Uranus and Uranus-twin rings. It means that also the Saturn-twin ring was tangent to the Neptune ring (precisely the Saturn-twin ring split into two rings tangential in one place). The Dogon myth suggests that the sun and star called Po-tolo it was binary system, also suggests that human life arose on planet revolving Po-tolo. In the deep past the star Sirius covered area near the Po-tolo and then arose the binary system of these two stars. Probability of such event is very low so the solar system is unique. Separation of the sun and Po-tolo should happen when there were the rings, not planets. It means that it was almost miracle the creation of the solar system.

Solar system

The megachain of binary systems of neutrinos is the first stage of evolution of photons emitted in the nuclear transformations. Mass of it is

$$m_{\text{photon-megachain}} = 2 \cdot 4^{32} \cdot m_{\text{neutrino}} / (2 \cdot 4^4) = 2.403 \cdot 10^{-50} \text{ kg.}$$

The megachain composed of the binary systems of neutrinos has the unitary angular momentum on orbit having radius equal to $r(\text{megachain}) = 1.464 \cdot 10^7 \text{ m}$. On this orbit collect the protonuclei Y-256 but they quickly decay to Pu-244 because these nuclei have long half-life period. Because the angular momentum of nuclei must be conserved so plutonium collected on orbit having following radius (from $mvr = \text{const.}$, for nuclei we obtain $r \sim 1/m^2$)

$$A_{\text{constituent-beginning}} + B_{\text{constituent-beginning}} = r(\text{plutonium}) = 1.611 \cdot 10^7 \text{ m.}$$

Next, the protonuclei Y-256 emitted by the surface of the solar cluster reached the plutonium orbit and then fell to pieces symmetrically analogically as the eta mesons inside the baryons [2]. It leads to the Titius-Bode law for strong gravitational field.

Calculate the radii of orbits of planets from the initial conditions.

From formula for angular momentum we know that if the masses of the rings changed with time very slowly then the evaporation of the solar cluster caused that the radii of rings increased inversely proportional to the mass of constituent of binary system: $m_{\text{ring}} v_{\text{ring}} r_{\text{ring}} = \text{const.}$, since $m_{\text{ring}} = \text{const.}$ and $v_{\text{ring}} = (GM_{\text{constituent}}/r_{\text{ring}})^{1/2}$ then $M_{\text{constituent}} r_{\text{ring}} = \text{const.}$

$$M_{\text{constituent-beginning}} = 4^4 \cdot 4.935 \cdot 10^{31} \text{ kg} = 1.263 \cdot 10^{34} \text{ kg,}$$

$$\text{whereas } M_{\text{constituent-now}} = M_{\text{sun}} = 1.99 \cdot 10^{30} \text{ kg.}$$

The radii of the rings increased $M_{\text{constituent-beginning}}/M_{\text{sun}} = 6348$ times.

At beginning, the radius of the Earth-ring was equal to

$$r_{\text{Earth-ring-beginning}} = A_{\text{constituent-beginning}} + 2B_{\text{constituent-beginning}}$$

$$\text{where } A_{\text{constituent-beginning}} = GM_{\text{constituent-beginning}}/c^2$$

$$\text{From it for } G = 6.674 \cdot 10^{-11} \text{ m}^3 \text{kg}^{-1} \text{s}^{-2} \text{ we obtain } A_{\text{constituent-beginning}} = 0.9382 \cdot 10^7 \text{ m.}$$

It means that for strong gravitational field is

$$A_{\text{constituent-beginning}}/B_{\text{constituent-beginning}} = 1.394$$

Because the orbits have some width then we see that the A/B has almost the same value for the strong gravitational field (A/B=1.394) and for the strong interactions (A/B=1.3898).

The initial radius of the Earth-ring was

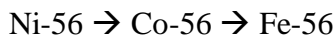
$$r_{\text{Earth-ring-beginning}} = 2.284 \cdot 10^7 \text{ m.}$$

The present radius of the orbit of Earth should be

$$r_{\text{Earth-ring-now}} = r_{\text{Earth-ring-beginning}} M_{\text{constituent-beginning}}/M_{\text{sun}} = 1.45 \cdot 10^{11} \text{ m.}$$

This result very well corresponds with observational fact $1.47 \cdot 10^{11} \div 1.52 \cdot 10^{11} \text{ m}$.

After the era of big stars in centre of the solar system arose star with mass about 1.44 times greater than the mass of the sun. After explosion of this Ia supernova, about 5 billion years ago, was created the sun. During the explosion of the supernova there took place following transformations

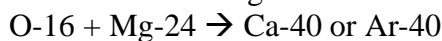
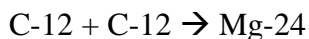
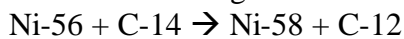


First, there appeared the nickel-56 because this nucleus is the proton-neutron symmetrical nucleus. Such symmetry is preferred in very high temperature.

Because in very high temperature the symmetrical decays are preferred then there should be produced following elements



But also following



The Kuiper's belt is remnant of supernova.

The Oort's cloud is remnant of era of the big stars.

Length of arms of massive spiral galaxy

Assume that core of protogalaxy, composed of the big neutron stars, emits the protonuclei containing 1, 2, 4, 8, 16, 32, 64, 128, and 256 the neutrons. The number 256 is for the $d=0$ in the Titius-Bode law, number 128 is for $d=1$, 64 for $d=2$, 32 for $d=4$, 16 for $d=8$, 8 for $d=16$, 4 for $d=32$, 2 for $d=64$, and 1 for $d=128$. The ranges of the protonuclei were inversely proportional to their masses and to the mass of emitter i.e. to the mass of the core of protogalaxy. We see that the last number d has value 128. Protogalaxy containing two cores, for example M31 - Andromeda, contained $2 \cdot 4^{16}$ the typical neutron black holes then the initial radius of the ring r_{initial} , for which $d=128$, had value ($A_{\text{initial}}=3.15 \cdot 10^{14}$ m, and $B_{\text{initial}}=A_{\text{initial}}/1.394$)

$r_{\text{initial}}=2.92 \cdot 10^{16}$ m i.e. 3.1 light-years.

If we assume that nowadays in the centre there is the binary system of globular protoclusters (it contains $2 \cdot 4^8$ the typical neutron black holes) then till today the radius r_{initial} increased 4^8 times i.e. the length of the spiral arm should be about 203 thousand light-years (62 thousand parsec). Length of the spiral arm in our galaxy should be about 101 thousand light-years.

Size of globular cluster

Similar calculations for globular cluster containing one core lead to the diameter equal to 79 light-years (it is if we assume that in the centre nowadays is a star having mass of the sun). Calculations for globular cluster containing two cores give 158 light-years (it is if we assume that nowadays in the centre is a binary system of the sun-like stars).

Summary

Table 3 *Theoretical results*

Physical quantity	Theoretical value
Radius of the sphere filled with CMB and dark energy	20,800 million ly
Radius of the sphere filled with baryons	13,200 million ly
Mass of the object before big bang suited to life	$1.961 \cdot 10^{52}$ kg
Mass of visible and dark matter of the Universe	$1.821 \cdot 10^{51}$ kg
Hubble constant for sphere filled with CMB and dark energy	$47 \text{ km} \cdot \text{s}^{-1} \cdot \text{Mps}^{-1}$
Hubble constant for the baryonic matter inside sphere of radius equal to 8.3 billion light-years	$74 \text{ km} \cdot \text{s}^{-1} \cdot \text{Mps}^{-1}$
Radius of the object before big bang suited to life	286.7 million ly
Radius of the loop of the early Universe	191.1 million ly
Number of massive galaxies	$4.295 \cdot 10^9$
Number of galaxies together with dwarf galaxies at assumption that there are 10÷20 dwarf galaxies per 1 massive galaxy	47,000÷94,000 millions
Abundance of H-1 and He-4 after era of big stars when we do not take into account the heavier elements	71% H and 29% He
Today abundance of H-1 and He-4 when we do not take into account the heavier elements	75.5% H and 24.5% He
Abundance of visible and dark matter and dark energy inside the sphere filled with baryons	visible matter: about 3.5% dark matter: about 23.5% dark energy: about 73%
Ω	0.08
Number of photons in cubic meter	372 millions
Anisotropy power for quadrupole	$134 \mu\text{K}^2$

Table 4 *Structures of the Universe*

Structures of the Universe	Mass
Biggest neutron star/black-hole	$4.9 \cdot 10^{31}$ kg
Massive galaxy	$4.2 \cdot 10^{41}$ kg
Group of galaxies	$1.7 \cdot 10^{42}$ kg
Supergroup of galaxies	$6.8 \cdot 10^{42}$ kg
Cluster of galaxies	$1.1 \cdot 10^{44}$ kg
Supercluster of galaxies	$2.8 \cdot 10^{46}$ kg
Chain of galaxies	$2.7 \cdot 10^{43}$ kg
Superchain of galaxies	$1.7 \cdot 10^{45}$ kg
Megachain of galaxies	$7.1 \cdot 10^{48}$ kg

Table 5 *Theoretical results*

Physical quantity	Theoretical value
A/B for strong gravitational field	1.394
Radius of orbit of the Earth	$1.45 \cdot 10^{11}$ m
Length of arms of the M31	203,000 ly
Length of arms of the Galaxy	101,000 ly
Size of globular clusters	79 ly or 158 ly

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Structure of Particles

Sylwester Kornowski

Abstract: On base of the four possible phase transitions of granulated spacetime and the Titius-Bode laws for strong interactions is described internal structure of mesons, hyperons, selected resonances, and leptons.

Introduction

In [1], [2], and [3] I described internal structure of spacetime, closed strings, neutrinos, electrons, and nucleons. In [4] I described evolution of the structure before big bang suited to life. Description of these structures is associated with the phase transitions of spacetime, chaotic vectorial field, and the symmetrical decays of particles in the strong field.

The s-particles are the particle-antiparticle pairs.

The gravitons, gravitational waves, other –inos, Higgs boson are not in existence. Photons are the quanta carried by the field composed of the binary systems of neutrinos.

From the Compton length of electron, we can calculate the time of vanishing of it whereas the state-lifetime of electron is the 2π times longer. Slowly moving electron has state-lifetime equal to about 10^{-20} s. It means that within one second electron appears in 10^{20} places of the chaotic vectorial field. It leads to the wave function. Electron, when ‘going’ through a set of slits (electron only appears whereas the wave function is going), appears many times in each slit. We cannot say that electron is going only through one slit.

Spin of the stable objects (i.e. the closed string, neutrino, core of baryon and object before big bang suited to life) we can calculate from the mvr. The renewable particles arise in different way. There appears in the chaotic vectorial field binary system of entangled loops having different internal helicity because then resultant internal helicity of the chaotic vectorial field is not broken. The resultant energy of the entangled loops multiplied by period of spinning must be equal to \hbar because then internal spin of the chaotic vectorial field is not broken - it is the reason why carriers of interactions associated with this field have unitary spin. Two entangled loops must have two times (or always) per period of rotation of spins the same direction and senses of spins. It means that two entangled loops create only one divergent field – it breaks symmetry of the chaotic vectorial field. It enforces immediate transition (it is possible because spacetime is composed of tachyons moving with speed about $8 \cdot 10^{88}$ times higher than the light in spacetime) of the two entangled loops into a positive-negative pair of source. The Compton length of electron is the radius of the loop. With the entangled loops are associated two tori as the polarised chaotic vectorial field. Surfaces of the tori look as the Ketterle surface for a strongly interacting Fermi gas discovered in 2005. The loops overlap with the equators of the tori. The binary systems of neutrinos the loops are composed of make the half-turns on the circular axis of torus and in centre of it because in those places the lines of electric forces, created by the polarised binary systems of neutrinos the torus is composed of, change their senses. It means that with torus, i.e. with the electric charge should be associated the half of the mass of the bare electron whereas the second half of the bare mass is associated with the centre of torus i.e. with the point mass of electron. The half-turns of the exchanged binary systems of neutrinos increase their energies in such way the electron always has the half-integral spin. Only creation of the torus-antitorus pair does not break the symmetry because the spins of the binary systems of neutrinos the tori are composed of are perpendicular to the surfaces of the tori. All spins either have the senses pointed to the interior of torus or pointed outside the surface. It leads to conclusion that there arises one divergent and one convergent field. Radius of bare electron is 554.32 times greater than the core of baryons. Outside of the bare electron, arise the virtual electron-positron pairs. Some part of photon can be outside of the occupied states in atom.

Muon is electron and the two different energetic neutrinos interacting with the point mass of electron. The point mass of electron cannot be a stable structure when contains only one energetic neutrino because then the resultant centrifugal force is not equal to zero. Because the simplest neutral pion is the two binary systems of neutrinos and because charged pion decays to muon and neutrino then mass of muon should be equal to the bare mass of charged pion minus one-fourth of the mass of neutral pion, and it is.

Tau lepton is electron and some massive particle, created inside baryon, interacting with the point mass of electron.

Mesons they are binary systems of the large loops created inside torus of baryons or the mesonic nuclei composed of the other mesons and the large loops, or they are the binary systems of the mesonic nuclei and/or other binary systems.

Charged pion is electron and three different energetic neutrinos interacting with the point mass of electron. This particle can transform into the neutral pion (i.e. into the binary system of the large loops) interacting with electron-neutrino pair, and vice versa. Charged pion is the four-particle system. There are not in existence fermions containing more than three different energetic neutrinos because two or more the components cannot have simultaneously the same internal helicity and the sign of the gravitational or electric charge.

In this paper are described interior of the other particles. Here are calculated the masses of selected mesons: of lightest mesonic nuclei, kaons, W and Z bosons, and D and B mesons. Model assuming that mesons are the mesonic nuclei or the binary systems of mesonic nuclei and/or other binary systems leads to very good results. To describe internal structure of the mesons are not needed the fractional electric charges. Mesons are built of the large loops created inside the torus of baryons or/and of pions (which are the binary systems of the large loops) or/and of other particles created in baryons.

A particle placed in different fields does not look the same. In electromagnetic field, many charged pions occupy the same state when are composed of different number of the binary systems of neutrinos so they are in different states for the electromagnetic field. In strong field, the neutral and charged pions look the same because both contain the same two strongly interacting large loops. The two large loops have in antiparallel arranged spins. It means that pion in strongly interacting field looks analogically as electron-electron pair with antiparallel arranged spins in ground state of atom. It means that in the ground state of baryons ($d=1$) can be only one pion. In the $d=2$ state can be more pions but they must look not the same. Because the T-B tunnels/orbits inside baryons are toroidal so there are only the S states [2].

To calculate magnetic moment of electron [3] and muon we must take into consideration the weak interactions of the virtual electron-positron pairs and the dark energy. Theories neglecting these problems are incorrect. My new QED is mathematically very simple and very short. Within the Feynman QED, we can obtain good results because there is internal mechanism fitting the theoretical results to the experimental data. It is because there are the ad hoc selected diagrams.

Symbols are the same as in [1], [2], [3], and [4].

Mesons

Masses of lightest mesonic nuclei

We can build three smallest not stable neutral objects containing the carriers of the strong interactions i.e. the pions (134.966 MeV, 139.570 MeV) and large loops (67.544 MeV). Each such object must contain the large loop because only then it can interact strongly.

The letter **a** denotes the mass of object built of the neutral pion and one large loop

$$\mathbf{a} = m_{(\text{neutral pion, loop})} = 202.510 \text{ MeV}$$

The parity of this object is $P=+1$ because both the pion and large loop have the negative parity so the product has positive value.

The letter **b** denotes the mass of two neutral pions and one large loop

$$\mathbf{b} = m_{(2 \text{ neutral pions, loop})} = 337.472 \text{ MeV}$$

whereas **b'** denotes the mass of two charged pions and one large loop

$$m_{(2 \text{ charged pions, loop})} = 346.648 \text{ MeV.}$$

The parity of these objects is $P= -1$.

In particles built of the objects **a**, **b**, and **b'**, the spins are oriented in accordance with the Hund law (the sign '+' denotes spin oriented up, the sign '-' denotes spin oriented down, word 'and' separates succeeding shells)

+ - and + - + + + - - - and + - + + + - - - + + + + + - - - - - and etc.

Because the electrically neutral mesonic nuclei may consist of the three different types of objects whereas only one contains the charged pions then the charged pions should be two times less than the neutral pions. It is also obvious that there should be some analogies for mesonic and atomic nuclei. I will demonstrate these analogies for the Ypsilon meson and the Gallion. The Gal is composed of 31 protons and has atomic mass equal to 69.72. Try to build meson having the mesonic mass equal to 69.5

$${}^{69.5}\text{Ypsilon} = 8\mathbf{a} + 14\mathbf{b} + 9\mathbf{b}' = 9460.8 \text{ MeV (vector)}$$

Such mesonic nucleus contains 18 charged pions and 36 neutral pions and contains 31 objects. When we subtract the binding energy of the charged pions (2.21 MeV) then we obtain that theoretical mass of the Ypsilon meson is equal to 9460.8 MeV. It is very good result because the experimental mass is equal to 9460.4 MeV.

The masses of lightest mesonic nuclei are as follows:

The Eta meson is an analog to the Helion-4. There are two possibilities because the Eta meson contains three pions. Such mesonic nucleus should contain one charged pion but such object is not electrically neutral. It means that the Eta meson should contain two charged pions or zero

$${}^4\text{Eta} = \mathbf{a} + \mathbf{b}' = 549.158 \text{ MeV (pseudoscalar)}$$

$${}^4\text{Eta}(\text{minimal}) = \mathbf{a} + \mathbf{b} = 539.982 \text{ MeV (pseudoscalar)}$$

The Eta' meson is an analog to Lithion-7

$$\text{Eta}' = 3\mathbf{a} + \mathbf{b}' = 954.178 \text{ MeV (pseudoscalar)}$$

We see that there are in existence following mesonic nuclei ($\mathbf{a} + \mathbf{b}'$) and ($3\mathbf{a} + \mathbf{b}'$) – it suggests that there should be also ($2\mathbf{a} + \mathbf{b}'$) but there is not in existence atomic nucleus having atomic mass equal to 5.5. Such mesonic nucleus can exist in bound state, for example inside a binary system of mesons

$$\mathbf{X} = 2\mathbf{a} + \mathbf{b}' = 751.668 \text{ MeV (vector)}$$

Masses of kaons

Calculate the mass of the particle created in the $d=0$ state in nucleon for which the ratio of its mass to the distance of masses between the charged and neutral pions is equal to $\alpha_{sw(d=0)}/\alpha_{w(\text{proton})}$

$$(m_{\text{pion}(+-)} - m_{\text{pion}(0)}) (\alpha_{sw(d=0)}/\alpha_{w(\text{proton})}) = 244.380 \text{ MeV} \quad (1)$$

This mass interacts with the point mass of particle which has the mass equal to $(m_{\text{pion}(+-)} - m_{\text{pion}(0)})$ so the total mass is 248.984 MeV. Two such particles create the binary system having mass equal to 497.723 MeV (the components are in distance equal to the Compton wavelength for the muon so we must subtract the binding energy) and it is the mass of neutral K^0 kaon. This kaon can emit one particle having mass equal to $(m_{\text{pion}(+-)} - m_{\text{pion}(0)})$. Created particle is in the charged state. If we add the radiation mass of whole particle (the components are not in distance equal to the Compton wavelength of the muon because there is only one charged muon) we obtain the mass of kaon K^+ equal to 493.692 MeV.

The neutral kaon decays to two pions because of the strong interactions – the coupling constant is equal to 1, or into three pions because of the weak interactions. The point mass of proton is about π times greater than the rest mass of the neutral pion so the coupling constant of weak interactions of two pions is π^2 times smaller than for the proton. It means that the K_L^0 kaons should live about 527 times longer than the K_S^0 .

Earlier I calculated the lifetimes of the pions.

Masses of W^{+} and Z^0 bosons and the up and top quarks

There are in existence the W^{+} and Z^0 bosons but they are not responsible for the weak interactions.

Calculate the masses of particles for which the ratio of their masses to the distance of masses between the charged and neutral pions is equal to $\alpha_w(\text{proton})/\alpha_w(\text{electron})$

$$[(m_{H(o)}+m_{W(+),d=1})-(m_{H(+)}+m_{W(o),d=1})](\alpha_w(\text{proton})/\alpha_w(\text{electron}))=87.680 \text{ GeV} \quad (2)$$

It is the first mass for the Z^0 boson.

The mass of the second ‘carrier of the weak forces’ we can obtain adding to the distance of masses between the two states of proton the mass of electron

$$[(m_{H(o)}+m_{W(+),d=1})-(m_{H(+)}+m_{W(o),d=1})+m_{\text{electron}}](\alpha_w(\text{proton})/\alpha_w(\text{electron}))=97.740 \text{ GeV} \quad (3)$$

Analogous calculations for the neutron lead to following results

$$[(m_{H(+)}+m_{W(-),d=1})-(m_{H(o)}+m_{\text{pion}(o)}+m_{Z(o)})](\alpha_w(\text{proton})/\alpha_w(\text{electron}))=192.537 \text{ GeV} \quad (4)$$

$$[(m_{H(+)}+m_{W(-),d=1})-(m_{H(o)}+m_{\text{pion}(o)}+m_{Z(o)})+m_{\text{electron}}](\alpha_w(\text{proton})/\alpha_w(\text{electron}))=202.596 \text{ GeV} \quad (5)$$

Scientists say that the last two particles contain the top quark but it is not true because the quarks are not in existence.

There exists particle having the same mass as the up quark

$$[(m_{H(o)}+m_{W(+),d=1})-(m_{H(+)}+m_{W(o),d=1})]=4.45 \text{ MeV} \quad (6)$$

For the kaons we obtain

$$(m_{\text{kaon}(o)}-m_{\text{kaon}(+-)})(\alpha_w(\text{proton})/\alpha_w(\text{electron}))=79.359 \text{ GeV} \quad (7)$$

It is the second mass for the Z^0 boson.

For pions we have

$$(m_{\text{pion}(+-)}-m_{\text{pion}(o)})(\alpha_w(\text{proton})/\alpha_w(\text{electron}))=90.633 \text{ GeV} \quad (8)$$

It is the second mass for the W^{+-} bosons.

D and B mesons

The neutral kaon is a binary system of two objects. If we divide the mass of neutral kaon by the mass of neutral pion, we obtain the factor for binary system built of two mesonic nuclei or mesonic nucleus and other binary system or two other binary systems

$$F_x=3.68776$$

Mean mass of binary system built of two kaons is

$$D(\text{charm}, 1865)=[(\pi^0(134.966)+\pi^{+-}(139.570))/2]F_x^2=1867 \text{ MeV}$$

Masses of binary systems built of different components are

$$D(\text{strange})=m(\text{Eta}(\text{minimal}, 539.982))F_x=1,991 \text{ MeV}$$

$$K^*(892)=m(244.380)F_x=901 \text{ MeV}$$

$$B=[m(\text{Eta}(\text{minimal}, 539.982)+m(K^*, 892))]F_x=5,281 \text{ MeV}$$

$$B(\text{strange})=[m(\text{Eta}', 954.178)+m(K^0, 497.723)]F_x=5,354 \text{ MeV}$$

$$B(\text{charm})=[m(X, 751.668)+m(\text{Eta}', 954.178)]F_x=6,291 \text{ MeV}$$

Why binary systems live longer than the lightest mesonic nuclei? It is because there changes the type of interaction. In the binary systems dominates the weak interaction so they behave similarly as muon. Lifetime is inversely proportional to four powers of mass then because mass of the B(charm) meson is $N_y=6,291/105.667=59.54$ times greater than the muon so the lifetime of the B(charm) meson we can calculate from following formula (the lifetime of muon is $t_{w(\text{muon})}=2.4 \cdot 10^{-6} \text{ s}$)

$$t_{w(B(\text{charm}))}=t_{w(\text{muon})}/N_y^4=1.9 \cdot 10^{-13} \text{ s}$$

This result very well corresponds with the experimental result $5 \cdot 10^{-13} \text{ s}$.

Hyperons, Resonances, and Tau Lepton

Hyperons

The $d=2$ state is the ground state outside the Schwarzschild surface for the strong interactions and is responsible for the structure of hyperons. In the transitions of the W pions from the $d=2$ state to $d=4$, in the $d=2$ state occur the vectorial mesons as result of decays of the W pions to two large loops. Each loop has mean energy equal to the E

$$E = (m_{W(-),d=2} + m_{W(o),d=2} - m_{W(-),d=4} - m_{W(o),d=4})/2 = 19.367 \text{ MeV} \quad (9)$$

The vectorial mesons interact with the W pions in the $d=2$ state. The mean relativistic energy E_W of these mesons is

$$E_W = E((A/(2B)) + 1)^{1/2} = 25.213 \text{ MeV} \quad (10)$$

Groups of the vectorial mesons can contain d loops. Then in the $d=2$ state may occur particles having masses calculated from following formula

$$M_{(+o),k,d=2} = m_{W(+o),d=2} + \sum_{d=0,1,2,4}^{d < 2^k} dE_W \quad (11)$$

where $k=0, 1, 2, 3$; the k and d determine the quantum state of particle having mass $M_{(+o),k,d}$.

Mass of hyperon is equal to the sum of the mass of nucleon and of the masses calculated from Eq.(11). Very good conformity with the experimental data we obtain assuming that hyperons contain following particles (values of the masses are in MeV)

$$m_{\Lambda} = m_{\text{neutron}} + M_{(o),k=0,d=2} = 1115.3 \quad (12)$$

$$m_{\Sigma(+)} = m_{\text{proton}} + M_{(o),k=2,d=2} = 1189.6 \quad (13)$$

$$m_{\Sigma(o)} = m_{\text{neutron}} + M_{(o),k=2,d=2} = 1190.9 \quad (14)$$

$$m_{\Sigma(-)} = m_{\text{neutron}} + M_{(-),k=2,d=2} = 1196.9 \quad (15)$$

$$m_{\Xi(o)} = m_{\Lambda} + M_{(o),k=1,d=2} = 1316.2 \quad (16)$$

$$m_{\Xi(-)} = m_{\Lambda} + M_{(-),k=1,d=2} = 1322.2 \quad (17)$$

$$m_{\Omega(-)} = m_{\Xi(-o)} + M_{(o-),k=3,d=2} = 1674.4 \quad (18)$$

From the equations Eq.(11-18) it follows that for the given hyperon the following selection rules are satisfied

- a) each addend in Eq.(11) contains d vectorial mesons,
- b) for the $d=2$ state the sum of values of the k numbers is equal to one of the d numbers,
- c) the sum of following three numbers i.e. of the sum of the values of the k numbers in the $d=2$ state plus the number of particles denoted by $M_{(+o),k,d=2}$ plus one nucleon is equal to one of the d numbers,
- d) in the nucleon or hyperon there cannot be two or more objects having the masses $M_{(+o),k,d}$ for which the numbers k and d have the same values,
- e) in the $d=1$ state there cannot be vectorial mesons because the $d=1$ state lies under the Schwarzschild surface and transitions from the $d=1$ state to the $d=2$ or $d=4$ states are forbidden, so in the $d=1$ state can be only one W pion,
- f) the mean charge of the torus of nucleon is positive so if the relativistic pions are not charged positively then the electric repulsion does not take place - but there is one exception to this rule: in the $d=1$ state there can be the positively charged pion because in that time the torus of proton is uncharged,
- g) to eliminate the electric repulsion between pions in the $d=2$ state there cannot be two or more pions charged negatively,
- h) in the $d=2$ state in proton there cannot be the charged negatively W pion not interacting with the vectorial mesons because this particle and the W pion in the $d=1$ state would annihilate,
- i) in the $d=2$ state in proton there cannot be the neutral pion because then the exchange of the charged positively pion in the $d=1$ state and of the neutral pion in the $d=2$ state takes place. It means that the proton transforms into the neutron. After such exchange the positively

charged pion in the $d=2$ state is removed from the neutron because of the positively charged torus. Such situation does not take place in the hyperon lambda $\Lambda=nW_{(o),d=2}$.

From these rules results that the structure of hyperons strongly depends on the d numbers associated with the Titius-Bode law for the strong interactions (i.e. with the symmetrical decays) and on the interactions of electric charges.

The above selection rules leads to conclusion that there are in existence only two nucleons and seven hyperons.

The spins of the vectorial mesons are oriented in accordance with the Hund law. The angular momentums and the spins of the objects having the masses $M_{(+o),k,d}$ are oriented in such way the total angular momentum of hyperon had minimal value. All the relativistic pions, which appear in the tunnels of nucleon, are in the S state. It means that Λ Σ and Ξ hyperons have the half-integral spin, whereas Ω has spin equal to $3/2$.

The strangeness of hyperon is equal to the number of particles having the masses $M_{(+o),k,d=2}$ taken with the sign '- '.

Notice also that the percentages for main channels of decays of Λ and Σ^+ hyperons are close to the x , $1-x$, y , $1-y$ probabilities. It suggests that in hyperon, before decay of it, the $W_{(o),d=2}$ pion transits to the $d=1$ state and in the decay there appears the pion which was in the $d=1$ state.

Selected resonances

Distances of masses between the resonances, and between the masses of resonances and hyperons or nucleons, are close to the masses of the S pions.

The lightest resonance $\Delta(1236)$ consists of the nucleon and the S pion in the $d=2$ state, i.e. the $\Delta(1236)$ consists of $S_{(+o),d=2}\{2-\}$ and of proton or neutron $\{1/2+\}$. The calculated mean mass of all charge states i.e. $++$, $+$, o , $-$, is 1236.8 MeV (the number before the signs '+' and '-' denotes the approximated value of angular momentum, whereas the '+' and '-' denote the orientations of the angular momentum respectively 'up' and 'down').

The parity of the $S_{(o),d}$ pions is assumed to be negative, the parity of the lambda hyperon is assumed to be positive. For selected resonances we have

$$m_{N(2650)}=3m_{S(o),d=1}\{2+2+2-\}+1m_{S(o),d=2}\{2+\}+1m_{S(o),d=4}\{1+\}+1m_{\text{proton}}\{1/2+\}$$

$$\text{(or } 1m_{\text{neutron}}\{1/2+\})=2688 \text{ MeV } (J^P=11/2^-)$$

$$m_{\Lambda(1520)}=1m_{S(o),d=1}\{2-\}+m_{\Lambda(1115)}\{1/2+\}=1537 \text{ MeV } (J^P=3/2^-)$$

$$m_{\Lambda(2100)}=2m_{S(o),d=1}\{2+2+\}+1m_{S(o),d=4}\{1-\}+m_{\Lambda(1115)}\{1/2+\}=2145 \text{ MeV } (J^P=7/2^-)$$

$$m_{\Lambda(2350)}=2m_{S(o),d=1}\{2+2+\}+2m_{S(o),d=4}\{1+1-\}+m_{\Lambda(1115)}\{1/2+\}=2332 \text{ MeV } (J^P=9/2^+)$$

$$m_{\Sigma(1765)}=3m_{S(o),d=4}\{1-1-1-\}+m_{\Sigma(1192.5)}(\text{it is the mean value})\{1/2+\}=1753 \text{ MeV } (J^P=5/2^-)$$

$$m_{\Sigma(1915)}=4m_{S(o),d=4}\{1+1+1+1-\}+m_{\Sigma(1192.5)}\{1/2+\}=1940 \text{ MeV } (J^P=5/2^+)$$

Mass of tau lepton

How big should be the mass $m_{T,d=1}$ in order to the constant of the electromagnetic interaction for this particle interacting with a particle having the mass equal to the radiation mass of electron was equal to the constant of the strong-weak interaction for the pion having mass $m_{W(+),d=1}$ and interacting with resting electron? Here the G_{em} and G_{sw} have the same value and we know that

$$\alpha_i = G_i M_i m_i / (c\hbar) \quad (19)$$

then

$$\alpha_{swW(+),d=1} m_{T,d=1} / m_{W(+),d=1} = \alpha_{em} m_{\text{electron}} / m_{\text{em(electron)}} \quad (20)$$

where $\alpha_{swW(+),d=1} = 0.762597$.

The mass $m_{T,d=1}$ interacts with the point mass of electron – it is the tau fermion. Calculated mass is equal to 1783 MeV.

Bound States of Electrons, Neutrinos, and Large Loops

Table 1 *New symbols*

Particle	Spin helicity ¹⁾	Internal helicity	Electric charge	Gravitational charge	New symbol
$v_{e(\text{anti})}$	+	L (left)		+	$v_{e(\text{anti})L+}$
v_e	-	R (right)		-	v_{eR-}
$v_{\mu (\text{anti})}$	-	R		+	$v_{\mu (\text{anti})R+}$
v_{μ}	+	L		-	$v_{\mu L-}$
e^-	-	R	-		e^-_R
e^+	+	L	+		e^+_L
p^+	+	L	+		p^+_L
p^-	-	R	-		p^-_R
n	+	L ²⁾		+	n_L
$n_{(\text{anti})}$	-	R ²⁾		-	$n_{(\text{anti})R}$
μ^-	-	R ²⁾	-		μ^-_R
μ^+	+	L ²⁾	+		μ^+_L
π^-	-	R ²⁾	-	+	π^-_R
π^+	+	L ²⁾	+	-	π^+_L

¹⁾ The sign ‘+’ is for the parallel senses of the velocity and spin, the sign ‘-’ is for the antiparallel senses.

²⁾ The resultant internal helicity is the same as the internal helicity of the largest torus.

The neutrinos interact with the point mass of the electron. They all are the fermions so the physical states of them should be different. Neutrinos and electron can differ by the internal helicity (it dominates inside the muon) and, if not by it, by the sign of the electric charge and gravitational charge (it is for the third neutrino inside pion). The possible bound states are as follows

$$\mu^-_R \equiv e^-_R v_{e(\text{anti})L+} v_{\mu L-}$$

$$\mu^+_L \equiv e^+_L v_{eR-} v_{\mu (\text{anti})R+}$$

$$\pi^-_R \equiv e^-_R v_{e(\text{anti})L} \gamma_{(\text{loop})L} \gamma_{(\text{loop})L} \rightarrow \mu^-_R v_{\mu (\text{anti})R+}$$

where $\gamma_{(\text{loop})L}$ denotes the large loop with the left helicity,

$$\pi^+_L \equiv e^+_L v_{eR-} \gamma_{(\text{loop})R} \gamma_{(\text{loop})R}$$

There are in existence following large loops

$$\gamma_{(\text{loop})L1} \equiv (v_{eR-} v_{e(\text{anti})L+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})L2} \equiv (v_{\mu L-} v_{\mu (\text{anti})R+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})L3} \equiv (v_{eR-} v_{\mu (\text{anti})R+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})L4} \equiv (v_{\mu L-} v_{e(\text{anti})L+})_{(\text{loop})L}$$

$$\gamma_{(\text{loop})R1} \equiv (v_{eR-} v_{e(\text{anti})L+})_{(\text{loop})R}$$

$$\gamma_{(\text{loop})R2} \equiv (v_{\mu L-} v_{\mu (\text{anti})R+})_{(\text{loop})R}$$

$$\gamma_{(\text{loop})R3} \equiv (v_{eR-} v_{\mu (\text{anti})R+})_{(\text{loop})R}$$

$$\gamma_{(\text{loop})R4} \equiv (v_{\mu L-} v_{e(\text{anti})L+})_{(\text{loop})R}$$

Then there are in existence the eight different large loops and it is some analogy to the eight gluons. It suggests that symmetric meson should be composed of the eight different large loops i.e. of four neutral pions. Mass of such meson is equal to the minimal mass of the eta meson (539.9 MeV). It is the reason why such virtual mesons are very important in the very

symmetric strong interactions. Remember that the symmetrical decays of the virtual eta mesons lead to the Titius-Bode law for the strong interactions ($A/B=1.38980$).

The kaon is binary system and each component of this binary system consist of two large loops (created on the circular axis of the nucleon), electron, and neutrino

$$K^0 \equiv \gamma_{(\text{loop})L1} \gamma_{(\text{loop})L2} e^-_R \nu_{e(\text{anti})L+} + \gamma_{(\text{loop})L3} \gamma_{(\text{loop})L4} e^+_L \nu_{eR-}$$

$$K^0_{(\text{anti})} \equiv \gamma_{(\text{loop})R1} \gamma_{(\text{loop})R2} e^-_R \nu_{e(\text{anti})L+} + \gamma_{(\text{loop})R3} \gamma_{(\text{loop})R4} e^+_L \nu_{eR-}$$

$$\text{mixture of } K^0 \text{ and } K^0_{(\text{anti})} \equiv \gamma_{(\text{loop})L1} \gamma_{(\text{loop})L2} e^-_R \nu_{e(\text{anti})L+} + \gamma_{(\text{loop})R3} \gamma_{(\text{loop})R4} e^+_L \nu_{eR-}$$

$$\text{and } \gamma_{(\text{loop})R1} \gamma_{(\text{loop})R2} e^-_R \nu_{e(\text{anti})L+} + \gamma_{(\text{loop})L3} \gamma_{(\text{loop})L4} e^+_L \nu_{eR-}$$

New QED

Magnetic moment of the muon

The external radius of the torus of muon is so many times smaller than the external radius of the torus of electron how many times the mass of the bare muon is greater than the mass of the bare electron. In the electric field of the muon are created the virtual electron-positron pairs but the sum of the masses of the virtual particles is for the muon so many times greater than for the electron how many times the bare mass of muon is greater than the bare mass of electron. It causes that the electromagnetic and weak masses, created in the interaction of the components of virtual pairs, are sufficiently great to create the additional virtual electron-positron pairs. Near the surface of the torus are created the virtual particles and the sum of their masses is equal to the bare mass of the muon. Then the sum of the masses of the virtual pairs is two times greater than the bare mass of the muon. The sum of masses of the additionally created virtual pairs must be equal to the radiation mass which creates these additional virtual pairs so in front of the addend associated with the creation of the additional pairs appears the factor 1/2. Notice also that the energy of interaction of virtual particle with the muon is so many times greater than the energy of interaction with the virtual antiparticle how many times the mass of muon is greater than the mass of electron.

Introduce symbol

$$\phi = 1 + m_{\text{electron}}/m_{\text{muon}} \quad (21)$$

The ratio of the radiation mass resulting from the interaction of the charges of the virtual pairs of first generation to the bare mass of muon is

$$\varphi = \phi \delta \quad (22)$$

where $\delta=0.0011596336$.

The expression associated with the creation of the additional virtual pairs by the mass $\varphi m_{\text{bare(muon)}}$ has following form

$$\xi = \phi \delta^2 / 2 \quad (23)$$

The whole ratio of the measured mass of muon to its bare mass, which is equal to the ratio of the magnetic moment of the bare muon to the magneton of muon, we can calculate from formula

$$\psi = 1 + (\varphi + \xi)[1 + \alpha'_w(\text{electron})/(2/3)] \quad (24)$$

From it we obtain for $m_{\text{muon}}=105.6667 \text{ MeV}$

$$\psi = 1.0011659367 \pm 0.0000000011 \quad (25)$$

Frequency of the radiation emitted by the hydrogen atom under a change of the mutual orientation of the electron and proton spin in the ground state

The parallel polarisation of two vortices increases the binding energy of a system

$$E_{\text{par}} = E + \Delta E_i \quad (26)$$

whereas the antiparallel polarisation decreases the binding energy

$$E_{\text{ant}} = E - \Delta E_i \quad (27)$$

Because $\Delta E_i = \alpha_i c \hbar / r$ then the change of the mutual orientation of spins causes that emitted energy is

$$E_i = 2\alpha_i c \hbar / r = h\nu \quad (28)$$

then

$$\nu = \alpha_i c / \pi r \quad (29)$$

where ν denotes the frequency.

The coupling constant defines by formula

$$\alpha_i = \alpha_{w(\text{proton})} M m / Y^2 \quad (30)$$

where $\alpha_{w(\text{proton})} = 0.0187233$ denotes the coupling constant for the weak interactions of proton, $m = 0.000591895$ MeV denotes the radiation mass of electron, $Y = 424.124$ MeV denotes the point mass of proton, whereas the M is the mass of virtual large loop created by charged W pion in the $d=1$ state. This loop interacts electromagnetically with the virtual loop created on the circular axis of torus so we should subtract the binding energy. It means that these loops are in distance $A/3+B$, it also means that the time of interaction of these two loops is $(1-y)$ because only for such time there is the charged W pion. The mean energy of the virtual loop in the $d=1$ state is

$$M = 67.5444(1 - y)[(2A/3)/(A + B)][1 - \alpha_{em}/((B + A/3)/A)] = 12.7848 \text{ MeV} \quad (31)$$

Using the set of equations Eq.(29-31) and knowing that $r_1 = 0.529177 \cdot 10^{-10}$ m (it is the radius of the first Bohr orbit) we obtain

$$\nu = 1420.37 \text{ MHz} \quad (32)$$

Lamb-Retherford shift

The Lamb shift is associated with the two different states of proton.

This shift we can calculate from the condition that the increase in the force acting on the proton must be equal to the increase in the force acting on the electron. The force is directly proportional to the energy of interaction falling to given segment. The energy of interaction is directly proportional to the coupling constant of interaction responsible for the change of the value of the force. The Lamb shift is caused by the weak interaction of the mass equal to the distance of masses between the relativistic and rest masses of the charged W pion in the $d=1$ state with the radiation mass of electron. Increase of the radius of the orbit of electron is so many times smaller than the external radius of the torus of proton how many times the sum of the coupling constants for the electron is smaller than the coupling constant of the weak interactions for the proton

$$dr/A = (\alpha'_{w(\text{electron})} + \alpha_{em}) / \alpha_{w(\text{proton})} \quad (33)$$

From this $dr = 2.72244 \cdot 10^{-16}$ m.

For the second shell of the atom of hydrogen the frequency associated with such shift is

$$\nu_L = Rc[1/4 - 1/(4 + dr/r_1)] = 1057.82 \text{ MHz} \quad (34)$$

where $R = 10,973,731.7 \text{ m}^{-1}$.

The Lamb shift we can also calculate using following equations

$$\Delta E_i = \alpha_i c \hbar / r = m_i c^2 \quad (35)$$

The Compton wavelength of the bare particle is equal to the external radius of the torus and is defined by formula

$$\lambda_c = r_{z(\text{torus})} = \hbar / (m_{\text{bare}} c) \quad (36)$$

then from Eq.(35-36) we obtain

$$m_i = \alpha_i m_{\text{bare}} / (r / r_{z(\text{torus})}) \quad (37)$$

Applying the above three equations and the Eq.(30) we obtain

$$\nu_L = \alpha_i c / (2\pi \cdot 4r_1) \quad (38)$$

where M in Eq.(30) denotes the distance of masses between the relativistic and rest charged W pion in the $d=1$ state

$$M_1 = 215.7612 - 139.5702 = 76.1910 \text{ MeV}$$

$$\nu_L = 1058.09 \text{ MHz}$$

(39)

Summary

Table 2 Mesons

Physical quantity	Theoretical value
Mass of K^{+-} kaon	493.692 MeV
Mass of K^0 kaon	497.723 MeV
Lifetime K_L^0 /lifetime K_S^0	527
Mass of $K^*(892)$	901 MeV
Mass of Eta	549.982 MeV
Mass of Eta'	954.178 MeV
Mass of Ypsilon	9460.8 MeV
Mass of Z^0	79.359 GeV and 87.680 GeV
Mass of W^{+-}	90.633 GeV and 97.740 GeV
Mass of D(charm)	1867 MeV
Mass of D(strange)	1991 MeV
Mass of B	5281 MeV
Mass of B(strange)	5354 MeV
Mass of B(charm)	6291 MeV
Lifetime of B(charm)	$1.9 \cdot 10^{-13} \text{ s}$

Table 3 Hyperons and resonances

Physical quantity	Theoretical value Mass	Theoretical value		
		J	P	S
Mass of hyperon Λ	1115.3 MeV	1/2	+1*	-1
Mass of hyperon Σ^+	1189.6 MeV	1/2	+1	-1
Mass of hyperon Σ^0	1190.9 MeV	1/2	+1	-1
Mass of hyperon Σ^-	1196.9 MeV	1/2	+1	-1
Mass of hyperon Ξ^0	1316.2 MeV	1/2	+1	-2
Mass of hyperon Ξ^-	1322.2 MeV	1/2	+1	-2
Mass of hyperon Ω^-	1674.4 MeV	3/2	+1	-3
Mass of tau lepton	1783 MeV	1/2		
Mass of resonance $\Delta(1232)$	1236.8 MeV	3/2	+1	
Mass of resonance N(2650)	2688 MeV	11/2	-1	
Mass of resonance $\Lambda(1520)$	1537 MeV	3/2	-1	
Mass of resonance $\Lambda(2100)$	2145 MeV	7/2	-1	
Mass of resonance $\Lambda(2350)$	2332 MeV	9/2	+1	
Mass of resonance $\Sigma(1765)$	1753 MeV	5/2	-1	
Mass of resonance $\Sigma(1915)$	1940 MeV	5/2	+1	

*Assumed positive parity

Table 4 *New QED*

Physical quantity	Theoretical value
Magnetic moment of electron to the Bohr magneton [3]	1.0011596531 ± 0.0000000011
Magnetic moment of muon to the magneton for muon	1.0011659367 ± 0.0000000011
Frequency of the radiation emitted by the hydrogen atom under a change of the mutual orientation of the electron and proton spin in the ground state	1420.37 MHz
Lamb-Retherford Shift	1057.82 MHz 1058.09 MHz

References

- [1] S Kornowski; *Experimental Data and Program of Ultimate Theory*
 [2] S Kornowski; *Phase Transitions of Spacetime and Nucleons*
 [3] S Kornowski; *Unification of All Interactions*
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Four-shell Model of Atomic Nucleus

Sylwester Kornowski

Abstract: On base of the four possible phase transitions of granulated spacetime and the Titius-Bode laws for strong interactions is described internal structure of atomic nuclei. Between other things are calculated volumetric binding energy, the magic numbers, radii of nuclei, groups of nucleons, binding energies for selected nuclei. Here is also formulated very simple theory of deuteron. The theoretical main path for the all most stable/abundant isotopes very good corresponds with the experimental data.

Introduction

On base of the four phase transitions of granulated spacetime and the Titius-Bode law for strong interactions [1], [2] and [3] I described interior of atomic nuclei

Volumetric binding energy of nucleus per nucleon

The sum of masses of the free relativistic charged and neutral $W(d=1)$ pions is 424.405 MeV. The nucleons an alpha particle composes of, occupy the vertices of square and the diagonal of this square is equal to $A+4B$. The exchanged pions are most often in the centre of this square. Because $A/r=v^2/c^2$ and $m_{W(+\cdot o),d}=m_{\text{pion}(+\cdot o)}/(1-(v^2/c^2))^{1/2}$ so for the distance $(A+4B)/2$ the sum of the masses of the W pions is 394.502 MeV. The distance of masses between the unbounded and bounded states is 29.903 MeV. Then the volumetric binding energy per nucleon is 14.952 MeV.

Radius of nucleus

From the binding energy per nucleon results that each nucleon occupies the volume of the cube having the side equal to $a_c=(A+4B)/2^{1/2}=1.91255 \cdot 10^{-15}$ m. Assume that the nucleons inside a nucleus are placed on the concentric spheres and distances between them are a_c . It means that the radius of the first sphere is equal to $a_c/2$. That leads to following formula for the radii of the spheres (they are not the radii of the nuclei because the spheres have the thickness)

$$r_{sn} = (n - 0.5)a_c \text{ where } n=1, 2, 3, 4 \quad (1)$$

The maximal number of the nucleons placed on sphere is

$$A_n = 4\pi(n - 0.5)^2 \quad (2)$$

then $A_1=3.14$, $A_2=28.27$, $A_3=78.54$ and $A_4=153.94$

If we round these numbers to nearest even number (nuclei containing even number of nucleons are more stable), we obtain the series: 4, 28, 78, and 154. It means that on four first wholly filled spheres are 264 nucleons. As we can see the first two numbers, the sum of the first and third and the result of subtraction of the third and second, and the fourth and second numbers, they are the well-known magic numbers 4, 28, 82, 50, 126. It cannot be a chance and it confirms that we are on the right way to build the correct theory of atomic nucleus. When the number of the neutrons becomes equal to one of the magic numbers then occur the transitions of the protons between higher and lower spheres. It increases the binding energy of nucleus.

To calculate the electric radius of nucleus (i.e. the radius of nucleus obtained in the experiments based on the bombardment of nucleus by the electrons) we have to add to the radius of the last sphere the electric radius of the nucleon. Since the charged pions in the nucleons are placed in the $d=1$ state then the electric radius is equal to $A+B=1.19927 \cdot 10^{-15}$ m. The electric radius of nucleus $A_n=110$ is

$$r_{je}(A_n=110) = 2.5a_c + (A + B) = 5.98 \cdot 10^{-15} \text{ m} \quad (3)$$

If we define the electric radius by formula

$$r_{je} = r_{oe}A_n^{1/3} \quad (4)$$

then for nucleus containing $A_n=110$ nucleons we obtain $r_{oe}=1.25$ fm. The value r_{oe} is changing from 1.28 fm for $A_n=32$ to 1.23 fm for $A_n=264$.

Since the range of strong interactions of nucleon is $A+4B$ so the radius of nucleus for the strong interactions (i.e. the radius of nucleus obtained in the experiments based on the bombardment of the nucleus by the nucleons having energy about 20 MeV) is greater than the electric radius

$$r_{ji}(A_n=110) = 2.5a_c + (A + 4B) = 7.49 \cdot 10^{-15} \text{ m} \quad (5)$$

If we define such radius by formula

$$r_{ij} = r_{oj} A_n^{1/3} \quad (6)$$

then for the nucleus containing $A_n=110$ nucleons we obtain $r_{oj}=1.56$ fm. The value r_{oj} is changing from 1.76 fm for $A_n=32$ to 1.47 fm for $A_n=264$.

Model of dynamic supersymmetry for nuclei

From [4] results that nucleons in nuclei are grouped in following way

a=2 protons and 2 neutrons

b=3 protons and 5 neutrons

c=3 protons and 4 neutrons

d=1 proton and 1 neutron

New theory explains it as follows

a) Proton exists in two states with probabilities:

$y=0.50838$ and $1-y=0.49162$ [2]

If we multiply these probabilities by 2 (for deuteron) or 4 (for alpha particle), we obtain in approximation the integers because the probabilities y and $1-y$ have almost the same values.

b) Neutron exists in two states with probabilities:

$x=0.62554$ and $1-x=0.37446$ [2]

If we multiply these probabilities by 8, we obtain in approximation the integers (5.004 i.e. about 5, and 2.996 i.e. about 3). The 8 is the smallest integer which leads to integers (in approximation).

c) For system containing 50% of **a**) and 50% of **b**), we obtain following probabilities

$(x+y)/2=0.56696$ and $(1-x+1-y)/2=0.43304$

The factor is equal to 7 (3.969 i.e. about 4, and 3.031 i.e. about 3).

Nucleus chooses mixture of the **a**), **b**), **c**), **d**) states in such manner the binding energy was greatest. The 2p2n groups appear when dominates the interactions of protons whereas the 3p5n groups appear when dominates the interactions of neutrons.

Energy of Coulomb repulsion of protons

Calculate the Coulomb energy of the repulsion of the protons for wholly filled spheres. Since the wholly filled spheres have the spherical symmetry of the potential then the Coulomb energy of the repulsion of the proton placed on the surface of the last wholly filled sphere per one nucleon is

$$E_{cn}/A_n = (kZe^2/r_{sn})(Z/A_n) \text{ where } k=c^2/10^7 \quad (7)$$

If the energy we express in the MeV then we obtain

$$E_{cn}/A_n [\text{MeV}] = 0.753Z^2/(A_n(n - 0.5)) \quad (8)$$

For $Z=2$, $A_n=4$ we obtain 1.5 MeV, for $Z=16$, $A_n=32$ we obtain 4.0 MeV, for $Z=46$, $A_n=110$ we obtain 5.8 MeV, for $Z=104$, $A_n=264$ we obtain 8.8 MeV.

Theory of deuteron

Magnetic moment of deuteron is only a little lower than the sum of the magnetic moments of proton and neutron. It suggests that the p-n binary system is bound for short times in region having high negative pressure. Assume that the negative pressure is created by resting-neutral-pion \rightarrow volumetric-binding-energy transitions (then nucleons are in distance $A+4B$ and electric force is equal to zero) for times equal to the coupling constant for the weak interactions of baryons ($T_{\text{transition}}/T=0.018723256$ [3]). Such transitions in neutron do not change magnetic moment and mean angular momentum of neutron because one of two states of neutron contains resting neutral pion ($H^0 Z^0 \pi^0$). In proton such transition changes magnetic moment and angular momentum because the transition is from the $H^+ W^0$ state having probability equal to $y=0.508385$ [2]. The $W^0 \rightarrow Z^0 \pi^0$ transition may not change the angular momentum of the relativistic W^0 pion. It is satisfied when the electromagnetic loop Z^0 is in

the $d=4$ tunnel i.e. in the last tunnel for the strong interactions for time equal to about $z=yT_{\text{transition}}/T=0.00951862$. I emphasize once more that resultant-internal angular momentum of nucleons cannot change. We see that probability of the $H^+W^0+H^+Z^0\pi^0$ state in proton in the bound state of the neutron and proton is $w=y+z$ whereas of the H^0W^+ state is $1-w$. It leads to the deuteron-nuclear magnetic moment ratio equal to about 0.85108.

In such state the linear axes of the tori of cores of nucleons overlap and the scattering length is

$$a_{\text{trip}}=2(A+4B)(1-z)+3(A+4B)z=(2+z)(A+4B)=5.4353 \text{ fm.}$$

Effective range is

$$r_{\text{trip}}=(2\pi A/3+A/3)(1-z)+2(A+4B)z=1.7286 \text{ fm}$$

To obtain the binding energy for deuteron we must take into account the electric interactions in the triplet states (spin=1).

The W^-W^+ interact from distance equal to $2\pi A/3$ for time equal to $1-w$.

The $H^+_{\text{proton}}W^-$ interact from L for time equal to $x-(1-w)$,

$$\text{where } L=[(2\pi A/3)^2+(A+B-2A/3)^2]^{1/2}=1.6349 \text{ fm.}$$

The $H^+_{\text{proton}}H^+_{\text{neutron}}$ interact from $2\pi A/3$ for time equal to $x-(1-y)$.

The $H^+_{\text{neutron}}W^+_{\text{proton}}$ interact from L for time equal to $(1-w)$.

It leads to the proton-neutron electric repulsion in deuteron equal to 0.20772 MeV and to the binding energy of deuteron equal to 2.2193 MeV.

Binding energy of nucleus and path of stability

In the alpha particle are possible two states - I call the square and deuteron states. The square state leads to the volumetric binding energy per nucleon (i.e. 14.95 MeV) and the electric repulsive force equal to 1.5 MeV per nucleon (see Eq.(8)). In the deuteron state, all linear axes of the tori of nucleons overlap so there arise one deuteron and two free nucleons or two deuterons. If we assume that the probability of both states is the same then for the deuteron state we obtain that the total binding energy is equal to 3.33 MeV. If we assume that also the probability of the square and deuteron states is the same then the binding energy per nucleon in the alpha particle is

$$E(\text{He-4})=(4\cdot 14.95-6+3.33)/8=7.1 \text{ MeV} \quad (9)$$

When the electric repulsive force per nucleon is lower than the total binding energy for two separated deuterons ($E<4.44$ MeV; it is for $A_n\leq 36$ – see Eq.(8)) and when a nucleus contains $4k$ nucleons, where k denotes the integral numbers, then there should dominate the protons. Then numbers of protons and neutrons should be the same because the probabilities y and $1-y$ have almost the same values (see chapter titled *Model of dynamic supersymmetry for nuclei*).

In particular this principle satisfy the even-even nuclei containing $k(2p+2n)$ less nucleons than the Ca-40: Ar-36, S-32, Si-28, Mg-24, Ne-20, O-16, C-12, He-4.

When the electric repulsive force per nucleon is higher than the total binding energy for two separated deuterons then there dominate the neutrons i.e. the groups containing 5 neutrons and 3 protons. It is because there is satisfied following formula

$$x/(1-x)=5/3 \quad (10)$$

In particular this principle satisfy nuclei containing $2k(3p+5n)$ more nucleons than the Ca-40 $10(2p+2n)$: Fe-56 [(Ca-40)+2(3p+5n)], Ge-72, Sr-88, Ru-104, Sn-120, Ba-136, Sm-152, Er-168, W-184, Hg-200 [(Ca-40)+20(3p+5n)].

Table 1 Main path of stability of nuclei

ZXA	a	b	c	d	ZXA	a	b	c	d	ZXA	a	b	c	d
1H1					36Kr84	9	6			71Lu175	10	16	1	
2He4 m	1				37Rb85	9	5	1	1	72Hf180	9	18		
3Li7			1		38Sr88 m	10	6			73Ta181	9	17	1	1
4Be9			1	1	39Y89	10	5	1	1	74W184	10	18		
5B11	1		1		40Zr90 m	12	5		1	75Re187	9	18	1	
6C12	3				41Nb93	11	5	1	1	76Os192	8	20		
7N14	3			1	42Mo98	10	7		1	77Ir193	8	19	1	1
8O16 m	4				43Tc97	12	5	1	1	78Pt194?	10	19		1
9F19	3		1		44Ru102	11	7		1	79Au197	9	19	1	1
10Ne20	5				45Rh103	12	6	1		80Hg202	8	21		1
11Na23	4		1		46Pd106	12	7		1	81Tl205	7	21	1	1
12Mg24	6				47Ag107	13	6	1		82Pb208 m	8	22		
13Al27	5		1		48Cd114	10	9		1	83Bi209	8	21	1	1
14Si28	7				49In115	11	8	1		84Po209	10	20	1	1
15P31	6		1		50Sn120 m	10	10			85At210	12	20		1
16S32	8				51Sb121	10	9	1	1	86Rn222	5	25		1
17Cl35	7		1		52Te130	6	13		1	87Fr223	6	24	1	
18Ar40	6	2			53I127	10	10	1		88Ra226	6	25		1
19K39	8		1		54Xe132	9	12			89Ac227	7	24	1	
20Ca40 m	10				55Cs133	9	11	1	1	90Th232	6	26		
21Sc45	7	1	1	1	56Ba138	8	13		1	91Pa231	8	24	1	
22Ti48	8	2			57La139	9	12	1		92U238	5	27		1
23V51 m	7	2	1		58Ce140	11	12			93Np237	7	25	1	1
24Cr52 m	9	2			59Pr141	11	11	1	1	94Pu244	5	28		
25Mn55	8	2	1		60Nd142	13	11		1	95Am243	7	26	1	
26Fe56	10	2			61Pm147	11	12	1		96Cm247	6	27	1	
27Co59	9	2	1		62Sm152	10	14			97Bk247	8	26	1	
28Ni58 m	12	1		1	63Eu153	10	13	1	1	98Cf251	7	27	1	
29Cu63	10	2	1		64Gd158	9	15		1	99Es254	7	28		1
30Zn64	10	2	1	1	65Tb159	10	14	1		100Fm253	9	26	1	1
31Ga69	9	3	1	1	66Dy164	9	16			101Md258	8	28		1
32Ge74	8	5		1	67Ho165	9	15	1	1	102No256	12	26		
33As75	9	4	1		68Er166	11	15		1	103Lr256	14	25		
34Se80	8	6			69Tm169	10	15	1	1	104Ku260	13	26		
35Br79	10	4	1		70Yb174	9	17		1					

ZXA – denotes atomic-number/symbol-of-element/mass-number
a=2p+2n=2He4; **b**=3p+5n; **c**=3p+4n=3Li7; **d**=p+n=1D2
? - denotes discrepancy with the results in the periodic table of elements
m – denotes magic-number nucleus

The remarks to table titled ‘Main path of stability of nuclei’:

Consistency with the experimental data is very high – only one result is inconsistent with the experimental data. Abundance of the 78Pt194 should be a little higher than the 78Pt195. It needs revision.

Mean number of the ‘a’ groups for nuclei greater than the 17Cl35 is 9 – it is consistent with the theoretical value $A_n=36$. Deviation from the mean value is significant $\pm 4a$.

In light nuclei dominate the groups **a**, whereas in heavy nuclei the groups **b**. It is because the binary system of the 2p2n can create the 4 deuteron bonds (it leads to additional binding energy about 1.1 MeV per nucleon) whereas the 3p5n only 3 (it leads to additional binding energy about 0.8 MeV per nucleon). Difference of binding energy is about 0.3 MeV per nucleon. Notice that in comparison with the 2p2n groups, the groups 3p5n significantly reduce the electric repulsion in heavy nuclei. There can be maximally only one the intermediate state **c** and only one state having low binding energy per nucleon **d**.

The smallest magic numbers (2 and 8) are associated with the four-neutrino symmetry $D=4^d$ where $d=1, 2$ whereas the D denotes the mass numbers of the smallest magic nuclei $D=4, 16$.

The magic number 20 is associated with the transition from the proton domination to the neutron domination. The $^{20}\text{Ca}40$ is the greatest nucleus composed only of the 2p2n groups.

The other magic numbers (28, 50, 82, and 126) are associated with the transitions of the protons between the higher shell of nucleus and lower shell/shells. It reduces the mean electric repulsive force – see Eq.(8). We should take into account that on the filled inner shells of nuclei the numbers of protons and neutrons have in approximate the same value. Detailed calculations lead to the binding energy associated with the transitions equal to about $0.23 \div 0.25$ MeV per nucleon.

Among the most abundant isotopes collected in table titled ‘Main path of stability of nuclei’, are only 10 elements with odd number of neutrons. Two are the very light elements $^4\text{Be}9$ and $^7\text{N}14$ and 8 are the radioactive elements. It suggests that there is the pairing of neutrons for strictly determined distances of them. In the light elements, neutrons are too close whereas on the surfaces of the radioactive elements they are too far away. There are two types of electromagnetic interactions [1]. The electrostatic interaction is associated with the polarization of the chaotic vectorial field whereas the electromagnetic is associated with exchanges of photons. Neutrons have electromagnetic structure and when they are very close one to another, there appears the electrostatic repulsion. When distance between neutrons is sufficiently high we can neglect the electrostatic repulsion whereas the attraction of neutrons as result of exchanges of photons we cannot neglect. Electromagnetic attractions of neutrons have maximums for distances equal to $A+8B$ and $2\pi A$ where the A denotes radius of the equator of core of baryons. These two distances respectively are about 4.7 fm and 4.4 fm. The diameter of the nuclei $^4\text{Be}9$ and $^7\text{N}14$ in approximate are equal to these distances but in light nuclei the neutrons most often are in centre of nucleus. It means that in these nuclei the pairing of neutrons is sometimes impossible.

We can calculate the lower limit for number of nucleons for the radioactive nuclei. It is when the electric repulsive force per nucleon is higher than the binding energy per nucleon in the alpha particle. From the Eq.(8) for the Bi-209 we obtain that the electric repulsive force is 7.09 MeV so the $A_n > 209$ defines the lower limit.

On base of the Eq.(10-12) we can calculate binding energy per nucleon for selected nuclei

$$E(\text{O}-16) = (7.1 + 3.33/4) = 8.0 \text{ MeV} \quad (11)$$

$$E(\text{Fe}-56) = (26 \cdot 8.0 + 6(14.95 - 4) + 24 \cdot (14.95 - 5.8)) / 56 = 8.8 \text{ MeV} \quad (12)$$

Without the proton transitions for Pb-208 we obtain

$$E(\text{Pb}-208) = (26 \cdot 8.0 + 6(14.95 - 4) + 78(14.95 - 5.8) + 98(14.95 - 8.8)) / 208 = 7.65 \text{ MeV} \quad (13)$$

The proton transitions increase the binding energy by about 0.25 MeV.

We see that the obtained approximate results good reflects the experimental curve. The binding energy per nucleon depends on internal structure of nucleons [2], the volumetric binding energy, Coulomb energy of repulsion and the transitions of protons associated with the magic numbers.

Summary

We obtain very good theoretical results taking into account only the internal structure of nucleons [2], volumetric binding energy, electric repulsion of nucleons, and transitions of protons between the shells.

Table 2 *Theoretical results*

Physical quantity	Theoretical value
Volumetric binding energy per nucleon	14.952 MeV
Magic numbers	4, 28, 50, 82, 126
Coefficient r_{oe} for radii of nuclei for electromagnetic interactions	$A_n=32$: 1.28 fm $A_n=264$: 1.23 fm
Coefficient r_{oj} for radii of nuclei for strong interactions	$A_n=32$: 1.76 fm $A_n=264$: 1.47 fm
Groups of nucleons in nuclei	dominants: $2p+2n$; $3p+5n$ accessory: $1p+1n$; $3p+4n$
Binding energy of deuteron	2.2193 MeV
Electric p-n repulsion in deuteron	0.20772 MeV
Deuteron-nuclear magnetic moment ratio	0.85108
n-p(triplet) scattering length	5.4353 fm
n-p(triplet) effective range	1.7286 fm
Upper limit for domination of protons	Mean value: $A_n=36$
Lower limit for radioactive nuclei (experimental result is >209)	$A_n>209$
Binding energy per nucleon for He-4	7.1 MeV
Binding energy per nucleon for O-16	8.0 MeV
Binding energy per nucleon for Fe-56	8.8 MeV
Binding energy per nucleon for Pb-208	7.9 MeV

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Theoretical Value of Gravitational Constant

Sylwester Kornowski

Symbols are the same as in [1] and [2]. We can calculate the gravitational constant G from following formula [1]

$$GK^4 = 2\pi c^3 A^2 / (3\hbar) = 2.60292 \cdot 10^{29} \quad (1)$$

where K denotes constant defining the phase transitions of spacetime, c – speed of light in spacetime, A – radius of equator of torus of core of baryons, and \hbar - Planck constant.

The G we can calculate also from following formula [2]

$$G(K^{16})^{1/3} = 4^{21} [12 / (\pi m_{\text{neutron}} m_{\text{LL}}^2)]^{1/3} (A+4B) c^2 / 2^{1/2} = 4.08096 \cdot 10^{42} \quad (2)$$

where m_{LL} denotes mass of the large loop responsible for the strong interactions, A and B – the parameters in the Titius-Bode law for the strong interactions.

From Eq.(1-2) we obtain

$$K = 0.7879 \cdot 10^{10}$$

$$G = 6.754 \cdot 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}.$$

The density of spacetime very slowly changes over time in cosmic scale. Pressure inside spacetime is directly proportional to the density of spacetime and two powers of the mean speed of tachyons. It means that pressure in spacetime is tremendous $\sim 10^{180}$ Pa. The tremendous pressure in spacetime and inflexibility of the closed strings cause that the G is constant. All physical quantities in Eq.(1-2) are calculated with very high accuracy then the calculated G should be consistent with experimental data. The theoretical G is consistent with the mean value obtained on base of the Cavendish experiment 6.75 [3] and [4] and is almost equal to the upper limit obtained in recent experiment 6.74 [5]. The theoretical G is inconsistent with the CODATA value 6.674 [6].

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N-N Scattering

Sylwester Kornowski

In [1] I calculated the characteristic cross sections for N-N and pion-N scattering. Here I calculated the effective ranges and lengths of scattering for the N-N scattering.

When we scatter protons on neutrons or neutrons on neutrons then there dominate exchanges of photons having length equal to $2\pi r$ where r denotes radius of orbit on which the photons arise. In proton photons arise in the $d=4$ tunnel because there decays the neutral pions. In the neutron the neutral pion arise in the $d=1$ tunnel laying under the Schwarzschild surface for strong interactions. It causes that the photons from the decays of the neutral pion transit to the ground state above the Schwarzschild surface for strong interactions i.e. to the $d=2$ state. For p-p scattering dominate the exchanges of the large loops because the protons repulsive one another. In the singlet state, the equators of the tori of nucleons lie on the same plane and have antiparallel arranged spins. To obtain the length of scattering we must add to the distance of nucleons, the multiplied by two maximal range of the strong interactions. In the triplet state of deuteron, the equators of the tori of nucleons are parallel and distance between them is $2\pi A/3$, where A is the radius of equator of torus of core of baryons [2]. The directions of the spins of the nucleons overlap and have the same senses. The p-n triplet state starts from the $d=2$ singlet state. Next, the spins make the quadrant-turns and distance between them decreases to the $2\pi A/3$. It means that triplet effective radius for the p-n scattering is $r_{\text{trip}}(\text{p-n})=A+2B=1.7$ fm.

Lengths of scattering are as follows

$$a_{\text{sing}}(\text{p-n})=2\pi(A+4B)+2(A+4B)=22.4 \text{ fm}$$

$$a(\text{n-n})=2\pi(A+2B)+2(A+4B)=16.1 \text{ fm}$$

$$a(\text{p-p})=(A+4B)+2(A+4B)=8.1 \text{ fm}$$

$$a_{\text{trip}}(\text{p-n})=2(A+4B)=5.4 \text{ fm}$$

Effective ranges are as follows

$$r_{\text{sing}}(\text{p-n})=r_1(\text{n-n})=r(\text{p-p})=A+4B=2.7 \text{ fm}$$

For the n-n scattering is also the second effective range

$$r_2(\text{n-n})=A+2B=1.7 \text{ fm}$$

For the triplet p-n scattering, effective range is

$$r_{\text{trip}}(\text{p-n})=A+2B=1.7 \text{ fm}$$

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Curvature of Space and Cosmological Constant

Sylwester Kornowski

Symbols are the same as in [1].

The baryonic mass density (visible plus dark) is

$$\rho_m(\text{baryonic matter density: visible plus dark matter})=2.3 \cdot 10^{-28} \text{ kg/m}^3$$

The dark 'energy' density is

$$\rho_\Lambda(\text{dark 'energy' density})=6.1 \cdot 10^{-28} \text{ kg/m}^3$$

For $r < 13.2$ billion light-years the total mass density is [1]

$$\rho(\text{visible and dark matter plus dark 'energy'})=8.4 \cdot 10^{-28} \text{ kg/m}^3$$

Mean density of the dark 'energy' filling infinite volume is [2]

$$\rho(\text{background})=1.1 \cdot 10^{-28} \text{ kg/m}^3$$

$$\rho(\text{background})/\rho(\text{visible and dark matter plus dark 'energy'})=1.3 \cdot 10^{55}$$

It means that the Universe is very flat ($k=0$). It is because the Universe is only a very small ripple on the infinite background. There is more the spreading dark 'energy' than the matter. Λ denotes the cosmological constant associated with the thickened cold chaotic vectorial field composed of the binary systems of neutrinos – it is the dark 'energy' (neutrino has mass $3.3 \cdot 10^{-67}$ kg [2]). This thickened field only insignificantly increases density of the background. It means that Λ also is practically equal to zero ($\Lambda=0$). We see that today the Universe describes the flat Friedman model ($k=\Lambda=p=0$) called also the Einstein-de Sitter model.

Ω denotes ratio of the mass density of a component to the total mass density (visible and dark matter plus dark 'energy') without the background.

Today for visible baryonic density is [1]

$$\Omega_b=0.035$$

For radius of sphere $r < 13.2$ billion light-years we have [1]

$$\Omega_m=\rho_m/\rho=0.27$$

For radius of sphere $r < 13.2$ billion light-years [1]

$$\Omega_\Lambda=0.73$$

Today the local radial speeds of baryonic matter are greater than the local radial speeds of the thickened chaotic vectorial field whereas the radial speed of the surface of the sphere filled with baryons cannot be greater than $0.63c$. It means that in future the baryonic matter will thicken near the surface. When the local radial speeds of the baryonic matter and dark 'energy' will have the same values then gravitational force acting on baryonic matter will slow down the local radial speeds of the baryonic matter whereas the dark 'energy' will expand with the same local radial speeds. It means that in future, over time, the dark 'energy' will flow out from the baryonic matter. Because range of the gravitational interactions is very great (about $2 \cdot 10^{36}$ m) then our Universe will have in the deep future the positive curvature of

space ($k=+1$, $\Lambda=0$). We see that in the deep future the Universe will transit from the opened to the closed state.

Radius of the sphere filled with the baryons is 13.2 billion light-years whereas the age of the Universe is about 20.8 billion years.

References

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Turning points in formulation of ultimate theory

At the beginning, I noticed that following formula describes the masses of hyperons $m(\text{MeV})=939+176n+26d$, where $n=0,1,2,3$ and $d=0,1,3,7$.

For nucleons is $n=0$ and $d=0$ what gives 939 MeV, for lambda is $n=1$ and $d=0$ what gives 1115 MeV, for sigma is $n=1$ and $d=3$ what gives 1193 MeV, for ksi is $n=2$ and $d=1$ what gives 1317 MeV, for omega is $n=3$ and $d=7$ what gives 1649 MeV. Later I noticed that distances of masses between the resonances and distances of masses between the resonances and hyperons are about 200 MeV, 300 MeV, 400 MeV, and 700 MeV. It was 1976.

In 1985, I grasped that to obtain good theoretical results for the hadrons, we should assume that outside of the core of nucleons is obligatory for the strong interactions some analog of the Titius-Bode law. On the 'orbits' are relativistic pions. In 1996, I understood that rotary whirl leads to divergent field. The year 1997 was for me most productive because I described the succeeding phase transitions of spacetime, the four-neutrino symmetry leading also to the visible today distribution of galaxies, and I described the fundamental phenomena associated with cosmology of the Universe and the infinite cosmos. In this eventful for me year I practically formulated the new particle physics and new cosmology. Scientists constantly believe in the quarks, gluons, flavours, colours, the fractional charges, and the stronger and stronger mutual attraction of the point quarks when they are moving away - all phenomena seen in the Universe contradict such behaviour of point objects. In 2001, I grasped the physical meaning of the four-neutrino symmetry - earlier it was for me only the mathematical formula.

Glossary

Antigravity: We should select neutrinos increasing density of spacetime inside it. Spin polarization of mirror composed of such neutrinos should create wormhole in spacetime. We see that there is needed a trap of neutrinos.

Background: The infinite volume filled with the internally structureless tachyons (it is the spacetime - the background for the gravitational interactions), non-rotating binary systems of neutrinos (it is the chaotic vectorial field - the background for the electromagnetic interactions), and virtual particle-antiparticle pairs (virtual particles do not change mean density of background).

Chaotic vectorial field: The field composed of the free non-rotating binary systems of neutrinos. I call it the chaotic vectorial field because the binary systems of neutrinos are the dipoles composed of two different poles of the gravitational charges. The structure of the torus of neutrino defines the gravitational charge. It looks as miniature of the electric charge. The torus of neutrino has gravitational charge because the closed strings the neutrino is composed of create the beams of spacetime. The gravitational interactions connected with the gravitational charges lead to the entangled particles and led to the visible distribution of galaxies.

Closed strings: In regions having high density of tachyons arise closed strings (radius is about $0.95 \cdot 10^{-45}$ m, not about 10^{-35} m as in the string/M theory). The natural speed of closed string in spacetime is about $2.4 \cdot 10^{59}$ times higher than speed of light in spacetime. The spin speed is practically equal to the mean linear speed of the tachyons because the new constant K has great value. Due to the eternal mean linear and angular speeds of tachyons, spacetime transforms only into the identical right- or left-handed closed strings. Maximal thickness of the closed string is equal to the diameter of the tachyon. The closed strings are stable because of their shape creating negative pressure inside it. It leads to the half-integral spin. Spacetime thickens near the closed string. It means that spacetime near/outside the closed strings is highly 'stretched' – the local time almost stops. Because of the dynamic viscosity of the tachyons and because of the internal helicity of the closed string, the closed string transforms the chaotic motions of tachyons, i.e. the spacetime, into the divergent field. The divergently moving tachyons (order), because of the direct collisions, create the gradient of pressure in spacetime (chaos) in such way that pressure is lower in places where mean density of the divergent trajectories is higher. It means that there is created 'niche' in spacetime (i.e. the mean distance between the free tachyons is greater) so time is going slower. The attractive gravitational force and the gravitational potential energy are associated with the gradient of negative pressure in spacetime. Range of such negative pressure is about $2 \cdot 10^{36}$ m so range of gravitational force is finite. It is the mechanism responsible for how closed string acquires its own gravitational field by interacting with spacetime. The closed string is the smallest particle having both the inertial and gravitational masses. These masses are the same because mass of closed string is directly proportional to volume of it. The closed strings arise as the closed string/antistring pairs because resultant spin speed and resultant internal helicity of spacetime must be equal to zero. Such closed strings are not flexible so it cannot vibrate. All closed strings have only one strictly determined frequency of internal helicity – it results from the law of conservation of energy (if we assume that mean linear kinetic energy and mean rotational kinetic energy of the tachyons have the same value then we obtain about $3 \cdot 10^{19}$ revolutions per spin period i.e. about $1.3 \cdot 10^{161}$ Hz). The gravity is classical because the free and bound tachyons cannot disappear in one place of the spacetime and appear in another, and so on. It means that wave function cannot describe behaviour of a tachyon, closed string, or neutrino. I claim that never will be formulated some coherent and fruitful quantum gravity. To

describe position, shape and motions of closed string we need 3 coordinates, 2 radii, 1 spin speed, 1 angular speed associated with the internal helicity and time associated with the linear speed. To describe the rotation of the spin vector we additionally need 2 angular speeds. It means that we need the 10 numbers (the 3 spatial dimensions plus time and plus the 6 false dimensions). To describe the string-antistring pair we need 11 'dimensions'. To describe neutrino, built of the closed strings, we need 26 numbers.

Coherent mathematics: We cannot formulate coherent mathematics on base of sizeless points because such points do not lead to surfaces and volumes having sizes not equal to zero. Coherent physics also cannot start from sizeless points. Truly abstract mathematics does not lead to the observed nature. Mathematics is not associated with the initial conditions the ultimate theory should be based. Mathematics appears on higher level of nature. The ultimate theory should start from some physical objects and their properties/parameters such as shape, size, dynamic viscosity resulting from smoothness of the shape (dynamic viscosity leads to the fundamental interaction resulting from the direct collisions), linear and rotational motions, density of the fundamental field i.e. of spacetime. We should derive the physical laws from the listed above properties/parameters. In other words, the ultimate theory should start only from a few physical parameters. Physical parameters lead to mathematics whereas the vice versa is untrue i.e. mathematical parameters do not lead to physics. Mathematics based on the sizeless points and numbers is not coherent because on base of that we cannot define the numerical axis, area, or volume (for example, volume of even infinite number of sizeless points is equal to zero). It means that coherent new particle physics and new cosmology need quanta of geometry.

Electromagnetic interaction: There are two possibilities. Tori built of the binary systems of neutrinos (i.e. the electric charges) polarize the chaotic vectorial field because the neutrinos the binary systems of neutrinos consist of (i.e. the electromagnetic dipoles) create jets of spacetime. Two antiparallel electromagnetic dipoles having the same direction repulse one another whereas two parallel attract themselves. The second possibility results from the exchanges of the photons i.e. of the excitations of the chaotic vectorial field.

Electron: Electron arises as polarisation of the field composed of the binary systems of neutrinos so the torus of the electron is the part of the chaotic vectorial field. Axes of these dipoles are perpendicular to the surface of the torus. Jets created by the polarized binary systems of neutrinos cross the circular axis and centre of torus so the binary systems crossing the circular axis and centre of torus make the half-turns so there appear two masses i.e. the circular mass and point mass. It is because such turns decrease pressure in the chaotic vectorial field and it causes that new binary systems of neutrinos flow into the bare electron. On the circular axis of electron, there is whole charge and only a half of the bare mass.

Elementary charge: The torus of electron and the torus of proton are composed of the same number of binary systems of neutrinos so both tori create the same number of jets in spacetime. It causes that the densities of the created beams in spacetime (resulting from the internal helicity of the neutrinos) are also the same. In the torus of proton the mean distance between the binary systems of neutrinos is about 554.3 times smaller than in the torus of electron. Near the bare electron, there arise the virtual photons and the virtual electron-positron pairs.

Gravitational interaction: All particles consist of the closed strings. Because of their internal helicity, they transform the chaotic motions of the free tachyons into the divergently moving tachyons. It causes that near and near bare particle pressure in spacetime decreases. Such is origin of the gravitational attraction.

Local time: Inside the gas composed of the tachyons the local time I define as directly proportional to the number of all direct collisions of free tachyons in some local volume of the spacetime.

Local unit of length: Local unit of length is the local mean distance between the free tachyons the spacetime consists of.

Local unit of time: Local unit of time is the mean time between the direct collisions of the free tachyons the local volume of spacetime consists of.

Magnetic interaction: Internal helicity and motions of the binary systems of neutrinos create beams in the chaotic vectorial field. In their contractions arises negative pressure.

Mind: A thought is composed of rings built of the binary systems of neutrinos. Axes of these electromagnetic dipoles are tangential to the rings. Minds may interact with a brain or matter gravitationally and magnetically.

Neutrinos and lacking dark energy: Neutrinos are composed of the closed strings (radius of neutrino is about $1.1 \cdot 10^{-35}$ m). There are created binary systems of neutrinos (mass of one binary system is about $6.6 \cdot 10^{-67}$ kg) moving with the speed of light in spacetime – it is because the granulated spacetime ‘sees’ the neutrinos as independently moving particles because the gravitational interaction of the gravitational charges of neutrinos is very weak. Similarly as stars, almost all neutrinos are in the binary systems. Spins of almost all binary systems of neutrinos do not rotate because the tachyons tend to equalize the means linear and rotational kinetic energies. Such processes are very slow in comparison with the Compton redshift but the infinite multiverse is eternal so there was time to reduce to zero the revolutions of spins of almost all binary systems of neutrinos. It is very difficult to detect such objects because they cannot transfer energy to detector. We can see them only indirectly – for example, we can see them as free neutrinos in very energetic collisions of ions because binary systems of neutrinos decay to energetic neutrinos only in field interacting weakly. We see showers of neutrinos when very energetic ions collide – it is the experimental fact. Neutrinos are very stable particles – we do not see products of neutrino-antineutrino annihilations. My theory leads to conclusion that internal energy of neutrino is about $0.6 \cdot 10^{119}$ times greater than energy of neutrino resulting from the formula $E=mc^2$ because neutrinos are built of the closed strings moving with superluminal speed (it is about $2.4 \cdot 10^{59}$ times higher than speed of light in spacetime). Tremendous energy frozen inside neutrinos excludes creations of the neutrino-antineutrino pairs in manner similar as, for example, the electron-positron pairs are. The observed new neutrinos are the products of decays, in the weak interactions, the rotating or non-rotating binary systems of neutrinos. The frozen internal energy of the neutrinos is the lacking dark energy. This energy is unobservable because it is not associated with mass – this energy is associated with the superluminal speeds of the bound closed strings the neutrinos consist of. The field composed of the free non-rotating binary systems of neutrinos I call the chaotic vectorial field because binary system of neutrinos is dipole composed of two different poles of the gravitational charges. The torus of neutrino is the gravitational charge. It looks as miniature of the electric charge. The torus of neutrino has gravitational charge because the closed strings the neutrino is composed of create the beams/jets of spacetime. The gravitational interactions connected with the gravitational charges lead to the entangled particles and led to the visible distribution of the galaxies. There are created also multiple systems containing $4^d/2$ binary systems of neutrinos (where $d=1, 2, 4, 8, 16, 32$ and $d=3, 6, 12$ – these numbers result from the four-neutrino symmetry – these systems are the neutral pions. Definition of the rest mass of neutral pion is associated with the internal structure of baryons. The surface of the torus of neutrino consists of the closed strings. The closed strings interact gravitationally. They have internal helicity then the beams of spacetime are thickened – there is created the negative pressure. The beams are thickening when they go through the surface of the torus of neutrino. Neutrinos have the gravitational charges so they polarize spacetime – interactions between the gravitational charges are the long-distant interactions. Neutrino looks as miniature of electron but neutrino is a classical particle because tremendous energy frozen inside neutrino causes that neutrino cannot disappear in one place of spacetime and appear in

another one, and so on. There are only 4 different states of neutrinos - the taon neutrino is not in existence.

Objects before big bang suited to life: The objects before big bangs suited to life consist of neutrons (radius is about $2.7 \cdot 10^{24}$ m). Torus of it consists of deuterium. The objects before big bangs are suited to life only if have strictly determined mass (about $1.9 \cdot 10^{52}$ kg) – then, just before big bang, is possible the object-before-big-bang \rightarrow neutrino transition. Creation of our Universe was similar to creations of the large loops, composed of the binary systems of neutrinos, inside torus of cores of baryons. Such large loops are responsible for the strong interactions. When the mass of the object before big bang was frozen as internal energy of neutrino then the very early Universe (mass of it was about $1.8 \cdot 10^{51}$ kg), which was the loop composed of the neutron black holes grouped in larger structures, started explosive evaporation. It was because the beta decays of neutrons (there arose the strongly collimated jets composed of the electrons and electron-antineutrinos) caused the electric repulsion of protons – it was the big bang. The dark energy is remnant of the object before big bang suited to life and this remnant composes of the non-rotating binary systems of neutrinos i.e. inside our Universe density of the field composed of the binary systems of neutrinos is higher than outside it. It is the positive pressure reducing the negative pressure in spacetime created by the mass of our Universe. The dark matter contains the remnants of the big stars of first generation. It is composed of the iron-nickel lumps. Detection of these lumps is very difficult because their temperature is the same as the cosmic microwave background radiation. The interior of sphere filled with the baryonic matter contains about 3.5% of the visible matter, about 23.5% of the dark matter and about 73% of the dark energy. The universes suited to life arise as universe-antiuniverse pairs from positive fluctuations of the field composed of the non-rotating binary systems of neutrinos. Distance between the components of such pair should be smaller than the range of the gravitational interactions.

Photons: Quanta of energy carried by the field composed of the binary systems of neutrinos.

Planck critical values: Inside the point mass of core of nucleons the neutrinos are maximally packed. On the surface of torus of proton, neutrinos are more packed but it is possible only for polarized surface. The critical energy/mass is the weak mass of mass fully filled with the tachyons and displacing one tachyon from spacetime. To calculate this mass, we must divide the mass of tachyon by density of spacetime, multiple it by density of tachyon, and next multiply it by coupling constant for weak interactions of nucleons. It is easy to notice that the critical energy densities for volume, area and line are associated with a cube. We know that nature does not compose of cubes. Smallest object moving with the speed ‘c’ is the neutrino so the listed critical values are associated with it. For energy of rotating neutrino is very well defined volume (rotating spin of torus leads to sphere) and linear distribution of the energy (it is the diameter of the sphere) whereas it is very difficult to define the surface energy density. Knowing the two first values we can calculate the radius of equator of the torus of neutrino – it is equal to about $1.1 \cdot 10^{-35}$ m.

Proton: The torus of proton is composed of the binary systems of neutrinos. It has the point mass and the circular mass. The emissions and absorptions of virtual particles and their decays create the tunnels in the chaotic vectorial field i.e. there arise holes in the field composed of the binary systems of neutrinos. In the tunnels are the relativistic pions in the S state. First relativistic pion is under the Schwarzschild surface for the strong interactions so proton is the stable particle.

Sizeless objects: Sizeless objects are not in existence. All things, also these considered as abstract, for example the words-thoughts, the numbers-thoughts, the mathematical expressions, emotions and so on, have sizes not equal to zero. Creations of particles in truly empty volume are impossible. The thought ‘truly empty volume’ also has size not equal to zero. Nature is in existence because truly empty infinite volume contains (and always

contained) some eternal physical objects i.e. objects having sizes not equal to zero. Spacetime also must be composed of some eternal physical objects. The simplest assumption is that all things are built of some internally structureless (i.e. internally continuous) moving granules and that their sizes are defined by their eternal motions.

Spacetime: Gas composed of the tachyons. The spacetime is highly deformed only inside and very near the surface of the closed string. This deformation is associated with the internal helicity of the closed strings. Outside the closed strings, because of the superluminal speeds of the tachyons i.e. because of the tremendous pressure in spacetime, spacetime behaves as a liquid-like substance. For interactions lasting longer than the Planck critical time, the spacetime looks as continuous substance.

Speed of light: The field composed of the binary systems of neutrinos carries the energy of photons. Neutrinos in binary systems interact gravitationally so they are moving almost independently. It causes that photons and neutrinos practically are moving with the same speed. Such speed is the natural speed of the neutrinos in the spacetime.

Strong interaction: This interaction results from the exchanges of the real or virtual large loops composed of the binary systems of neutrinos or their pairs or groups created on the circular axis of torus of nucleon or there are exchanged the real or virtual mesons.

Tachyons: All particles are composed of the tachyons. They are moving about $8 \cdot 10^{88}$ times faster than photons in spacetime. The unchanging eternal mean speed of the free and bound tachyons defines the mean radius of tachyons and lead to the principle of relativity and to the law of conservation of energy. The high mean linear speed and the viscosity lead to ideal granulation of the eternal internally continuous tachyons. It is because for smaller radius of tachyons the time of interactions of them, in the direct collisions, is shorter and area of contact smaller. It means that finally, for strictly determined radius, the grinding of the tachyons stops. In interactions lasting longer than about 10^{-60} s particles 'see' spacetime as continuous substance. The tachyons interact only because of the direct collisions – such interactions are associated with dynamic viscosity of tachyons resulting from smoothness of their surfaces. The eternal mean linear kinetic energy of tachyons is equal to the eternal mean rotational energy of tachyons – it is the fundamental symmetry of nature. My theory leads to conclusion that in such spacetime there are possible only four succeeding phase transitions leading to stable objects. The granulated spacetime composed of the structureless tachyons fills infinite truly empty volume because tachyons interact only because of the direct collisions – they are the bare particles. Tachyons do not emit and absorb other particles because there is not in existence a more fundamental spacetime. Trajectories of the tachyons have all possible directions (chaos). With spacetime is associated only one set of physical laws. The tachyons have only the inertial mass because they cannot emit any particles - inertial mass of tachyon is directly proportional to volume of it. Spin of the tachyons is about 39 powers of ten smaller than the Planck constant so practically they are the zero-spin bosons. The tachyons lead to the coherent quantum mechanics i.e. to the coherent wave function because the superluminal speeds of tachyons cause that very distant points of the wave function can quickly communicate.

Tunnels in the chaotic vectorial field: When virtual particles decays to two parts moving in opposite directions, in the place of decay is created hole in field composed of the binary systems of neutrinos. Set of such holes creates tunnel.

Weak interaction: This interaction results from the exchanges of the small neutrino loops created on the equator of the point masses of particles.