

The Ultimate Picture of Particle Physics and Cosmology

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Abstract: The string/M theory, cosmology, General Theory of Relativity and Quantum Physics are the approximate descriptions of Nature so there appear many incorrect assumptions and wrong interpretations. Here I pointed the limitations for the basic method applied in the Quantum Physics associated with the action of orthogonal groups on column vector representing a spinor. Such action leads to the spin representations. Spinor can represent the half-integral spin of a quantum loop in a pair that returns to original position after 720 degree rotation. It is characteristic for the zero-helicity vector particles. This property, the theory of spinors itself, the classification of the Clifford algebras and the double-covers/spin-groups that are the Lie groups, suggest that succeeding phase transitions of the modified Higgs field can be in existence and it is the foundations of the lacking part of ultimate theory i.e. the Everlasting Theory. In the last theory there as well appear the scalar condensates and the imaginary part of Nature that appear in the classification of the Clifford algebras. The succeeding phase transitions radically simplify the basic mainstream theories via elimination of the approximations and free parameters. The classification of the Clifford algebras and the succeeding phase transitions prove that Nature on its lowest level is superluminal, classical and non-relativistic. Within the Everlasting Theory, theory of spinors, Clifford algebras and Lie algebra, we can show how the only inertial-masses/volumes lead to the Principle of Equivalence. It is the Higgs mechanism. On the other hand, the Principle of Equivalence and the confinement forced by the Mexican-hat mechanism lead to the scalar condensations composed of the Einstein-spacetime components. Unification of the 6(7) different interactions is possible only via the theory of succeeding phase transitions and the atom-like structure of baryons.

1. Introduction

The lacking part of ultimate theory is based on two fundamental axioms [1]. There are the phase transitions of the fundamental spacetime composed of the superluminal and gravitationally massless pieces of space (the tachyons). The phase transitions follow from the saturated interactions of the tachyons and lead to the superluminal binary systems of closed strings responsible for the entanglement [1], [2] and [3], lead to the binary systems of neutrinos i.e. to the Einstein-spacetime components, to the cores of baryons and to the cosmic objects (protoworlds) that appeared after the era of inflation but before the observed expansion of our Universe. The second axiom follows from the symmetrical decays of bosons that appear on the surface of the spinor/core of baryons. It leads to the Titius-Bode law for the strong interactions i.e. to the atom-like structure of baryons. The two first phase transitions are

associated with the Higgs mechanism that leads from the modified non-gravitational Higgs field to the Principle of Equivalence and the initial conditions applied in the General Theory of Relativity (GR). The three first phase transitions concern the particle physics whereas the structure and evolution of the most sophisticated spinor, i.e. the cosmic spinor/object, defined by the four phase transitions leads to the new cosmology.

The Everlasting Theory directly leads to the possible symmetries and origin of the broken symmetries. The broken symmetries can be only local whereas the global symmetry of the Cosmos [4] must be conserved. There are not in existence spontaneously broken symmetries. Such symmetries follow from the fact that the mainstream theories are incomplete – I will prove it in this paper.

On the other hand, the Noether (first) theorem says that any differentiable symmetry of the action of a physical system has a corresponding conservation law [5]. Contrary to the mechanics version, in the field theory version, the Noether theorem is for continuous fields in 4-dimensional spacetime. Via the action invariant under certain transformations of the spacetime coordinates and the fields there appear the conserved current densities. It means that, for example, electric charge within a sphere is conserved when there is not a flow of a charge through the sphere. When Lagrangian is constant in its third argument we obtain the conservation law for the stress-energy tensor. For field in the configuration space of smooth functions there appears in the action the Lagrangian density that depends on the field, its derivation and the position. At the end we obtain the Noether current associated with the symmetry [6]. I will show that due to the succeeding phase transitions we can at once describe origin of such symmetries.

In the quantum physics dominate the theory of spinors, the classification of the Clifford algebras and Lie algebra. Most important is the action of orthogonal/Lie/spin groups on a column vector (a spinor) that leads to the spin representations. Applying such method we can only partially decipher structure and behaviour of Nature. I will show the limitations. Just the succeeding phase transitions of the modified Higgs field are the lacking part of ultimate theory. In the theory of the orthogonal groups, a spinor is an element of a complex vector space. The classification of the Clifford algebras provides a description of the spin representations of the spin groups whereas the presented theory of spinors lead to the double-covers/spin-groups that are the Lie groups.

In this paper, comparing the theory of the succeeding phase transitions of the modified Higgs field described within the Everlasting Theory, with the mainstream theories I will show that the basic mainstream theories are incomplete and I will point the incorrect assumptions and wrong interpretations.

Some definitions applied in the Everlasting Theory:

1.

Modified Higgs field: This field is defined by the initial conditions. It is the gas composed of the classical, non-relativistic, gravitationally massless tachyons. Their undetectable non-gravitational rotational energy is approximately 10^{54} times lower than their undetectable kinetic energy and their angular momentum is about 10^{66} times smaller than the reduced Planck constant so the modified Higgs field is the undetectable almost scalar field.

Higgs mechanism: There are four constituents of this mechanism: one pseudoscalar (it is a tachyon when we neglect its infinitesimal angular momentum), two vectors i.e. the spins of the entanglons and the Einstein-spacetime components, and one scalar i.e. the condensate of the entanglons in the centre of the torus of neutrino. It is defined by the Clifford algebra $Cl_{0,2}(\mathbf{R})$ and it is spinor in two dimensions. When we neglect the infinitesimal angular momentum of the tachyons then there appear the spontaneously broken symmetries that, in reality, are not in existence.

Entanglon: It is the directly undetectable binary system of the superluminal closed strings created due to the first phase transition of the modified Higgs field. Spins of the closed strings are half-integral and parallel whereas their helicities are opposite. They are the zero-helicity vector particles. Since the global symmetry of the Higgs field must be conserved so the entanglons appear as the binary systems with opposite spins of the components.

Component of the Einstein spacetime: It is binary system of neutrinos with opposite weak charges defined by torus of neutrino. A torus of a neutrino is built of the entanglons in such a way that all spins are perpendicular to the surface of the torus and all point the inside of the torus or all point the outside. Since torus has internal helicity so there are the four possibilities that lead to the four-neutrino symmetry. Since the global symmetry of the Einstein spacetime (Es) must be conserved so the Es components appeared during the inflation as the binary systems with opposite spins of the components. Only spins of the entanglons placed on the plane of the equator of the torus of a neutrino are perpendicular (orthogonal) to the spin of the neutrino/spinor but this plane is very important for the interactions. We can see that the theory of spinors and the Clifford algebras do not fully describe the bare half-integral-spin fermions (i.e. spinors) or their pairs (they are the spinors as well and they are the zero-helicity unitary-spin vector particles) but are useful in descriptions of the interactions. The Es components are as well the zero-helicity vector particles.

The state of a bare fermion-antifermion pair we can describe via two-component spinors.

The quantum time-like loops are produced inside the tori of the spinors. They have the same helicity as the spinors. For example, we can describe the quantum time-like loops produced inside particles/spinors defining the product of the gamma matrices within the Clifford algebra $Cl_{1,3}(\mathbf{R})$. Such matrix (it is not a fifth gamma matrix) is useful to describe the quantum mechanical chirality. There appears the left-handed and right-handed two-component Weyl spinor.

2. The special theory of spinors realized by Nature

Due to the succeeding phase transitions of the modified Higgs field [1] there appear the spinors. History of quantum physics proves that the spinors are essential to understand Nature. What a spinor is?

A spinor is a generalization of tensor and vector whereas tensor is a generalization of vector and scalar. One of most important mathematical method is the action of orthogonal group on column vector (spinor) that leads to spin representations. Via investigating the spin representations we can decipher structure and behaviour of Nature. On the other hand, there are some representations of the Lie algebra of the orthogonal groups (the double-covers i.e. spin-groups $Spin(p,q)$) that cannot be formed by the tensor constructions. These missing representations lead to the spin representations. It suggests that some part of Nature cannot be described within the General Theory of Relativity. Emphasize: There is action of the double-covers/spin-groups on the spinors that leads to the spin representations; then, the classification of Clifford algebras provides a complete description of the spin representations of the spin groups so we can as well find the relationships between the spin representations.

The phase transitions show that the vector objects on higher and higher levels of Nature consist of increasing number of different vector particles arranged in specific way. The succeeding objects which appear in the phase transitions are the tori/spinors having half-integral spin and helicity. A bigger torus consists of the next smaller torus-antitorus pairs, and so on. At the lowest level there is the modified Higgs field. There are the three dual tori and the circle/closed-string which as well has the internal helicity and it is the condensation of the tachyons into circle. A torus consists of the next smaller torus-antitorus pairs that spins are unitary and all of them point the interior of the torus or all point its exterior. The resultant speeds of the pairs of the same size are the same. This leads to conclusion that besides the

spin speeds of the pairs on a torus there appear their radial speeds. Only the pairs placed on the equator of a torus have the radial component of their velocity equal to zero. The radial components of the velocities of the pairs on a torus cause that in centre of the torus there appears a condensate.

We can see that some parts of the objects created in the phase transitions behave as the spinors. It concerns the resultant spinor and the spinors on its equator. For the three first phase transitions, the spins of the resultant spinor and of the two different pairs/spinors on the equator of the resultant spinor (it is the core of baryons which consists of the Einstein-spacetime components and the entanglons) are orthogonal. Presented here the extended theory of spinors concerns as well the condensate in the centre of baryons which is responsible for the weak interactions at very low energies. Inside the torus there arise the time-like quantum loops (pions are the zero-spin binary systems of such loops) which spin is unitary and parallel to the spin of the resultant spinor. The resultant internal helicity of the time-like quantum loops is the same as the resultant spinor. Just the time-like quantum loops acquire similar properties as the resultant spatial spinors. We can see that we can describe the core of baryons applying the Clifford algebra $Cl_{1,3}(\mathbf{R})$ and it as well is in the 1(time)+3(space) dimensional relativistic quantum field theory. Using the 4×4 Dirac gamma matrices (they generate a matrix representation of the Clifford algebra $Cl_{1,3}(\mathbf{R})$) we obtain the 4 component Dirac spinors. We can describe the helicity of quantum time-like loops produced inside spinors defining the product of the gamma matrices within the Clifford algebra $Cl_{1,3}(\mathbf{R})$. Such matrix (it is not a fifth gamma matrix) is useful to describe the quantum mechanical chirality. There appears the left-handed or right-handed Weyl spinor.

What is the difference between the spatial-like objects and time-like objects? The time-like loops arise inside the stable (so time-independent) spatial-like torus and acquire some its properties. But the time-like loops are not an integral part of a spatial-like torus. They arise due to the quantum entanglement of the Einstein-spacetime components. The time-like loops are emitted by the core of baryons (i.e. they disappear in one place and appear in another, and so on, so they are the time-like and quantum objects) and are responsible for the strong interactions at very low energy. How we can unify the time-dimension with the spatial dimension within the orthogonal groups? We can assume that the time dimension is imaginary – it is the mathematical trick. The theory of the complex numbers shows that the transition from the real axis to the imaginary is under the $\pi/2$ rotation i.e. the real and imaginary axes are orthogonal. In this case, the mathematical trick has physical meaning. The entanglons responsible for the quantum entanglement are the classical objects i.e. they are moving but they cannot disappear in one place and appear in another, and so on, so they are the spatial vectors. But due to these objects, the loops can behave in the quantum way. Moreover, the entanglons are the gravitationally massless objects so they, when free, have broken contact with fields that have gravitational mass density i.e. we can describe motions of the entanglons (more precisely: the motions of the condensate of the tachyons into the binary system of closed strings; it does not concern the spin of the entanglon) in an imaginary space separated from the fields. It causes that the Clifford algebra $Cl_{1,3}(\mathbf{R})$ can coherently describe Nature. Moreover, the phase transitions described within the Everlasting Theory leads to conclusion that the equatorial plane of the torus of baryons is very important when we want to describe the interactions.

In the Everlasting Theory, the Higgs mechanism is associated with the Clifford algebra $Cl_{0,2}(\mathbf{R})$ where the zero defines the time dimensions whereas the 2 the spatial. This means that the Higgs mechanism is associated with the two first phase transitions whereas the Higgs bosons appear due to the third phase transition.

So, why the mainstream theories are such messy? Why there appear the approximations, mathematical tricks and free parameters?

1.

The mainstream theories incorrectly describe the bare fermions. They neglect the existence of the tori that define the charges, spins and internal helicity.

2.

There does not appear the atom-like structure of baryons.

3.

The spontaneously broken symmetries appear because the mainstream theories neglect some fundamental properties of physical objects. For example, in reality, the Higgs field is not a scalar field (see the definition). It causes that the entanglons and Es components are the zero-helicity vector particles. The entanglons are the binary systems of the closed strings with parallel spins and opposite internal helicities. Since the global symmetry of the Cosmos cannot be broken then the entanglons were produced as the binary systems with opposite spins i.e. a fully symmetric group must contain 4 closed strings. The same concerns the Es components. We can see that there is broken the local symmetry but it follows from the properties of the Higgs field. It is not a spontaneously broken symmetry. We should eliminate the term “spontaneously broken symmetries” from the theories.

There appears a problem when we try to describe fully the structure and evolution of the cosmic objects produced in the fourth phase transition. The universes appear as the loops produced inside the cosmic torii [1]. It is very easy to describe the structure and evolution of the protoworlds and universes within the Everlasting Theory but it is very difficult to do it within the methods applied in the relativistic quantum field theory. Just there are the 4 different spatial spinors and the cosmic loop in which, due to the very high mass density, time is going very slowly). There appear as well the time-like quantum loops inside the baryons. It is easy to see that we need following Clifford algebra $Cl_{4,4}(\mathbf{R})$ i.e. there must be four orthogonal real axes and four imaginary axes. Physically it is impossible because space is 3-dimensional. But we can neglect the first phase transition which is responsible for the quantum entanglement and leads to the confinement i.e. to the two foundations of the Quantum Physics. Then, the gravity will dominate. Such approximation leads to the dark energy and expansion of the Universe [1]. The Protoworld looked as big core of baryons but the entangled Es components we must replace for the nucleon-nucleon pairs.

Spinor can represent the half-integral spin of a quantum loops (in reality they are the binary systems with the unitary spin) that return to original position after 720 degree rotation. We can see that a 360 degree rotation associated with the helicity transforms the numeric coordinates of the spinor into their negatives. The complex numbers associated with the spinors under a rotation of the helicity angular momentum by angle φ get multiplied by $e^{\pm i\varphi/2}$ (it is associated with the rotation of the spin of a spinor as a whole).

The tori have strictly determined sizes i.e. the circle associated with the spin speed has circumference two times longer than the circles associated with the helicity [1]. It means that under the helicity rotation of a test particle interacting with surface of a torus by angle 720° the spin rotation is 360° only.

Generally, the bare fermions arise as the particle/spinor-antiparticle/antispinor pairs. Due to the vortices produced in the Einstein spacetime, the matter-antimatter symmetry can be broken. For example, such vortices breaks the electron-positron and proton-antiproton symmetries in such a way that there are produced the proton-electron pairs as well [1]. Consider an electron-positron pair. One component of the pair has mass two times smaller than the binary system. We know that length of wave representing mass is inversely proportional to the mass. This means that when length 2λ (or 720°) represents rotation of a component of the binary system then λ (or 360°) represents rotation of the binary system. It leads to conclusion that such spinor as the electron-positron pair with parallel spins and

opposite helicities of the components, under a rotation of spin by angle 180 degrees causes the rotation of the angular momentum associated with a torus by angle 360 degrees.

The spinors are objects associated to a vector space. The theory of spinors shows that for a given quadratic form, many different spaces of spinors may be in existence. It leads to conclusion that on a higher defined level of Nature there can be many different spinors. The Clifford algebras provide a complete picture of the spin representations.

Unification of the GR and QP within the same methods is impossible but we can see that there is possible a partial unification via the succeeding phase transitions of the modified Higgs field (see formula (280) here [1]).

We can see that particle physics needs the Clifford algebra $Cl_{1,3}(\mathbf{R})$. Such Clifford algebra provides a complete picture of the spin representations. The matrices applied in physics represent the action of a set of orthogonal basis vectors. They act on the column vectors and the resultant object is the space of spinors on which the Clifford algebras of spacetime act. In such mechanism can appear infinitesimal spatial rotations. Using the 4×4 Dirac gamma matrices (they generate a matrix representation of the Clifford algebra $Cl_{1,3}(\mathbf{R})$) we obtain the 4 component Dirac spinors. They are used in the 1(time)+3(space) dimensional relativistic quantum field theory.

The spinors representing the fermions have the internal helicity. It forces to introduce the product of the four gamma matrices but it is not one of the gamma matrices. The product of 4 Dirac matrices we can use to describe the quantum mechanical chirality. Then, in the Dirac field can appear the left-handed or right-handed 1-component spinors. Remember that, for example, the Pauli matrices are a set of matrices with metric of Euclidean signature ($t = 0, s = 3$). Existence of the simpler Clifford algebras suggests that Nature on its lowest level should be classical.

The Everlasting Theory shows that existence of the spinors follows from the succeeding phase transitions of the modified Higgs field composed of the classical non-relativistic tachyons and that the spinors are objects associated to a vector space. The complete theory of the spinors should be based on the Clifford algebra $Cl_{4,4}(\mathbf{R})$ but I will prove that under the dogma that there are maximum the three spatial dimensions, such algebra is mathematically incoherent. The scalar condensate in the core of baryons leads to the W and Z bosons and is not directly associated with the Higgs mechanism that transforms the non-gravitational mass into gravitational mass. This condensate follows from the Mexican-hat mechanism (the confinement) concerning the Einstein-spacetime components and follows from the radial speeds of the Es components the torus in core of baryons consists of (see the next paragraphs).

There are three dual spinors i.e. protoworld, core of baryon and neutrino. In symmetric Einstein spacetime they arise as the object-antioobject pairs. The bigger spinor or pair of spinors consists of the smaller spinors. This causes that there are the subgroups of the orthogonal groups. A group containing more constituents covers the groups containing less.

In the theory of spinors there appear the double-covers/spin-groups that are Lie groups. Can we show physical interpretation of the double-covers within presented above extended theory of spinors that follows from the succeeding phase transitions described within the Everlasting Theory? The set of all unit quaternions (4) is very important for the orthogonal groups. Such set forms a 3-dimensional sphere and a Lie group under multiplication of the unit quaternions. The Lie group is double covering the spin group of rotation $SO(3, \mathbf{R})$ of real orthogonal 3×3 matrices. It is because two unit quaternions concern each rotation ($4/2 = 2$). It causes that under the same rotation there appear two possibilities. Can we within the extended theory of spinors show that this "incoherence" has physical meaning? I proved that the entanglons and the Einstein-spacetime components are the zero-helicity vector particles. There are the two possibilities for senses of their spins on equator of the tori in the core of baryons or leptons: one arrangement leads to torus/particle whereas the second to antitorus/antiparticle. This

means that under $\pi/2$ rotation of the spin of the resultant spinor, we obtain two states (i.e. under the same rotation there appear two different states) i.e. the double-covers indeed describe the reality. The double covers, i.e. Lie groups, are refer to as the spin groups $\text{Spin}(p,q)$. The spin groups define all the properties of spinors. The Lie algebra corresponding to Lie groups $O(n,F)$ and $SO(n,F)$ consists of the antisymmetric $n \times n$ matrices, with the Lie bracket defined by the commutator.

The succeeding phase transitions of the modified Higgs field, described within the Everlasting Theory, suggest the new point of view. The phase transitions show how the spinors look. Without any mathematics we can understand behaviour of the spinors under any rotation. We even do not need the Lie groups to know how the spinors behave under the orthogonal transformations. Just there is in existence only one strictly determined picture. The picture that follows from the phase transitions shows that the mainstream description is incomplete and within the Everlasting-Theory picture we can decode much more properties of the spinors and say much more about their interactions. Just most important is the internal structure of the spinors/particles. Such picture radically simplifies mathematical description of motions and interactions. Most important is the fact that the larger spinors/particles consist of smaller spinors, and so on, and that there appear the simple mathematical objects as the tori/charges/spins/vectors and balls/condensates/scalars.

3. Higgs mechanism

Tachyonic fields play a very important role in modern physics. The phase transitions described within the Everlasting Theory leads to conclusion that the tachyon field is not a quantum field. Due to the infinitesimal inertial-only angular momentum of the classical tachyons, the tachyon field is only some approximation of the pseudoscalar field. In the Everlasting Theory the mean angular momentum of tachyons is not neglected so there do not appear the spontaneously broken symmetries. The term ‘unobserved tachyons’ means that tachyons are not surrounded by any field.

The Higgs mechanism involves four constituents: in approximation there is one pseudoscalar (tachyon), two vectors i.e. the spins of the entanglons and the Einstein-spacetime components, and one scalar i.e. the condensate of the entanglons in the centre of the torus of neutrino. It is defined by the Clifford algebra $Cl_{0,2}(\mathbf{R})$ and it is spinor in two spatial dimensions. This mechanism describes the transition from the gravitationally massless Higgs field to the Principle of Equivalence. Such mechanism was possible during the inflation. At first, there were the condensations of the tachyons into the binary systems of the closed strings. Due to the infinitesimal angular momentum of the tachyons, the closed strings have internal helicity. Due to their interactions with the gravitationally massless Higgs field they produce the antiparallel tachyonic half-jets that I refer to as the lines of gravitational forces. Due to the second phase transitions there were produced the neutrinos. The torus of a neutrino produces divergent field composed of the half-jets. Due to the collisions of the tachyons in the half-jets, with the tachyons in the Higgs field, there arises gradient in the Higgs field. It is the gravitational field of the neutrino [1]. Since the global symmetry of the Higgs field must be conserved so the neutrinos appeared as the neutrino-antineutrino pairs with the opposite weak charges (defined by the tori of neutrinos) of the components of a neutrino. We can see that the local symmetries are broken but they are not the spontaneously broken symmetries.

Emphasize once more that the Higgs mechanism describes how the Einstein-spacetime components acquired their gravitational mass during the inflation. The gravitational constant G depends on the internal structure of the Es components and inertial-mass density of the Higgs field. The Higgs mechanism is beyond the General Theory of Relativity but leads to the initial conditions applied in this theory. The GR, via the Kasner solution, leads indirectly to the proportions of the torus of neutrinos [1] but it is impossible to calculate its size within the

Kasner solution. The size is calculated within the Everlasting Theory and is close to the Planck length.

Notice that in the Everlasting Theory the entanglons and Es components are the zero-helicity vector particles. On the other hand, the broken gauge symmetries lead to the massless Goldstone bosons [7]. Then, many authors noticed that we can eliminate the massless bosons introducing zero-helicity states of vector particles associated with broken local symmetries. Due to such Higgs mechanism, the vector particles acquire their masses. We can see that it is consistent with the Higgs mechanism described within the Everlasting Theory but within the theory I described as well the internal structure of the zero-helicity vector particles and calculated their inertial masses, sizes, speeds and the other properties. On base of such Higgs mechanism we can understand the electroweak interactions [8]. But due to the phase transitions described within the Everlasting Theory we can radically simplify the description of the electroweak interactions and eliminate the free parameters (see the paragraph titled 'Electroweak interactions').

There are two types of mass generation models: gravity-free models and models that involve gravity. But it is obvious that Nature can realize only one Higgs mechanism. Due to the Higgs mechanism described within the Everlasting Theory, during the inflation there appeared the ground state of the Einstein spacetime which components are moving with the speed of light c .

As I wrote, in the Everlasting Theory, the Higgs mechanism is associated with the Clifford algebra $Cl_{0,2}(\mathbf{R})$, where the zero defines the time dimensions whereas the number 2 the spatial. This means that the Higgs mechanism is associated with the two first phase transitions whereas the Higgs bosons appear due to the third phase transition, i.e. the theory of the Higgs bosons is associated with the Clifford algebra $Cl_{1,3}(\mathbf{R})$ (I described it in the next paragraphs). Creation of the Higgs bosons is associated with the confinement which concerns the Higgs mechanism as well and follows from the Mexican-hat mechanism.

4. The Mexican-hat mechanism in the Everlasting Theory

The complete and mathematically coherent theory of the phase transitions lead to the basic foundations of the quantum physics i.e. both the confinement that follows from the Mexican-hat mechanism associated with the Einstein-spacetime components, and superluminal entanglement.

Due to the dynamic viscosity of the free and bound tachyons, the free tachyons interact with the bound tachyons the neutrinos consist of. This means that number density of the free tachyons inside a neutrino is higher than outside it. It causes that the symmetric state of the neutrino is unstable.

Similar situation is when photons interact with electric charge of proton – then there are produced the electron-positron pairs. The annihilations of the electron-positron pairs cause that around the proton is created the potential electric well that radius is 2π times greater than the reduced Compton length of the bare electron $\lambda_{\text{bare-electron}} = 3.8661 \cdot 10^{-13}$ m. The theory of chaos described here [1] shows that the internal structure of proton leaks outside it due to the gluon-photon transition. So we can assume that similar proportions should concern the electrons and positrons in the electron-positron pairs created by an atomic nucleus. The mean distance between the entangled Es components on the torus of electron is $L = 554.321$ (see formula (16) here [1]) times greater than on the torus in the core of proton [1] so the radius of the electric well of any atomic nucleus is $R_{\text{electric-well}} = 2\pi L \lambda_{\text{bare-electron}} = 1.3465 \cdot 10^{-9}$ m. We can see that potential is raised inside and very close to a nucleus and sharply increases on the edge of it. It looks in an approximation as the Mexican-hat. Can we indirectly detect existence of such Mexican-hat mechanism? Notice that the range of the well is 25.44 greater than the Bohr

radius. This leads to conclusion that only 5 electron shells are inside the electric well. We can compare it with the spectrum of the Hydrogen atoms.

The same concerns the other atoms. Classical radius is inversely proportional to number of protons Z in atomic nucleus. On the other hand, number of produced electron-positron pairs is directly proportional to Z so associated length of wave, so the radius of the well as well, is inversely proportional to Z . This means that inside an atom the upper limit for number of electrons is 110 ($2(1^2 + 2^2 + 3^2 + 4^2 + 5^2) = 110$).

From the theory of chaos follows that near the Es components should be created some weak analogs to the electron-positron pairs created near protons. The proportions should be conserved i.e. the radius of the weak well near the Es components should be

$$R_{\text{weak-well}} = 2\pi L r_{\text{neutrino}} = 3482.9 r_{\text{neutrino}}. \quad (1)$$

The weak well around the Es components leads to the confinement. We can see that the electromagnetic and weak interactions can be unified due to the duality of these two interactions.

5. The electroweak interactions

Here I will compare the descriptions of the electroweak interactions in the Everlasting Theory and the mainstream theory.

In the Everlasting Theory, the condensates of the Einstein-spacetime components arise due to the radial velocities that appear in the spinors. Concentrate on the weak interactions of the baryons. At low energies (it is below the vacuum expectation value defined in the mainstream electroweak theory, i.e. about 250 GeV), for the weak interactions is responsible the rest or relativistic mass of the condensate in the centre of baryons. The mass of the resting condensate is $Y = 424.12$ MeV [1].

Calculate within the Everlasting Theory the vacuum expectation value for weak interactions via the W and Z bosons. Within this theory I calculated the mass of the sham Higgs boson $H = 125.00$ GeV [1], [9]. It follows from the electromagnetic interactions of the core of baryons and density of the Einstein spacetime. Due to the confinement of the Es components that appears inside the Higgs boson due to the energy of collision, the mean distance of the Es components R_{Es} decreases from

$$R_{\text{Es}} = (2m_{\text{neutrino}}/\rho_{\text{Es}})^{1/3} = 3510.2 r_{\text{neutrino}}, \quad (2)$$

where $2m_{\text{neutrino}}$ is the mass of Es components whereas ρ_{Es} is the mass density of the Es, to value calculated in formula (1). Mass associated with a matter wave is inversely proportional to length of the wave. This means that the mass of the sham Higgs boson increases and the increase in mass ΔH is

$$\Delta H/H = (R_{\text{Es}} - R_{\text{weak-well}})/R_{\text{Es}}. \quad (3)$$

Then $\Delta H = 0.975$ GeV i.e. the modified mass is $H^* = H + \Delta H = 125.975$ GeV.

The vacuum expectation value O concerns the collisions so there appears a pair so the vacuum expectation value is $O = H^*H^* = 251.95$ GeV.

Calculate the masses of the W and Z bosons. From the vacuum expectation value can be created the Z boson and the W^+W^- pair (the Z and W denote the masses as well). Since the H^*H^* pair is the scalar so such production should be the 3-jet event. We obtain following relation

$$O = H^*H^* = 2W + Z. \quad (4)$$

For the weak interactions is characteristic the 4-particle symmetry [1]. Assume that the W^+W^- pair is created in the collision of two objects each composed of 4 electron-positron pairs due to the transitions from the weak interactions of electrons-muons to the weak interactions of baryons. The ratio of the weak coupling constants for proton and electron-muon is $X_W = 19685.3$ (see formula (57) here [1]). Then the mass of a W boson is

$$4 \cdot 2m_{\text{bare-electron}} X_W = 80.380 \text{ GeV}. \quad (5)$$

The mass of the Z boson calculated from formula (4) is $Z = 91.184 \text{ GeV}$.

Within the Everlasting Theory we can as well calculate the coupling constant of the electromagnetic interactions for the vacuum expectation value (VEV) $\alpha_{\text{em}}(\mathbf{O})$. This theory shows that the sham Higgs boson arises due to the electromagnetic interactions [1] so we can assume that the relative increase in mass is equal to $\alpha_{\text{em}}(\mathbf{O})$

$$\Delta H/H = \alpha_{\text{em}}(\mathbf{O}) = 1/128.2. \quad (6)$$

The obtained within the Everlasting Theory the theoretical results concerning the electroweak interactions are perfect. This theory, contrary to the mainstream theory does not contain any free parameters. In the mainstream electroweak theory, to calculate the mass of W boson we need the three free parameters taken from experimental data. They are the mass of Z boson, the Weinberg angle and $\alpha_{\text{em}}(\mathbf{O})$.

Photons are the rotational energies of the Es components. They can be entangled due to the exchanges of the superluminal entanglons between the Es components. In the Everlasting Theory the photons are massless since distance between their carriers, i.e. the Es components, is greater than the range of the confinement defined by the Mexican-hat mechanism. Mass density of the carriers of an entangled photon is the same as the Einstein spacetime. The broken symmetry between the weak and electromagnetic interactions follows from the difference of the range of the confinement of the Es components that follows from the Mexican-hat mechanism, and the today distance between them. During the inflation there was period when all Es components were in the weak wells. It is easy to notice that in this period the W and Z bosons were massless i.e. they were the Goldstone bosons.

6. Hierarchy problem

The hierarchy problem I described here [1]. The Es components consist of the superluminal gravitationally massless entanglons. The Es components acquire their gravitational mass due to the Higgs mechanism. It causes that the superluminal gravitationally massless energy frozen inside the Es components is approximately $0.6 \cdot 10^{119}$ times higher than the gravitational mass of these components [1]. It is the lacking energy that follows from the quantum physics and concerns the ranges smaller than the Planck length. It solves the hierarchy problem.

On the other hand, within the mainstream theory is assumed that supersymmetry will solve this problem. The problem associated with the hierarchy problem is as follows. Contrary to the fields of fermions and gauge bosons, the scalar fields can acquire big bare masses. No symmetry of the Standard Model can introduce a mechanism leading to an upper limit for the masses of the bare scalar fields [7]. It leads as well to conclusion that other masses should be close to the Planck mass about $2 \cdot 10^8 \text{ kg}$. It is assumed that the hierarchy problem can be solved by placing the Standard Model in the supersymmetric theory. Then, above the unification energy the scalars and fermions could be massless [7].

But the Everlasting Theory shows that the masses of the scalar condensates follow from the radial speeds in the spinors. Moreover, the scalar condensate inside the centre of the baryons, which is responsible for the weak interactions of baryons at low energy, is the black hole in respect of the weak interactions [1]. We can see that the Everlasting Theory leads to the limitations for the masses of the scalar condensates but not for their massless energy. But the statement that the hierarchy problem can be solved by placing the Standard Model in the supersymmetric theory is generally correct. It is due to the fact that the presented here extended theory of spinors is directly associated with the modified string/M theory [1].

7. The basic problem in the Standard Model at very low energy

The extended theory of spinors shows that the assumption that resting nucleons consist of the relativistic up and down quarks is incorrect. Inside the baryons, there is the core/spinor whereas outside it, due to the symmetric decays of some bosons, is obligatory the Titius-Bode

law for the strong interactions – it is the atom-like structure of baryons [1]. The wrong assumption causes that we still cannot define the exact masses of the up and down quarks. The domination of the quarks is above about 5 GeV [1].

8. Redshift and illusion of acceleration of the expansion of the Universe

Around each gravitational mass there is sphere in which dominates the gravitational field of the mass. Greater mass means that radius of the sphere is greater. If photons are emitted from interior of such sphere of a galaxy then their redshift is determined by the classical Doppler redshift (not quantum), i.e. for the relative speed is $z = v/c$ where v is the speed of the galaxy. Such situation is realized when velocity of a galaxy is the same as the local velocity of the dark energy and the entangled carriers of the photon are a part of the dark energy. If photon is emitted by a truly relativistic mass, then we must apply the relativistic formula $z_r = (z^2 + 2z)/(z^2 + 2z + 2)$. Assume that for some Type Ia supernova is $z = 1$. Then, for relativistic Doppler is 0.6 what suggests that the supernova is closer to us. It is the reason why the mainstream cosmology leads to the wrong conclusion that the Type Ia supernovae are fainter than they should be. To explain it, there appeared the shocking incorrect conclusion that expansion of the Universe accelerates. It is obvious that the Einstein spacetime cannot expand since expansion leads to instability of the stable particles. Densities of the local acoustic fluctuations and protuberances in the Es must be much lower than the density of the Es. And it is [1], [4].

In the protuberances of the dark energy produced at the beginning of expansion of our Universe, the speediest protogalaxies were moving with speeds about 10 times higher than the speed of light c [1] but their speed in relation to the protuberances was equal to zero so they were the non-relativistic objects. Such protuberances were very quickly damped [1].

9. The answers to some questions

1.

Why we must apply the orthogonal groups in physics?

The phase transitions described within the Everlasting Theory lead to the spinors. But why there is the action of the orthogonal groups on the spinors to obtain the spin representations?

The Everlasting Theory shows that a resultant spinor can emit the subspinors (for example, in the theory of baryons they are the carriers of gluons and the superluminal entanglons responsible for the quantum phenomena) in directions parallel to the spins of the resultant spinors and to the subspinors the resultant spinors consist of and they should lie on the equator of the resultant spinor. In the theory of baryons there arise a jet and the plane of interactions on which the equator of the resultant spinor lies. The plane is perpendicular to the jet. To describe the jet, we need one spatial dimension whereas to describe the plane we need two orthogonal directions because the spins of the different subspinors are perpendicular. The spin of the quantum loop responsible for the strong interactions is parallel to the spin of the resultant spinor but if we define it as the imaginary direction then we obtain the four orthogonal directions. But why we take into account only the equators of the tori? It is because only on the equator the spin speeds of the next smaller spinors are the same as in spacetime and fields (in the theory of baryons they are the carriers of gluons).

We can see that the action that leads to the spin representations, fully describes the interactions. We can investigate the spin representations to understand how Nature acts.

2.

Why the zero-spin pions are responsible for the strong interactions?

The loops produced inside the torus cannot change the spin, internal helicity and charge of the torus in the core of baryons. This means that resultant spin, internal helicity and charge of the particles produced inside the torus must be equal to zero. It causes that there appear the

binary systems of the quantum loops with antiparallel spins so the resultant helicity is equal to zero as well. Such binary systems of loops are the neutral pions [1].

3.

Why massless gluons and photons have different properties?

The gluons and photons are the rotational energies of the Es components. Their properties are different since their carriers, i.e. the Es components, have three different helicities. Contrary to the electromagnetic field, the strong fields have internal helicity so we cannot neglect in such fields the internal helicities of the carriers. Just outside the strong fields the gluons become the photons. The Everlasting Theory shows that there is one photon and 8 gluons [1].

4.

Why a gauge of the electric potential and a gauge of the vector potential cannot change electric charge?

The global symmetry of the Cosmos must be conserved so the absolute value of the electric charges of electrons and protons must be the same. Due to the shortest range of the entanglement between the components of the torus of proton, it is very stable structure and its mass density is much greater than the Einstein spacetime. On the other hand, the density of the other fields is much lower than the Einstein spacetime. This leads to conclusion that no gauge can change the electric charge of proton. At the beginning of the inflation, densities were higher than density of the surface of the proton torus. Under such conditions the baryon-antibaryon pairs had not been created.

5.

Can the dark energy be detected?

The dark energy consists of the additional Es components that appeared due to the evolution of the Protoworld [1]. We cannot detect directly this energy.

6.

Is possible simultaneous flatness and curvature of spacetime?

Gravitational masses produce the potentials in the modified Higgs field. This field is curved by masses. The Einstein spacetime cannot be curved, it is flat [4]. Since inertial mass density of the modified Higgs field is in approximation 10^{-43} times lower than the gravitational mass density of the Einstein spacetime so the spacetime as a whole is flat.

7.

What is shape of rotating black hole?

When density of matter is sufficiently high then the Einstein spacetime inside a black hole rotates with the same angular velocity as the black hole. This means that rotating black hole is in rest in relation to the inner Einstein spacetime. This means that there is the spherical symmetry.

8.

Are gravitational waves in existence?

Gravitational waves are not in existence because the gravity is associated with the modified Higgs field composed of the tachyons. Today, from the tachyons cannot be created any particles. It is the reason that quantum gravity is today not in existence.

To change gravitational potential of a mass, the mass must emit particles having gravitational mass i.e. must emit the Es components. This means that there must be created radial outflows of dark energy i.e. flows of the additional Es components. It is possible when number of annihilating particle-antiparticle pairs is greater than created. See also the next point – there is the correct interpretation of the formula $E = mc^2$.

9.

Is the interpretation of the formula $E = mc^2$ correct?

Due to the entanglons, the massless rotational energy of the Es components (the entangled photons or gluons) can behave in the quantum way i.e. it can “disappear” in one configuration and appear in another, and so on. The configurations are entangled via the entanglement of the carriers of photons or gluons i.e. the Es components. When there appears a vortex of entangled massless energy E then due to the order (it is the vortex), the local pressure of the Einstein spacetime inside the vortex decreases. Since pressure in the Einstein spacetime must be conserved then there are the inflows of the Es components into the vortex that increase the local mass density of the Einstein spacetime i.e. there appears the gravitational mass m. Since the Es components are moving with the speed c so there is obligatory the formula $E = mc^2$. The correct interpretation of this formula is as follows. It is true that the massless energy E is “equal” to the gravitational mass but it is untrue that the massless energy E can physically transform into gravitational mass. For example, when an electron-positron pair annihilates then there appears the massless energy/information E whereas the mass m expands similarly as the dark energy in our Universe – the dark energy are the additional non-rotating-spin Es components.

Emphasize that the Higgs mechanism shows how only inertial-masses/volumes transform into gravitational masses i.e. the Higgs mechanism has nothing with the interpretation of the Einstein formula $E = mc^2$.

After the matter-antimatter annihilation into the quantum radiation and the dark energy, the excited Einstein spacetime try to transit to the ground state i.e. the quantum rotational energies of the Es components (the photons) transform into the classical kinetic energy of the Es components. It is due to the fact that the higher levels of Nature try to behave as the modified Higgs field for which the kinetic energy of the tachyons is approximately $(10^{97} \text{ [m/s]}) / (10^{70} \text{ [m/s]})^2 = 10^{54}$ times higher than the rotational energy [1]. We can see that over the time the quantum energy of the excited states of the Es regions, transforms into the classical kinetic energy of the Einstein spacetime components i.e. there increases the mean speed of the Es components i.e. there increases the classical temperature of the Einstein spacetime understood as a whole. Due to the acoustic fluctuations [4], the maximum changes in the speed c can be approximately $10^{-6}c$ i.e. about 300 m/s. But in the protuberances of the dark energy produced at the beginning of expansion of our Universe, the speediest protogalaxies were moving with speeds about 10 times higher than the speed of light c [1] but as I explained it earlier, their velocity in relation to the protuberances was equal to zero so they were the non-relativistic objects.

10. The ultimate picture of particle physics and cosmology

Let us return to the action of rotation of orthogonal groups/spin-groups/matrices (generators) on column vector (spinor) that leads to the spin representations. Within such method we can investigate the properties/picture of the spin representations. Using other words, we can say that the column vectors on which the matrices act becomes a space of spinors. It can represent infinitesimal spatial rotations. They are very important in seeking the symmetries and next, the laws of conservation.

Concentrate on the field of the most sophisticated spinor in the Everlasting Theory i.e. on the zero-helicity-vector-cosmic-pair/spinor i.e. the protoworld-antiprotoworld pair (the cosmic torus-antitorus pair). Its column vector should be complex with four complex components i.e. 4 real and 4 imaginary components. The Protoworld is left-handed whereas antiprotoworld is right-handed [1]. The supercharge is unitary. We can use the left-handed and right-handed two-component Weyl spinor to separate the descriptions of the Protoworld and Antiprotoword. Concentrate on the left-handed component – it is the Protoworld that created our Universe as the left-handed loop inside the left-handed cosmic torus [1]. The column vector of the Protoworld looks as follows

$$\begin{pmatrix} \mathbf{a}_E & + & i \mathbf{b}_{E-L} \\ \mathbf{c}_S & + & i \mathbf{d}_{S-L} \\ \mathbf{e}_D & + & i \mathbf{f}_{D-L} \\ \mathbf{g}_P & + & i \mathbf{h}_{U-L} \end{pmatrix}$$

The i is the imaginary unit $i = \text{sqrt}(-1)$,

\mathbf{a}_E defines the unitary spin of the entanglons,

\mathbf{b}_{E-L} defines angular momentums of tachyons in their condensate to the closed loop,

\mathbf{c}_S defines the unitary spin of the Einstein-spacetime components (binary systems of neutrinos),

\mathbf{d}_{S-L} defines angular momentums of the entanglons in their condensate to the loop inside the torus of a neutrino,

\mathbf{e}_D defines the unitary spin of the neutron-proton(plus electron) pairs the torus of the Protoworld consisted of,

\mathbf{f}_{D-L} defines angular momentums of the Es components in their condensate to the quantum loop inside the torus in the core of nucleons,

\mathbf{g}_P defines the half-integral spin of the Protoworld,

\mathbf{h}_{U-L} defines angular momentums of the protogalaxies (composed of the neutron black holes) in their condensate to the cosmic loop inside the cosmic torus [1].

The limitations of such description of Nature are as follows.

1.

In the above description is lack of the three condensates in centers of the tori i.e. neutrino, core of baryons and protoworld. It must be described in some sub-theory.

2.

In Quantum Theory of Fields, spinors describe the state of relativistic many-particle systems. It is not true. The objects \mathbf{a}_E and \mathbf{b}_{E-L} are classical and non-relativistic but superluminal.

3.

There are the four loops that define the different times inside the resultant spinor and the different subspinors.

4.

There are the three orthogonal spins of the resultant spinor (i.e. of the Protoworld) and the next two smaller spinors (i.e. of the nucleon-nucleon pairs and Es components) whereas we cannot define direction of the spin of the entanglons on the equator of the Protoworld because their tori do not cross the equator in any point. This means that the presented particle-physics-cosmology theory can be the mathematically coherent theory when we neglect the first component in the column vector i.e. we must neglect the confinement and the superluminal entanglement both responsible for the quantum effects. Of course, we can describe the quantum effects but we must reject the resultant spinor i.e. we must reject cosmology.

We can see that within the methods applied in the Quantum Physics we cannot unify Quantum Physics with cosmology. It is possible only via the phase transitions of the modified Higgs field described within the lacking part of ultimate theory i.e. the Everlasting Theory.

To describe fully the Protoworld we need following Clifford algebra $Cl_{4,4}(\mathbf{R})$. Under the dogma that space must be 3-dimensional such algebra is mathematically incoherent. But we can define in a coherent way some Clifford subalgebras. It leads to conclusion that there is not in existence an ultimate equation of Nature. There can be in existence only a set of coherent theories but each theory from such a set is incomplete. We can unify partially all the possible interactions only via the phase transitions (see formula (280) here [1]).

11. Summary

The string/M theory, cosmology, General Theory of Relativity and Quantum Physics are the approximate descriptions of Nature. These theories do not lead to the complete and coherent theory of the succeeding phase transitions so there appear many incorrect assumptions, wrong interpretations and many alternative descriptions of the same phenomena. Here I pointed the limitations for the basic method applied in the Quantum Theory of Fields associated with the action of orthogonal groups on column vector representing a spinor. Such action leads to the spin representations that we can investigate to decipher the structure, motions and interactions of particles.

Spinor can represent the half-integral spin of a quantum loop that returns to original position after 720 degree rotation. It is characteristic as well for the zero-helicity vector particles. This property, the theory of spinors itself, the classification of the Clifford algebras and the double-covers/spin-groups that are the Lie groups, suggest that succeeding phase transitions of the modified Higgs field can be in existence and it is the foundations of the lacking part of ultimate theory i.e. the Everlasting Theory. In the last theory there as well appear the scalar condensates and the imaginary part of Nature that appear in the classification of the Clifford algebras. Most important is the fact that larger spinors/particles consist of smaller spinors, and so on, and that there appear the simple mathematical objects as the tori/charges/spins/vectors and balls/condensates/scalars. The return to original position after 720 degree rotation leads directly to the proportions of the torus and next to the fractional charges $1e/3$ and $2e/3$.

The succeeding phase transitions radically simplify the basic mainstream theories via elimination of the approximations and free parameters (the physical constants and the mathematical constants applied in physics are the free parameters as well). The Everlasting Theory points the incorrect assumptions and the wrong interpretations in the mainstream theories. Here, on base of the mathematically coherent and complete theory of succeeding phase transitions of the Higgs field, I solved many basic problems.

The classification of the Clifford algebras and the succeeding phase transitions prove that Nature on its lowest level is superluminal, classical and non-relativistic. Within the Everlasting Theory, Clifford algebras and theory of spinors we can show how the only inertial-masses/volumes lead to the Principle of Equivalence. It is the Higgs mechanism. On the other hand, the Principle of Equivalence and the confinement forced by the Mexican-hat mechanism lead to the scalar condensates composed of the Einstein-spacetime components. Unification of the 6(7) different interactions is possible only via the theory of succeeding phase transitions (see formula (280) here [1]). The succeeding phase transitions are indeed the lacking part of ultimate theory because it leads as well to the physical constants and the mathematical constants applied in physics and to hundreds results consistent or very close to experimental data. There are as well results that cannot be calculated within the mainstream theories as, for example, the masses of the nucleons and quarks and the free parameters applied in the correct parts of the mainstream theories. The Everlasting Theory is based on 7 parameters only i.e. about 3 times less than in the Standard Model.

The complete and mathematically coherent theory of the phase transitions leads to the basic foundations of the quantum physics i.e. both the confinement that follows from the Mexican-

hat mechanism associated with the Einstein-spacetime components, and to the superluminal entanglement.

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