The Big Answers in Cosmology and Particle Physics

Sylwester Kornowski

Abstract: Here, on base of the lacking part of ultimate theory i.e. the Scale-Symmetric Theory, I answered the big questions that cannot be answered within the mainstream theories. What is origin of the dark matter and dark energy? What is the cause of the exit of our Universe from the black-hole state? What is origin of the VEVs (the vacuum expectation values)? Can we show physical meaning of the mathematical analogy between the real Higgs mechanism and the electroweak theory? Can we prove that the mainstream electroweak theory and the real Higgs mechanism are the parts of the Scale-Symmetric Theory? Why renormalization does not act in the General Relativity? What is origin of the "spontaneously" broken symmetries? Why equations can be symmetrical whereas their solutions are not? Why all energies are so low in comparison with the Planck energy? Why the string/M theory is useless? What is origin of the physical constants and mathematical constants applied in physics? All these questions can be answered within the phase transitions of the fundamental spacetime.

1. Introduction

The lacking part of ultimate theory, i.e. the Scale-Symmetric Theory, I described in the book and papers [1]. This theory is based on two fundamental axioms. There are the phase transitions of the fundamental spacetime composed of the superluminal and gravitationally massless pieces of space (the tachyons). It is the modified Higgs field that I refer to as well as the Newtonian spacetime. The phase transitions follow from the saturated interactions of the tachyons and lead to the superluminal binary systems of closed strings (entanglons) responsible for the entanglement, lead to the binary systems of neutrinos i.e. to the Einstein-spacetime components, to the cores of baryons and to the cosmic objects (cores of 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.

Here, within the Scale-Symmetric Theory, I answered the big questions in cosmology and particle physics.

2. The big answers

A.

What is origin of the dark matter and dark energy? What is the cause of the exit of our Universe from the black-hole state?

According to the Scale-Symmetric Theory ([6] – see Chapter "New Cosmology") the dark matter consists of the additional Einstein-spacetime components from the core-of-Protoworld→neutrino transition. On the other hand, the dark energy consists of the radialy moving carriers of photons from the annihilations of the virtual electron-positron pairs. The virtual pairs look as the real pairs but they are placed in local Einstein spacetime with lowered mass density. The dark energy appeared due to the evolution of the Protoworld i.e. the biggest object created due to the phase transitions of the fundamental spacetime.

B.

What is origin of the VEVs (the vacuum expectation values)? Can we show physical meaning of the mathematical analogy between the real Higgs mechanism and the electroweak theory? Can we prove that the mainstream electroweak theory and the real Higgs mechanism are the parts of the Scale-Symmetric Theory?

The Scale-Symmetric Theory leads to the complete mass spectrum of the Higgs boson with a mass of 125 GeV [2]. This theory shows that there is obligatory following formula:

$VEV = 2H = W^+ + W^- + Z,$

where H =125.972 GeV is the mass of the sham Higgs boson (the Higgs boson is associated indirectly with the Planck energy [3]) whereas W and Z are the masses of the carriers of weak interactions above the VEV. Since the W and Z bosons are the vector particles (their spin is unitary) so their exchanges cause that there appears the left-handed–right-handed asymmetry. We should observe such asymmetry, for example, for very energetic electrons scattered on deuterons (Stanford 1978). The obtained experimental results are consistent with the predictions within the electroweak theory. The rate of scattering was different for electrons rotating to the left and rotating to the right. But the Scale-Symmetric theory shows that the nucleons have the left internal helicity so the observed phenomena can follow not from the weak interactions. Similarly is for atoms – the electrons have the right internal helicity so the atoms should rotate the planes of polarization of light. Such phenomena as well are not associated with the weak interactions.

Moreover, the Scale-Symmetric Theory shows that at low energies the weak interactions are associated with properties of the scalar condensates in centers of the baryons and charged leptons. The weak interactions carried by the scalar condensates should not lead to the left-handed–right-handed asymmetry.

We need more precise experiments to test the mainstream electroweak theory and the electroweak theory described within the Scale-Symmetric Theory.

The Scale-Symmetric Theory shows that at low energies the weak interactions are associated with the scalar condensates composed of the Einstein-spacetime components. The scalar condensates appear due to the Mexican-hat mechanism associated with neutrinos and the Einstein-spacetime components (they are the binary systems of neutrinos) [4]. The Mexican-hat mechanism leads to the confinement. Since the neutrinos as well have internal helicity so we should observe the left-handed–right-handed asymmetry for neutrinos scattered on electrons or baryons. We should not observe such asymmetry for neutrinos scattered on the scalar condensates.

A scalar condensate as well is in centers of neutrinos but it consists not of the Einstein-spacetime components but of the superluminal binary systems of closed strings that appeared during the inflation due to the first phase transition of the fundamental spacetime. Since the neutrinos are the miniatures of the charged core of baryons and since neutrinos and cores of baryons appear due to the phase transitions so we can calculate the radius of the scalar

condensate inside the neutrinos – it is in approximation $R = 1.397 \cdot 10^{-37}$ m. On the other hand, the maximum density of space is about $8.322 \cdot 10^{85}$ kg/m^3 [6] (it is not the Planck energy). Calculate inertial-mass E of sphere which radius is R and filled with maximum dense space – we obtain $E \approx 533$ GeV. Such inertial mass is needed to produce the neutrinos – emphasize that neutrinos and groups/scalar-condensates of neutrinos or binary systems of neutrinos are responsible for the weak interactions. We can rewrite the formula for VEV as follows

$$E \approx 533 \text{ GeV} \approx 2 \cdot VEV = 4H = 2(W^+ + W^-) + 2Z \approx 504 \text{ GeV}. \quad (1)$$

This formula suggests that there should be a mathematical analogy between the real Higgs mechanism (the real Higgs boson consists of four different neutrinos [3]) and the mainstream electroweak theory.

Why 4H instead 2H? The Scale-Symmetric Theory shows that for the weak interactions is characteristic the 4-particle symmetry. The neutrinos were produced as the groups composed of four different neutrinos. Below the inertial-mass E, the neutrinos responsible for weak interactions cannot be produced so it is the vacuum expectation value. Around each scalar condensate was produced the torus. Its structure causes that the neutrinos have gravitational mass, spin and weak charge. Such is the mechanism that transforms the inertial mass only into the Principle-of-Equivalence neutrinos and into the Einstein-spacetime components. Such is physical meaning of the Higgs mechanism – the VEV causes that the scalar fields/condensates transform into the gravitational fields of the Einstein-spacetime components (neutrino-antineutrino pairs). From the expanding condensate are produced the binary systems of the closed strings – they are the gravitationally massless Goldstone bosons. Their spins are the eigenvectors for each generator leading from the global symmetry group to the subgroup with "spontaneously" broken symmetry. The "spontaneously" broken symmetry follows from the infinitesimal spins of the tachyons the fundamental spacetime consists of. The mass matrix of the gravitationally massless (the spins are the imaginary quantities only) fields has the eigenvalue equal to zero. The binary systems of the closed strings appear due to rotation. The spins are tangent or parallel to the expanding surface of the condensates whereas in the torus the spins are perpendicular to the surface. This means that to transform the inertial mass only into the Principle-of-Equivalence neutrino, the resultant fields must be orthogonal to the eigenvectors of the initial gravitationally massless fields in which are only the imaginary spins of the entanglons i.e. of the binary systems of closed strings.

When we replace in Lagrangian the initial scalar fields for the resultant fields then there appears the new mass matrix that can lead to the massless photon and the W and Z bosons. Gerard 't Hooft [5] showed that renormalization of such theory is possible when propagators of the vector bosons (in the Scale-Symmetric Theory they are the entanglons) decrease as $1/k^2$, when momentum $k \rightarrow \infty$. Physical meaning of such renormalization we can describe within the Scale-Symmetric Theory. We can write the Einstein formula for total energy of a Principle-of-Equivalence particle for the gravitationally massless tachyons the binary systems of closed strings consist of [6]. When speed of tachyons is much higher than the speed of light then their energy is inversely proportional to speed. It is possible because inertial mass of a tachyon decreases faster with speed than the speed increases. Since the inertial mass has the three degrees of freedom so it should be inversely proportional to three powers of speed. This leads to conclusion that energy of tachyon is inversely proportional to four powers of speed. Propagator gives the probability amplitude. The modulus squared of the probability amplitude represents a probability or probability density. This means that energy is proportional to two powers of propagator so propagator of a closed string for $v >> c$ is inversely proportional to two powers of speed i.e. for the non-relativistic binary systems of closed strings (entanglons) their propagator changes, if such changes could be possible, as $1/k^2$.

The described scalar condensates, so the neutrinos as well, were produced during the inflation only i.e. the real Higgs mechanism acted during the inflation only. The observed oscillations of the neutrinos are in fact the exchanges of the free neutrinos for the neutrinos in the Einstein-spacetime components.

The real Higgs mechanism concerns the production of the neutrinos and the Einstein-spacetime components during the inflation only. But we can see that the VEVs concerning the real Higgs mechanism and the mainstream electroweak theory are in approximation the same so there is some analogy in the mathematical descriptions. In the real Higgs mechanism the Goldstone bosons are the binary systems of closed strings or loops composed of such binary systems. On the other hand, in the mainstream electroweak theory, the Goldstone bosons are the loops composed of the entangled Einstein-spacetime components – due to the Mexican-hat mechanism, they can acquire mass.

Can we show equivalence of the Scale-Symmetric Theory and the mainstream electroweak theory? Within the Scale-Symmetric Theory, on base of the phase transitions of the fundamental spacetime, I calculated the results obtained within the mainstream electroweak theory with higher accuracy. Moreover, I calculated physical quantities that cannot be obtained within the mainstream theory and I calculated the three quantities which are the parameters in the mainstream theory. The Weinberg angle and the fine-structure constant for the VEV I calculated in paper [2] whereas the Fermi coupling constant G_F we can calculate from the sum of the mass of muon $m_{muon(bound)} = 105.667$ MeV ([6] – see formula (27)) and the electromagnetic energy that leads to the sham Higgs boson 125 GeV ([6] – see formula (273)), i.e. $E_{em} = 3.097$ MeV [6], both produced in the relativistic d = 0 state in baryons [6]. The speed in the relativistic d = 0 state is v = 0.99381298c ([6] – see formula (48)). Since the rate of decay of muon follows from the weak interactions of electron (which appears in the decay) with a proton so we obtain following formula

$$G_F \approx \alpha'_{W(electron\text{-}proton)}/(m_{muon(bound),d=0} + E_{em,d=0})^2 = 1.16733 \cdot 10^{-5}\ GeV^{-2}, \qquad (2)$$

where $\alpha'_{W(electron\text{-}proton)} = 1.11943581 \cdot 10^{-5}$ is the coupling constant for the weak interactions of proton and electron ([6] – see formula (58)). The obtained value for G_F is very close to experimental result $1.166364(5) \cdot 10^{-5}\ GeV^{-2}$ (Source: 2010 CODATA) – the ratio is about 1.0008.

It is not true that above the VEV is some unification of different interactions. I showed that processes associated with the VEV concerning the real Higgs mechanism are irreversible i.e. there is needed lower energy to produce neutrinos during the inflation than destroy them today. It follows from the fact that the fundamental spacetime started from the densest state so production of the binary systems of the closed strings was very easy. They arose due to the viscosity of the tachyons. Today, since the dynamic viscosity of the tachyons is tremendous [6], to destroy the closed strings is needed tremendous energy. On the other hand, the processes associated with the VEV concerning the mainstream electroweak theory are reversible i.e. the Z and W bosons can decay into the free Einstein-spacetime components when absorbed energy is sufficiently high to increase the mean distance above the range of the confinement.

The “spontaneously” broken symmetries of the Einstein spacetime result from the entanglement and/or confinement. Since entanglement and confinement are associated with the superluminal phenomena then they are the very energetic interactions but the involved inertial mass only (the binary systems of the closed strings are gravitationally massless; they produce only the jets i.e. the interactions are directional) is very low.

C.

Why renormalization does not act in the General Relativity?

The gravitational fields are produced by the neutrinos and the Einstein-spacetime components in the fundamental spacetime composed of the classical gravitationally massless tachyons (the fundamental spacetime I refer to as well as the Newtonian spacetime or modified Higgs field). Today in this spacetime cannot be produced any virtual particle-antiparticle pairs as it is possible in the Einstein spacetime. The weak, strong and electromagnetic interactions concern the Einstein spacetime in which the quantum processes are possible.

Some integrals appearing in the successive orders of perturbation theory for propagators are divergent. The change in mass, i.e. the mass renormalization, results from the interactions of a bare particle with its field. The sum of the bare mass and the mass renormalization gives the observable mass of a particle.

Since the bare particles have radius not equal to zero so we can reject the infinite energies – the result is the mass renormalization. To do this we introduce the counterterms to cancel the divergences – they represent the region occupied by the bare mass. Now we can write that the observable mass of a particle is the sum of unknown bare mass and the known mass renormalization. Since we know the observable mass from experimental data (it is the free parameter) so we can calculate the bare mass. On base of such renormalization theory we can calculate other physical quantities, for example, magnetic moments.

On the other hand, the phase transitions of the fundamental spacetime directly lead to the bare masses so such theory is mathematically very simple – just the renormalization is not needed. Moreover, the phase transitions lead to origin of the scalar condensates, to origin of spin, charge, mass renormalization, and so on.

Described above the Renormalization Theory is useless for gravitation. Elimination of infinities for one graviton does not eliminate infinities for two exchanged gravitons, and so on. It follows from the fact that gravitational energy is not associated with the Einstein spacetime. The gravitational energy concerns the gradients produced in the fundamental/classical spacetime in which the quantum processes are today impossible. The neutrinos and the Einstein-spacetime components, i.e. the two smallest pieces of gravitational masses, transform the chaotic motions of the tachyons into sets of divergent jets – in such a way are produced the gravitational gradients [6]. We can unify the gravity and the entanglement responsible for the quantum phenomena with the other interactions only via the phase transitions of the fundamental spacetime.

Quantum gravity can act correctly at low energies because we can reject the succeeding infinities but it does not act correctly at high energies.

D.

What is origin of the "spontaneously" broken symmetries? Why equations can be symmetrical whereas their solutions are not?

The "spontaneously" broken symmetries result from the infinitesimal spin of tachyons, which must be conserved in the bound states of tachyons, and the scalar condensates of the tachyons that appeared during the inflation. These two conditions lead to creations of the closed strings having internal helicity and spin. Since the total/global internal helicity and total/global spin of the initial fundamental spacetime were equal to zero so the closed strings appeared locally as the groups of four closed strings grouped in two binary systems with opposite spins – the spins in a binary system are parallel whereas internal helicities are opposite. We can see that "spontaneously" broken symmetries are local.

Due to the phase transitions, Nature repeats in the Einstein spacetime the phenomena that led during the inflation to the locally broken symmetries of the fundamental spacetime. Since the Einstein-spacetime components, i.e. the neutrino-antineutrino pairs, have unitary spin

(they are the vector pairs) so there arise the particle-antiparticle pairs which components similarly as in the binary systems of closed strings, have parallel spins and opposite internal helicities. They are the zero-helicity vector particles/pairs. In such a way arise, for example, the electron-positron pairs.

The phase transitions of the fundamental spacetime show that the components of the objects created due to the succeeding phase transitions are moving slower and slower. For example, the binary systems of closed strings in the neutrino-antineutrino pairs are moving with speed about $2.4 \cdot 10^{59}$ times higher than the Einstein-spacetime components in the bare electrons. Unit of time we can define as period of spinning of, for example, neutrino and electron. This leads to conclusion that the inner times are going differently for neutrinos and electrons whereas the outer times for neutrinos and relativistic electrons are going the same. This means that the fields composed of neutrinos and relativistic electrons can be symmetrical whereas for a neutrino and resting electron can be not. It is the reason that equations for fields composed of neutrinos (they are the non-relativistic particles moving with the speed of light) and relativistic electrons can be symmetrical whereas their solutions are not. We can see that such theories are incomplete due to the fact that they neglect the phase transitions of the fundamental spacetime. We can see that all problems of the Standard Model follow from the fact that description of the "spontaneously" broken symmetries is incomplete. Some selected properties of particles can be consistent only with one solution, not all – it is the "spontaneously" broken symmetry.

The electromagnetism is associated with the excited states of the Einstein spacetime. The mean distance between the Einstein-spacetime components causes that they are outside the Mexican-hat volume that is responsible for the confinement directly associated with the weak interactions. During the inflation the mean distance between the Einstein-spacetime components was smaller than the range of the confinement so there dominated the weak interactions – there was symmetry between the excited weak and electromagnetic states. At the end of inflation the mean distance became a little greater than the range of the confinement – it caused that the symmetry between the weak and electromagnetic interactions was "spontaneously" broken (it was due to the inflation).

We can see that within the Scale-Symmetric Theory we can point the causes of the "spontaneously" broken symmetries – it is impossible within the Standard Model.

Notice as well that all particles greater than neutrinos consist of the Einstein-spacetime components. Since the real Higgs boson consists of four different neutrinos [3] so when we neglect energy emitted due to the confinement and entanglement then all particles greater of 4 neutrinos acquire masses proportional to the mass of the real Higgs boson.

E.

Why all energies are so low in comparison with the Planck energy?

I explained this problem in paper [3] and book [6]. The neutrinos consist of the superluminal binary systems of closed strings. It causes that energy, not mass, frozen inside neutrino is tremendous in comparison with the "observable" mass of neutrino. The geometric mean of the superluminal energy and gravitational mass of a neutrino is very close to the Planck energy. Since the masses of the neutrinos and the Einstein-spacetime components are very low in comparison with the frozen superluminal energy (the mass is $0.6 \cdot 10^{119}$ times lower [6]) so all observable energies are very low in comparison with the Planck energy.

It is the solution of the hierarchy problem.

F.

Why the string/M theory is useless?

This theory as well neglects the phase transitions of the fundamental spacetime. The closed strings have size about 10^{10} times smaller than it is assumed in the string/M theory. They are inflexible i.e. they cannot vibrate. Moreover, the string/M theory neglects the fact that during

the inflation the binary systems of the closed strings had assembled in such a way that there appeared the tori and scalar condensates. But it is true that there is some substitute of the fermion-boson symmetry [6].

The closed string is not a relativistic quantum string.

G.

What is origin of the physical constants and mathematical constants applied in physics?

Physical meaning of the physical constants and mathematical constants applied in physics as well follows from the phase transitions of the fundamental spacetime [6].

The gravitational constant follows from the properties of the Einstein-spacetime components and neutrinos and density of the fundamental spacetime ([6] – see formulae (11) and (12)). The half-integral spin results from the properties of the closed strings and due to the fact that due to the phase transitions of the fundamental spacetime the spin of the entanglons is ”copied” by the greater structures ([6] – see formula (4)). The speed of light depends on properties of the tachyons and closed strings ([6] – see formula (10)). The electric charge depends on its structure (torus), gravitational constant and densities of the fundamental and Einstein spacetimes ([6] – see formulae (20) and (18)). The base of the natural logarithm follows from the entangled massless structures that can appear in the Einstein spacetime [7], [6]. The number π and the imaginary number i = sqrt(-1) follow from the structure and properties of the closed strings ([6] – see Chapter “Mathematical Constants”).

The Scale-Symmetric Theory as well leads to the mental world ([6] – see Chapter “Fractal Field”).

3. Summary

Here, within the lacking part of ultimate theory i.e. the Scale-Symmetric Theory, I answered the big questions in cosmology and particle physics. All these questions can be answered within the phase transitions of the fundamental spacetime. The phase transitions of the fundamental spacetime are neglected in the mainstream theories so they are incomplete and mathematically very complicated. This causes that within them appear many wrong interpretations and free parameters.

References

[1] Sylwester Kornowski (2012 - 2013). http://vixra.org/author/sylwester_kornowski .

[2] Sylwester Kornowski (23 September 2013). ”The Complete Mass Spectrum of the Higgs Boson with a Mass of 125 GeV”. http://vixra.org/abs/1309.0157 .

[3] Sylwester Kornowski (14 October 2013). ”The Different Sequels to the Higgs Mechanism”. http://vixra.org/abs/1310.0094 .

[4] Sylwester Kornowski (18 September 2013). ”The Ultimate Picture of Particle Physics and Cosmology”. http://vixra.org/abs/1309.0135 .

[5] G. ‘t Hooft, *Nucl. Phys.* **B35**, 167 (1971).

[6] Sylwester Kornowski (3 December 2012). ”The Scale-Symmetric Physics”. http://vixra.org/abs/1203.0021 .

[7] Sylwester Kornowski (27 October 2013). ”Derivation of the Pauli Exclusion Principle and Meaning Simplification of the Dirac Theory of the Hydrogen Atom”. http://vixra.org/abs/1304.0081 .