The Big Answers in Cosmology and Particle Physics

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Abstract: Here, applying the lacking part of ultimate theory i.e. the Scale-Symmetric Theory, we answered the big questions that cannot be answered within the mainstream theories. What is the 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)? What is the difference between the mainstream electroweak interactions and electroweak interactions described within SST? Why renormalization does not act in the General Relativity? What is the 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 the origin of the physical constants and mathematical constants applied in physics? All these questions can be answered within the phase transitions of the superluminal non-gravitating Higgs field (of the inflation field).

1. Introduction

The General Relativity leads to the non-gravitating Higgs field composed of tachyons [1A]. On the other hand, the Scale-Symmetric Theory (SST) shows that the succeeding phase transitions of such Higgs field lead to the different scales of sizes [1A]. Due to the saturation of interactions via the Higgs field and due to the law of conservation of the half-integral spin that is obligatory for all scales, there consequently appear the superluminal binary systems of closed strings (entanglons) responsible for the quantum entanglement, stable neutrinos and luminal neutrino-antineutrino pairs which are the components of the luminal Einstein spacetime (it is the Planck scale), cores of baryons, and the cosmic structures (protoworlds) that evolution leads to the dark matter, dark energy and expanding universes [1A], [1B]. The non-gravitating tachyons have infinitesimal spin so all listed structures have internal helicity (helicities) which distinguish particles from their antiparticles [1A]. SST shows that a fundamental theory should start from infinite nothingness and pieces of space [1A]. Sizes of pieces of space depend on their velocities [1A]. The inflation field started as the liquid-like field composed of non-gravitating pieces of space [1A]. Cosmoses composed of universes are

created because of collisions of big pieces of space [1A], [1B]. During the inflation, the liquid-like inflation field (the non-gravitating superluminal Higgs field) transformed partially into the luminal Einstein spacetime [1A]. In our Cosmos, the two-component spacetime is surrounded by timeless wall – it causes that the fundamental constants are invariant [1A], [1B].

Due to the symmetrical decays of bosons on the equator of the core of baryons, there appears the atom-like structure of baryons described by the Titius-Bode orbits for the nuclear strong interactions [1A].

The two first phase transitions describe the Higgs mechanism that leads from the superluminal non-gravitating Higgs field to the Principle of Equivalence and Quantum Mechanics.

Here, within SST, we answered the big questions in cosmology and particle physics.

2. The big answers

2.1

What is the 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, dark matter consists of the additional Einstein-spacetime components that are entangled with the Standard-Model matter. The dark matter is the remnant from the core-of-Protoworld→neutrino transition [5B].

On the other hand, the dark energy consists of the additional Einstein-spacetime components that interact gravitationally only – we will call such neutrino-antineutrino pairs the free pairs). The dark energy appeared in our Universe because of the inflows of the additional Einstein-spacetime components. They appeared because the radial motions (i.e. the ordered motions) of the virtual remnants from the annihilations of the virtual particle-antiparticle pairs after the core-of-Protoworld→neutrino transition, decreased pressure inside our Universe.

SST shows that the creation of our Universe and the inflation were separated in time [1A], [1B]. The exit of our Universe from the black-hole state was because of the inflows of the dark matter and dark energy into the early Universe (it was the double loop composed of the modified neutron black holes (MNBHs)) [1B]. Emphasize that SST shows that there are not in existence the black holes with central singularity but there are in existence the modified black holes with an orbit with the spin speed equal to the speed of light in "vacuum" c.

2.2

What is the origin of the VEVs (the vacuum expectation values)? What is the difference between the mainstream electroweak interactions and electroweak interactions described within SST?

The Scale-Symmetric Theory leads to the composite Higgs boson with a mass of $125\ \mathrm{GeV}$ [1A]. This theory shows that there is obligatory following relation [2]:

$$VEV = 2H + H^{+}\nu_{e} + H^{-}\nu_{e,anti} + H^{o}\nu = 252.180\ \mathrm{GeV} \approx W^{+} + W^{-} + Z, \qquad (1)$$

where $H = 125\ \mathrm{GeV}$ is the mass of the composite Higgs boson, H^{+}, H^{-}, and H^{o} are the masses of the core of baryons, whereas W and Z are the masses of the carriers of weak interactions above the VEV. There appears a pair of the composite Higgs bosons because in the collisions of nucleons such Higgs bosons are created as the pairs [3]. On the other hand, in

the decays of pions that are responsible for the nuclear strong interactions, can appear three different neutrinos that lead to the 3-jet events.

SST shows that at energies below the VEV, the weak interactions are carried by the scalar condensates in centres of fermions, not by the W and Z bosons. Contrary to the vector W and Z bosons, the scalar condensates should not force a left-right asymmetry in weak interactions at low energy. But fermions have the spin and internal helicity associated with charge [1A]. It leads to conclusion that at energies below the VEV, the observed left-right asymmetry can follow from the spin and internal helicity of the charges, not from the spin of the carriers of weak interactions. Since the central scalar condensate and charge are inseparable, [1A], so we need more precise experiments to distinguish the spin and helicity of charge from the spin of carriers of the weak interactions.

SST shows that the broken symmetry follows from the fact that Nature tries to eliminate turbulences from the two-component spacetime. It means that particles are created as groups of four particles (the quadrupole symmetry) because then the resultant charge, spin and internal helicity are equal to zero i.e. such a group is a scalar quadrupole. On the other hand, the internal helicity of fermions follows from the infinitesimal spin of the tachyons the superluminal non-gravitating Higgs field consists of. We can see that the broken symmetry of the components of a scalar condensate does not follow from a spontaneously broken symmetry without some cause as it is in the mainstream electroweak theory – the SST shows that the broken symmetry is directly associated with spacetime free from turbulences and with the infinitesimal spin of tachyons.

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 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 $k \rightarrow \infty$ [4]. SST shows that the image of particle interactions is exactly the opposite. The propagator gives probability amplitude for a particle to travel with a certain momentum. SST shows that the motion of an entanglon is a motion in one dimension and that entanglons are the non-relativistic objects. Moreover, when distance increases then increases length of wave produced by exchanged entanglon (length is equal to the distance between the entangled objects because the initial and final states of the exchanged entanglon must be the same. The speed of entanglons and their inertial mass are invariant so squared momentum is inversely proportional to distance r ($h\,\nu = m\,\mathrm{v}^2$; $h\,m\,\mathrm{v} / \lambda = k^2$, i.e. $r \sim 1 / k^2$).

The observed oscillations of the neutrinos are in fact the exchanges of the free neutrinos for the neutrinos in the Einstein-spacetime components.

2.3

Why renormalization does not act in the General Relativity?

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. Within such renormalization theory we can calculate other physical quantities, for example, magnetic moments.

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.

On the other hand, the SST shows that the gravitational fields are the gradient produced by neutrinos and by the Einstein-spacetime components in the superluminal non-gravitating Higgs field [1A]. Contrary to the Einstein spacetime, today in the Higgs field cannot be produced any virtual particle-antiparticle pairs. The weak, strong and electromagnetic interactions (i.e. the Standard-Model interactions) concern the luminal gravitating Einstein spacetime in which the quantum processes are possible (due to the superluminal quantum entanglement, a quantum particle can disappear in one place and appear in another one, and so on – it leads to the wave function) [1A].

Gravity acts correctly in SST because collisions of the non-gravitating tachyons cause that range of gravitational fields is finite whereas the succeeding phase transitions of the superluminal non-gravitating Higgs field lead to not sizeless bare particles i.e. the quanta carrying infinite energies are eliminated because of the initial conditions. Moreover, SST shows that inside the lightest gravitational masses (i.e. inside neutrinos) there are only the non-gravitating objects (i.e. entanglons and free tachyons) so there does not appear a singularity. Emphasize once more that within SST singularities and infinities do not appear because of the initial conditions – just Nature started from the non-gravitating tachyons i.e. the initial inflation field was non-gravitating and grainy.

2.4

What is the 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 that causes that fermions have internal helicity. Nature tries to eliminate turbulences in the two-component spacetime. It causes that fermions are created as groups in such a way the resultant charge, spin and internal helicity were equal to zero.

We can see that there are not in existence spontaneously broken symmetries i.e. broken symmetries without any causes. SST shows that the broken symmetries result from the initial condition (the tachyons have infinitesimal spin) and from the fact that Nature tries to eliminate turbulences in the two-component spacetime.

There appears the four-fermion symmetry (the quadrupole symmetry) [1A].

The succeeding phase transitions of the Higgs field show that there are the natural spin speeds and linear speeds of the created objects. Bigger and bigger structures are spinning and moving slower and slower. Units of time we can define as the periods of spinning or we can relate them to the linear speeds. Consider neutrino and electron. The inner time is going in a different way for neutrinos and electrons whereas the "outer" time, which relates to the linear speeds, for neutrinos and relativistic electrons is 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 at low energies are not. We once more showed that we cannot neglect the succeeding phase transitions.

2.5

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

I explained this problem in paper [5]. The neutrinos consist of the superluminal entanglons. It causes that the non-gravitating energy, not mass, frozen inside neutrino is tremendous in comparison with the "observable" gravitational mass of neutrino. The geometric mean of the

superluminal non-gravitating energy and gravitational mass of a neutrino is close to the Planck energy. Non-gravitating superluminal energy frozen inside a stable neutrino is about $0.6 \cdot 10^{119}$ times higher than its gravitational mass. This tremendous energy is the energy predicted within the Quantum Physics. The subluminal particles consist of the entangled and/or confined Einstein-spacetime components and/or neutrinos – it causes that their gravitational masses are very small in comparison with the Planck mass. It is the solution to the hierarchy problem.

2.6

Why the string/M theory is useless?

This theory as all mainstream theories neglects the phase transitions of the Higgs field also so there do not appear the scales of sizes and internal structures of bare particles. It causes that within the string/M theory we cannot solve correctly the hierarchy problem. SST shows that Nature cannot realize the scenarios postulated within string/M theory that lead to the superpartners. But it is true that there is some substitute of the fermion-boson symmetry, for example, the pions are the superpartners of nucleons.

SST shows that in reality the closed-strings/circles composed of the non-gravitating tachyons have size about 10^{10} times smaller than it is assumed in the string/M theory. They must be inflexible to conserve spin and they cannot vibrate because only then the gravitational constant is invariant. The SST closed string is not a relativistic quantum string.

2.7

What is the 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 Higgs field [1A], [6].

The base of the natural logarithm follows from the virtual dark-matter structures produced in the Einstein spacetime [6]. The number π and the imaginary number $i = sqrt(-1)$ follow from the structure and properties of the entanglons.

Contrary to SST, the physical constants and mathematical constants applied in physics in the mainstream theories are not derived from initial conditions so they are the free parameters.

3. Summary

Here, applying the lacking part of ultimate theory i.e. the Scale-Symmetric Theory, we answered the big questions that cannot be answered within the mainstream theories. What is the 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)? What is the difference between the mainstream electroweak interactions and electroweak interactions described within SST? Why renormalization does not act in the General Relativity? What is the 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 the origin of the physical constants and mathematical constants applied in physics?

All these questions can be answered within the succeeding phase transitions of the superluminal non-gravitating Higgs field (of the inflation field). The phase transitions of the Higgs field are neglected in the mainstream theories so they are incomplete and mathematically very complicated. There appear many approximations, mathematical tricks and free parameters. This causes that within them appear many wrong interpretations and free parameters.

References

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