From Stable Boundary of Multiverse to Inertia

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Abstract: During the inflation the classical Higgs field partially transformed into the Einstein spacetime which is the scene for the quantum fluctuations. The quantum fluctuations were impossible until inflation ended. The succeeding phase transitions of the Higgs field (it consists of the classical, non-relativistic tachyons) and strictly determined radius of our-Cosmos/Multiverse (it is the finite multiverse composed of the expanding universes with the same laws of physics and physical constants) lead to the origin of inertia.

1. Introduction

The lacking part of ultimate theory, i.e. the Everlasting Theory, I described in book [1] (there is the foundations) and 26 papers [2]. This theory is based on two fundamental axioms. There are the succeeding 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 succeeding phase transitions follow from constancy of spin and lead to the superluminal binary systems of closed strings (entanglons) responsible for the quantum 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/protoworlds that appeared after the era of inflation but before the observed expansion of our Universe. The phase transitions lead to internal structure of the fundamental bare particles (bare neutrinos, bare electrons and baryons) - it significantly simplifies the Standard Model because it eliminates the renormalization and free parameters. Moreover, the phase transitions lead to origin and values of physical constants and to origin of mathematical constants applied in physics.

The second axiom follows from the symmetrical decays of bosons that appear on the surface of the core of baryons. It leads to the Titius-Bode law for the strong interactions i.e. to the atom-like structure of baryons.

The Everlasting Theory starts from seven parameters and three very simple formulae. These initial conditions lead to all basic phenomena and within this theory I calculated hundreds of basic quantities which are consistent or very close to experimental data and observational facts.

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 to the initial conditions applied in the General Theory of Relativity. The three first phase transitions concern the particle physics whereas the structure and evolution of the most sophisticated spinor, i.e. the cosmic-object/Protoworld, defined by the four phase transitions, lead to the new cosmology.

The complete and mathematically coherent theory of the phase transitions lead to the 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 as well associated with the Einstein-spacetime components [3].

Due to the interactions of the Higgs field with the Einstein-spacetime components, the Einstein-spacetime components acquire their gravitational mass [1], [3].

What stopped the inflation? When there appeared the Einstein spacetime then there was an abstract sphere outside which the positive gravitational pressure forced on an Einstein-spacetime component by the matter inside the sphere was higher than the dynamic pressure of this spacetime [4]. This means that outside the sphere, the Einstein spacetime had collapsed so there appeared the timeless spatial boundary. It stopped the inflation and fixed the initial conditions. The boundary is non-transparent for both the Higgs-field and Einstein-spacetime components.

Description of the stationary states during the inflation we can find here [5]. The described three states are the succeeding stages in the Higgs mechanism that leads from the gravitationally massless tachyons to the Principle-of-Equivalence Einstein-spacetime components.

The Higgs field (and gradients produced in this field by masses) is associated with gravity whereas the Einstein spacetime with, strong and weak interactions. The very small ratio of densities of the Higgs field to the Einstein spacetime causes that the gravitational interactions are very weak in comparison with the three interactions described within the Standard Model. The very different properties of the Higgs field and Einstein spacetime cause that to describe gravity we must apply different methods than the applied in the Standard Model. Unification of the gravity, electromagnetism, weak and strong forces is possible only via the succeeding phase transitions of the Higgs field.

The 8 different gluons lead to four different neutrinos (two families of neutrinos). It leads to conclusion that the tau-"neutrinos" are in reality the entangled three different neutrinos of the four different neutrinos (electron- neutrino and muon-neutrino and their antiparticles). The neutrino-antineutrino pairs (i.e. the Einstein-spacetime components) are the carriers of gluons and photons. The entangled four different neutrinos are the carriers of entangled two gluons or two photons.

The Cosmos/Multiverse: It is finite and is fully filled with the Higgs field and Einstein spacetime. The Higgs field, due to the succeeding phase transitions, during the inflation, partially transformed irreversibly into the Einstein spacetime. I calculated the radius of the Cosmos applying two different methods [4]. The initial radius of the Higgs field/liquid (it was the beginning of the inflation) that transformed into the Einstein spacetime was about $1.2 \cdot 10^{11}$ m. At the end of the inflation, the radius of the Cosmos (without the boundary) was and still is about $2.3 \cdot 10^{30}$ m i.e. about 10,000 times greater than the today radius of our Universe.

The universes: Due to the entanglement and confinement of the Einstein-spacetime components during the inflation, there appeared the cosmic structures (they appeared due to the fourth phase transition of the Higgs field) which transformed into the expanding dark energy and the mass and radiation the universes consist of. Evolution of all the first-generation universes/antiuniverses is the same as our Universe. The Everlasting Theory shows that all the (anti)universes are the open (anti)universes. Since there are the universes and antiuniverses so one day they will start to overlap and there will be the matter-antimatter annihilation.

Constancy of the gravitational constant leads to conclusion that the Cosmos composed of the universes and antiuniverses, as a whole, cannot even expand. Due to expansion of the dark energy, there expand the universes and antiuniverses. The dark energy consists of the additional Einstein-spacetime components so the front of the dark energy has the radial speed

equal to the speed of light in ‘vacuum’. The Einstein-spacetime components cannot have speed higher than the c in relation to the ground state of the Einstein spacetime so acceleration of expansion of the dark energy is impossible. Acceleration of expansion of the groups of galaxies was possible at the beginning of expansion when the radial speeds of the groups of galaxies were smaller than the local radial speeds of the dark energy. The General Relativity is incomplete because both the Higgs field and Einstein spacetime are grainy, not some continuous objects.

The mainstream picture is that quantum fluctuations took place already during the inflation. Such assumption leads to separate bubble universes with different laws of physics. Such multiverse is infinite.

Sean Carroll at the California Institute of Technology and his colleagues assumed that quantum fluctuations were impossible until inflation ended (“Quantum twist could kill off the multiverse” [6]). Such model leads to finite multiverse with expanding universes in which the fixed laws of physics are the same. And it is exactly what we can find in the Everlasting Theory.

The Everlasting Theory leads to the finite Cosmos (the finite multiverse) containing expanding universes with the same laws of physics and the same physical constants. During the inflation the classical Higgs field partially transformed into the Einstein spacetime which is the scene for the quantum fluctuations. The same as in the Carroll model, in the Everlasting Theory the quantum fluctuations were impossible until inflation ended.

The moving pieces of space in our Cosmos are the classical objects. The quantum effects appear on higher level of Nature. In our Cosmos, the quantum effects are characteristic for the particles composed of entangled or/and confined the Einstein-spacetime components. It means that the fundamental field in our Cosmos, i.e. the Higgs field, is not the quantum foam. The Higgs field is the classical and non-relativistic field.

2. Motivation

Cosmoses/multiverses are created due to collisions of the very big pieces of space. This leads to cosmoses with different physical laws and different physical constants. But the scenario is always similar: the very big pieces of space crack onto the smaller pieces. Due to their dynamic viscosity there can be created the closed strings composed of the smaller pieces of space. In some cosmoses, there are possible succeeding phase transitions similar to the phase transitions in our Cosmos.

Now I will justify that the Cosmos never will be dead unless something will destroy the boundary. The two first phase transitions of the Higgs field are non-reversible. It leads to conclusion that the number of the free tachyons, the Higgs field consists of, is constant. The same concerns the free neutrinos plus the neutrinos in the Einstein-spacetime components. More precisely, the exits of the universes from the black-hole state are due to creation of new neutrino [1] but now there is the era of expansion of the first-generation (anti)universes so such phenomena cannot today change properties of the ground state of the Einstein spacetime. There as well are the creations and annihilations of particles which locally can change number density of the Einstein-spacetime components. But the ratio of mean mass density of matter plus dark energy to mass density of the ground state of the Einstein spacetime is infinitesimal (today the ratio in our Universe is about 10^{-55} [1]). It leads to conclusion that in the Cosmos with the stable boundary the ground states of the Higgs field and Einstein spacetime are conserved. It leads to conclusion that the excited states of the Einstein spacetime, which appeared at the end of inflation, are eternal i.e. the quantum fluctuations are eternal. Of course, over time, due to the quantum entanglement and confinement, distribution of the quantum fluctuations can change.

We motivated that there is strictly determined energy associated with the ground states of the Higgs field and the Einstein spacetime. And there are the additional rotational energies (the photons and gluons) of the Einstein-spacetime components. The rotational energies cannot transform into the pieces of space or Einstein-spacetime components so the excited states of the Einstein-spacetime components will be forever. The loops of the rotational energies locally decrease pressure in the Einstein spacetime so there are the flows in the Einstein spacetime that increase local mass density of the Einstein spacetime - they can transform into the known particles. Such is origin of the Einstein formula $E = mc^2$. It is not true that the rotational energy can directly transform into gravitational mass.

We can see that the excited states of the Einstein spacetime (the particles, bodies) never can change the properties of the ground state of the Higgs field and, in cosmic scale, cannot change properties of the ground state of the Einstein spacetime (i.e. its mean mass density and the luminal speeds of the components). Just the Higgs field and the Einstein spacetime conserve their mean mass density and mean speed of their components i.e. conserve their ground state. It causes that classical bodies “slide” without resistance in the two spacetimes whereas the bare quantum particles disappear in one region of spacetime and appear in another one, and so on (the quantum waves “slide” without resistance as well). Such is the origin of the inertia – the non-interacting masses moving in the Higgs field and Einstein spacetime try to conserve their velocities. Due to the irreversible processes during the inflation, there is strictly determined energy associated with the ground state of the Higgs field and the Einstein spacetime plus free neutrinos. On the other hand, the quantum entanglement causes that the perfect distribution of the rotational energies is impossible (not all Einstein spacetime components and neutrinos are simultaneously entangled).

There will be the end of the first generation of the universes and antiuniverses. But there will be the remnants and, what is most important, there still will be created the infinitesimal fluctuations in the Einstein spacetime. Such fluctuations can transform into new universes but their mass and evolution can differ very much from the strictly quantized mass and evolution of the first-generation universes (such universes are fit for life [1]).

Due to stability of the Higgs field and the Einstein spacetime in our Cosmos and due to the superluminal pieces of space the Higgs field consists of and due to the superluminal entanglons exchanged between the entangled Einstein-spacetime components, the physical constants will be constant forever unless a collision will destroy the boundary of our Cosmos – then particles will decay to the pieces of space.

3. Summary

Inertia as we know it can appear only in cosmoses/multiverses with stable boundary. In such cosmoses, due to the succeeding phase transitions of the Higgs field, there can appear expanding universes.

Due to the non-reversible processes during the inflation and due to the stable boundary of the Cosmos, the number of both the Higgs-field components and bound tachyons cannot change. The same concerns their mean speed. The ratio of the number of the entangled or confined Einstein-spacetime components to number of the free Einstein-spacetime components is infinitesimal so properties of the ground states of the Higgs field and Einstein spacetime are conserved (the masses and mean speeds of the components are conserved; the Einstein-spacetime components are the non-relativistic objects) i.e. they over time cannot change. It leads to conclusion that the rotational energies of the Einstein-spacetime components (i.e. the photons and gluons) cannot disappear due to an increase in kinetic energy of the ground-state components of the Higgs field and Einstein spacetime. It causes that classical bodies “slide” without resistance in the two spacetimes whereas the bare quantum particles disappear in one region of spacetime and appear in another one, and so on

(the quantum waves “slide” without resistance as well). Such is the origin of the inertia – the non-interacting masses moving in the Higgs field and Einstein spacetime try to conserve their velocities.

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