The Hierarchy Problem and Oscillations of Neutrinos in the Scale-Symmetric Everlasting Theory

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Abstract: The hierarchy problem follows from the very big energetic gap between the Planck scale and the masses of the most massive known particles. This problem is solved within the scale-symmetric Everlasting Theory. This theory is based on the four succeeding phase transitions of the modified Higgs field composed of the superluminal pieces of space (due to the size of our Cosmos, the next phase transitions are impossible). There appear the four very different scales i.e. the superluminal-quantum-entanglement scale, luminal Planck scale, observed-particles scale and cosmological scale. Due to the irreversible processes during the inflation, the electron and muon neutrinos are the stable particles. The observed oscillations follow from the decays or creations of the unstable tau "neutrinos" and from the exchanges of the free neutrinos for the neutrinos in the neutrino-antineutrino pairs the Einstein spacetime consists of.

1. The scale-symmetric Everlasting Theory

The scale-symmetric Everlasting Theory, [1] and [2], starts from the expansion of the cracked space (it is the inflation of the Higgs field – the big bang) which leads to the Einstein spacetime (E spacetime). There appear the four succeeding phase transitions of the modified Higgs field (due to the size of our Cosmos, the next phase transitions are impossible) and the atom-like structure of baryons.

During the inflation described within the Everlasting Theory, due to the two first phase transitions of the fundamental modified Higgs field composed of the superluminal pieces of space, there appeared the superluminal binary systems of closed strings composed of the superluminal pieces of space (they are the superluminal non-Principle-of-Equivalence entanglons responsible for the superluminal quantum entanglement) and, next, there appeared the E spacetime composed of the luminal neutrino-antineutrino pairs. The resultant weak charge of the E-spacetime components is cancelled and their Principle-of-Equivalence mass is very small (about $6.7\cdot10^{-67}$ kg) so their detection is much more difficult than detection of neutrinos. The collapse of the front of the expanding E spacetime stopped the inflation and there appeared the free entanglons which are exchanged between the E-spacetime components.

The modified Higgs field only partially transformed into the E spacetime in such a way that the inertial-mass density of the non-Principle-of-Equivalence modified Higgs field is about

$4 \cdot 10^{42}$ times lower than the Principle-of-Equivalence mass density of the E spacetime. The Higgs field leads to the gravitational interactions whereas the E spacetime to the electromagnetic, weak and strong interactions. We can see that unification of the General Relativity and the Standard Model within the same methods is impossible.

Due to the third phase transition which leads to the core of baryons and next to the atom-like structure of baryons, there appear the known particles so the most massive as well i.e. the Higgs boson (mass is about 125 GeV i.e. about $2.2 \cdot 10^{-25}$ kg) and the top quark (mass is about 173 GeV i.e. about $3.0 \cdot 10^{-25}$ kg). Besides these two most massive known particles, the Everlasting Theory leads to Higgs-boson-like particle with mass of about 17.1 TeV but even this mass does not solve the hierarchy model. The known particles, beside the neutrinos, consist of the entangled (it is due to the superluminal quantum entanglement of the E-spacetime components) and/or confined (it is due to the Mexican-hat mechanism characteristic for the E-spacetime components) E-spacetime components.

Due to the quantum entanglement and the fourth phase transition of the modified Higgs field, there can appear the cosmic object-antiobject pairs (the protoworld-antiprotoworld pairs) which solve the matter-antimatter asymmetry in our Universe. Due to the evolution of the cosmic objects, there appears the dark energy and expanding universes (the 'soft' big bangs).

Due to the four phase transitions, there are in existence the four scales i.e. the superluminal-quantum-entanglement scale, luminal Planck scale concerning the E-spacetime components, observed-particles scale and cosmological scale. Just the Everlasting Theory is the scale-symmetric theory.

2. The hierarchy problem

The hierarchy problem follows from the very big energetic gap between the Planck scale (the Planck energy is about $2.2 \cdot 10^{-8}$ kg) and observed-particles scale. We can see that the Planck energy is about 10^{17} times greater than the masses of the heaviest known particles. There are two different ideas to explain the gap.

The first method follows from the supersymmetry. Within this method we assume that there is the fermion-boson symmetry i.e. that each fermion/particle has its superpartner (boson) referred to as sparticle. A field composed of the sparticles causes that the energetic gap between the Planck scale and observed-particles scale is cancelled. But, unfortunately, up to now no sparticle was discovered.

The second method follows from the scale symmetry. Within this method we assume that the two very different scales follow from two very different mechanisms/phenomena. Within many scale-symmetric theories is one in which is assumed that the very big energetic gap follows from phase transition.

How the hierarchy problem is solved within the scale-symmetric Everlasting Theory and what this theory says about the two different methods i.e. supersymmetry and scale symmetry?

The Everlasting Theory shows that there is in existence the modified supersymmetry but within such supersymmetry we cannot solve the hierarchy problem. Just the "sparticles" of the neutrons and protons are the pions whereas the "sparticles" of the electrons are the photonic loops which can transform into electron-positron pairs. Their masses are too small to solve the hierarchy problem.

The so far not discovered particles are the neutrino-antineutrino pairs i.e. the E-spacetime components – above I substantiated why their detection is very difficult. The non-Principle-of-Equivalence energy frozen inside the E-spacetime components (it is the energy of the superluminal entanglons) is about $0.6 \cdot 10^{119}$ times greater than the Principle-of-Equivalence mass of the E-spacetime components. The equivalent mass of the non-Principle-of-

Equivalence frozen energy is about $4 \cdot 10^{52}$ kg. The geometric mean of the Principle-of-Equivalence mass of the E-spacetime components and the tremendous energy frozen inside them is about $16 \cdot 10^{-8}$ kg. For one component of a neutrino-antineutrino pair is $8 \cdot 10^{-8}$ kg. This value is close to the Planck energy and such is the origin of this energy. We can see that the non-Principle-of-Equivalence frozen energy of the E-spacetime components is tremendous but their Principle-of-Equivalence mass is very small. The known particles, besides the neutrinos, consist of the confined and/or entangled E-spacetime components – sometimes there are one or more neutrinos. It concerns the Higgs boson and the top quark as well.

The very small Principle-of-Equvalence mass of the E-spacetime components in comparison with the non-Principle-of-Equivalence frozen energy inside the E-spacetime components solves the hierarchy problem. The geometric mean of the small mass and tremendous frozen energy leads to the Planck scale whereas the confinement and/or entanglement of the small masses carried by the E-spacetime components lead to the observed-particles scale. The two very different mechanisms which lead to the two scales result from the succeeding phase transitions of the modified Higgs field.

3. "Oscillations" of neutrinos

The scale-symmetric Everlasting Theory shows that there are only two species of stable neutrinos i.e. the electron and muon neutrinos. There are the antineutrinos as well so there are four different stable neutrinos. The third unstable "neutrino", i.e. the tau "neutrino" consists of confined three different stable neutrinos i.e. the tau "neutrino" in fact is a nucleus composed of three different stable neutrinos. It can decay to three stable neutrinos or to a carrier of photon/gluon (i.e. to the E-spacetime component) plus stable neutrino.

There are not in existence the "observed" oscillations of neutrinos. Just due to the irreversible processes during the inflation, the neutrinos are the stable particles. The "oscillations" of neutrinos follow from the decays or creations of the tau "neutrinos" and from the exchanges of the free neutrinos for the neutrinos in the E-spacetime components. Since the Earth mass follows from the entangled or/and confined E-spacetime components so at night we should observe more "oscillations" and we know that it is true. The difference should be small because there is as well the E spacetime which mass density is much higher than the Earth.

4. Summary

The hierarchy problem follows from the very big energetic gap between the Planck scale and the masses of the most massive known particles. This problem is solved within the scale-symmetric Everlasting Theory. This theory is based on the four succeeding phase transitions of the modified Higgs field composed of the superluminal pieces of space (due to the size of our Cosmos, the next phase transitions are impossible). There appear the four very different scales i.e. the superluminal-quantum-entanglement scale, luminal Planck scale, observed-particles scale and cosmological scale. The second and third scales solve the hierarchy problem.

Due to the irreversible processes during the inflation, the electron and muon neutrinos are the stable particles. The observed "oscillations" follow from the decays or creations of the unstable tau "neutrinos" and from the exchanges of the free neutrinos for the neutrinos in the neutrino-antineutrino pairs the Einstein spacetime consists of.

The scale-symmetric Everlasting Theory based on the four succeeding phase transitions of the modified Higgs field composed of superluminal pieces of space was formulated in May 1997. The part of the Everlasting Theory describing the atom-like structure of baryons was formulated in August 1985.

References

[1] Sylwester Kornowski (14 March 2014). “The Everlasting Theory and Special Number Theory”.
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[2] Sylwester Kornowski (2012 – 2014).
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