The Scale-Symmetric Theory Solves the Mass-Gap Problem

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Abstract: In this article we can find only certain summary of the mass-gap problem that is already solved within the Scale-Symmetric Theory (SST). We cannot solve the Yang-Mills mass-gap problem within the quantum Yang-Mills theory because it is incomplete i.e. this theory does not lead to the internal structure of bare baryons (of the core of baryons) that is responsible for production of the massive carriers of the nuclear weak and strong interactions. To solve the mass-gap problem we must describe following three mechanisms: the real Higgs mechanism i.e. we must show how the Einstein-spacetime components (i.e. the neutrino-antineutrino pairs) acquire their gravitational mass because of their interactions with the non-gravitating superluminal Higgs field - it follows from the succeeding phase transitions of the Higgs field described within SST, the mechanism of production of the condensates composed of the neutrino-antineutrino pairs that are responsible for the nuclear weak interactions, and the mechanism of production of the pions that are responsible for the nuclear strong interactions of baryons. Such mechanisms are described within SST which is the mathematically coherent theory.

In this article we can find only certain summary of the mass-gap problem that is already solved within the Scale-Symmetric Theory (SST) [1].

We cannot solve the Yang-Mills mass-gap problem within the quantum Yang-Mills theory because it is incomplete i.e. this theory does not lead to internal structure of bare baryons (of the core of baryons [1]) that is responsible for production of the massive carriers of the nuclear weak and strong interactions. Such carriers have finite ranges.

To solve the mass-gap problem we need new theory that should lead to the internal structure of the bare particles. It is obvious that mathematical-point/bare-particle (as it is in the Standard Model) cannot have physical properties such as, for example, electric charge or spin.

Why the Scale-Symmetric Theory leads to internal structure of the bare particles [1]?. The General Relativity leads to the superluminal Higgs field composed of the non-gravitating tachyons. The succeeding phase transitions of such non-gravitating Higgs field lead to the different scales of sizes i.e. to the internal structures of cores of particles (of bare particles) – there appear the superluminal entanglons responsible for the superluminal quantum entanglement, neutrinos, cores of baryons, [1], and cores of some cosmic objects that evolution leads to the dark matter, dark energy and expanding universes [2].

The real Higgs mechanism concerns the transformation of the non-gravitating superluminal Higgs field into the gravitating neutrinos and gravitating neutrino-antineutrino pairs that are

the components of the luminal Einstein spacetime [1]. The detected Higgs boson with a mass of 125 GeV is not the real Higgs boson – it is the composite Higgs boson composed of the Einstein-spacetime components i.e. composed of particles which already have gravitational mass [1].

The carriers of the nuclear weak and strong interactions, i.e. the condensates of the confined neutrino-antineutrino pairs (they are responsible for the weak interactions) and the binary systems of loops composed of the entangled neutrino-antineutrino pairs (they are the pions; they are responsible for the strong interactions of baryons) [1], are built already of the gravitating neutrino-antineutrino pairs so creations of the condensates and loops does not solve the mass-gap problem but we must describe them to understand fully the problem.

We can see that to solve the mass-gap problem we must describe following three mechanisms:

1.

The real Higgs mechanism i.e. we must show how the Einstein-spacetime components (i.e. the neutrino-antineutrino pairs) acquire their gravitational mass because of their interactions with the non-gravitating superluminal Higgs field – we solved this problem via the succeeding phase transitions of such Higgs field [1].

2.

The mechanism of production of the virtual and real condensates of the Einstein-spacetime components – such condensates are responsible for the nuclear weak interactions [1]. The phase transitions of the Higgs field lead to the torus/electric-charge placed in the core of baryons. It is built of the entangled neutrino-antineutrino pairs. Equatorial spin speed of the pairs is equal to the speed of light in "vacuum" c. It leads to conclusion that a mean spin speed of the torus is lower than the c. But resultant speeds of the pairs must be equal to the c so there appear as well the radial motions of the pairs that cause that in the centre of the torus appear a condensate. At low energy, the condensate has mass equal to $Y = 424.124\ \mathrm{MeV}$ but at higher energies there appear the W and Z bosons [1]. Calculated masses of such bosons, [1], [3], are very close to experimental data [4].

3.

The mechanism of production of the virtual and real pions - they are responsible for the nuclear strong interactions [1]. According to SST, range of the pions (two large loops each carrying energy $m_{LL} = 67.5444\ \mathrm{MeV}$) are equal to their circumference i.e. mass m_{LL} has range about $2.9\ \mathrm{fm}$. There is not some confinement of gluons – just the range of the nuclear strong interactions is close to the circumference of the pion loops. The large loops are produced on the circular axis inside the torus in the core of baryons. Their radius is defined by size of the torus – it is $2A/3$ where A is the equatorial radius of the torus (of the core as well).

According to SST, the gluons and photons are the rotational energies of the neutrino-antineutrino pairs i.e. when we neglect the carriers (i.e. the pairs) then gluons and photons are the non-gravitating energies. Outside the nuclear strong fields, the gluons behave as photons. The different properties of gluons and photons follow from different interactions of the rotating neutrino-antineutrino pairs with fields having internal helicity (the strong fields have internal helicity) and fields that have not internal helicity (the electromagnetic and gravitational fields have not internal helicity) [1].

SST shows that inside nucleons there are three very dense fields composed of the carriers of gluons i.e. the central condensate, the torus and a ring [1]. The RHIC experiment showed that indeed inside nucleons are very dense gluon fields [5]. SST shows that there cannot be produced single quarks – quarks appear as the quark-antiquark pairs. It is the reason that we still are unable to calculate precise mass and spin of nucleons whereas within the Scale-

Symmetric Theory it is possible [1]. SST shows as well that such model leads to the sums of squared charges of nucleon components consistent with experimental data [3].

References

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