Theory of Everything Once Again

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Abstract: Here is a brief summary of the issues relating to the formulation of Theory of Everything (ToE). To formulate ToE, we must answer following questions and calculate following quantities from some more fundamental initial conditions applying much less parameters than the tens parameters that appear in the two fundamental theories i.e. in the General Theory of Relativity (GR) and the Standard Model (SM). Are the GR and SM the complete and mathematically coherent theories? Can we unify GR and SM within the same methods? If not, then what is the cause and why gravitational constant is about 42 powers of ten times lower than electromagnetic constant for electron-positron pair (it is not the fine-structure constant)? We must calculate masses of all fundamental fermions (i.e. neutrinos, electron, muon, tauon, quarks, proton and neutron) and mixing angles that appear in the PMNS neutrino-mixing matrix and in the CKM quark-mixing matrix. We must calculate fundamental physical constants and coupling constants. We must define the dark-matter (DM) particle and the dark-energy (DE) particle. There as well should appear a formula that ties masses/energies responsible for all interactions. We must solve many other fundamental problems in particle physics and cosmology unsolved within GR and SM. For example, why hyperons are created due to the nuclear strong interactions whereas they decay due to the electroweak interactions (the answer that it is due to the properties of the strange quark does not solve the problem)? All listed problems are solved within the Scale-Symmetric Theory (SST), therefore, we believe that SST is missing part of the ToE.

1. Introduction

Here, applying the Scale-Symmetric Theory (SST) [1], we show that the Theory of Everything (ToE) is not a theory that unifies the four fundamental interactions (i.e. gravitational, electromagnetic, nuclear weak and nuclear strong) at high energies within the same methods. SST shows that the four fundamental forces at high energies are not merged into one single force with one unified coupling constant. SST shows that the succeeding phase transitions of the Higgs field composed of the non-gravitating tachyons irreversibly separated GR and SM i.e. there appeared the two-component grainy spacetime with very different properties of the mutually interacting components – such interactions cause that the neutrinos

acquire their masses. All other SM particles besides the E. Kasner particles (i.e. the tachyons and entanglons responsible for the quantum entanglement that are the non-gravitating particles) consist of entangled and/or confined neutrinos – it concerns as well the composite Higgs boson with a mass of $125\ \mathrm{GeV}$.

The SST shows that the succeeding phase transitions of the superluminal non-gravitating Higgs field during its inflation (the initial big bang) lead to the different scales of sizes/energies [1A]. Due to a few new symmetries, there consequently appear the superluminal binary systems of closed strings (entanglons) responsible for the quantum entanglement (it is the quantum-entanglement scale), stable neutrinos and luminal neutrino-antineutrino pairs which are the components of the luminal gravitating Einstein spacetime (it is the Planck scale), cores of baryons (it is the electric-charge scale), and the cosmic-structures/protoworlds (it is the cosmological scale) that evolution leads to the dark matter, dark energy and expanding universes (the "soft" big bangs) [1A], [1B]. The electric-charge scale leads to the atom-like structure of baryons [1A].

2.

Are the GR and SM the complete and mathematically coherent theories?

The neutrino oscillations lead to masses of neutrinos so SM is incomplete. In both theories appear infinities and the mathematical indeterminate forms so they are the incomplete and mathematically incoherent theories.

According to SST, due to the tremendous value of the coupling constant for the shortest-distance quantum entanglement of the Einstein-spacetime components [1A], the lifetime of proton in our finite Cosmos [1B] is infinite.

3.

Can we unify GR and SM within the same methods? If not then what is the cause and why gravitational constant is about $4.2\cdot10^{42}$ times lower than electromagnetic constant for electron-positron pair (it is not the fine-structure constant)?

During the inflation, the Higgs field (it is associated with gravitational fields described within GR) partially had transformed irreversibly into the Einstein spacetime (the quantum phenomena in the Einstein spacetime, not in the Higgs field associated with gravity, lead to the SM interactions/forces). Properties of the two components of spacetime are very different so unification of GR and SM within the same methods is impossible – we can partially unify GR and SM via the succeeding phase transitions described within SST. Density of the non-gravitating Higgs field (the entanglons, the neutrinos consist of, produce gradients, i.e. gravitational fields, in the Higgs field) is about $4.2\cdot10^{42}$ times lower than density of the gravitating luminal Einstein spacetime (it carries the photons and creates the virtual electron-positron pairs) – it causes that electromagnetic constant for electron-positron pairs is about $4.2\cdot10^{42}$ times higher than gravitational constant G [1A].

Moreover, time is going in a different way in the GR spacetime (due to the gradients in the Higgs field, time is local) and SM spacetime (due to the flatness of the Einstein spacetime, even in presence of other SM fields, time is global).

4.

We must calculate masses of all fundamental fermions (i.e. neutrinos, electron, muon, tauon, quarks, proton and neutron) and mixing angles that appear in the PMNS neutrino-mixing matrix and in the CKM quark-mixing matrix.

SST reproduces the observed fermion masses and mixing angles – there is no difficulty to do it.

SST explains the number of fermion generations and their masses – it is done via the succeeding phase transitions of the non-gravitating superluminal Higgs field and the atom-like structure of baryons.

We calculated masses of neutrinos [2], masses of electron and muon [1A], mass of tauon [2], masses of quarks [1A], [1D], masses of nucleons [1A], the neutrino-mixing angles in the PMNS matrix [2], and the quark-mixing angles in the CKM matrix [3].

5.

We must calculate fundamental physical constants and coupling constants.

It is done within SST [1A].

6.

We must define the dark-matter (DM) particle and the dark-energy (DE) particle.

The Einstein-spacetime (Es) particles, DM particles, and DE particles all are the neutrino-antineutrino pairs [1B]. But in the ground state of Es that does not expand, the pairs interact gravitationally only. The DM pairs are entangled so there are created the DM structures i.e. loops and filaments – the DM structures are entangled with baryonic matter. The DE pairs are the additional pairs that interact gravitationally only as the Es particles – the dynamic pressure of the field composed of the DE pairs causes that the Universe expands.

7.

There as well should appear a formula that ties masses/energies responsible for all interactions.

We can write the ultimate formula which ties the properties of the non-gravitating tachyons with the all masses/sources responsible for the all types of interactions.

The ultimate equation looks as follows [1A]

$$4\,\pi\, m_{tachyon}\,\rho\,/\,(3\,\eta) =$$

$$= (2\, m_{closed\text{-}string}\,/\,\hbar)^2\,(2\, m_{neutrino}\,/\,\rho_E)^{1/3}\,(m_{bare(electron)}\,/\,2)\,c\,(X\,/\,H^+)^{1/2}. \qquad (1)$$

The $4\pi/3$ on the left side of the ultimate formula shows that the tachyons are the balls carrying the inertial mass only so they are the Kasner particles – we can apply to them the Kasner solution within GR. The mean inertial-only mass of tachyons is the mean mass of the source of the fundamental interaction that follows from the direct collisions of tachyons and their viscosity which results from smoothness of their surface. The ρ is the inertial mass density of the tachyons (it is not the inertial mass density of the Higgs field). The η is the dynamic viscosity of the tachyons.

The two masses of the closed strings (it is the entanglon – its total spin is $2\cdot\hbar/2 = \hbar$) on the right side of the ultimate formula are the carriers of the quantum entanglement – they are the Kasner particles as well so we can apply to them the Kasner solution within GR as well. The two Principle-of-Equivalence masses of entangled neutrinos, i.e. the neutrino-antineutrino pair, are the source of the gravitational field, linear quantum entanglement and volumetric confinement. The mass of single stable neutrino is the smallest gravitational mass. In the formula, the smallest gravitational mass is multiplied by 2 that points that the non-rotating-spin neutrino-antineutrino pairs are the components of the ground state of the Einstein spacetime (the ρ_E in the denominator is the mass density of the gravitating luminal Einstein spacetime). The half of the mass of the bare electron is the mass of the electric charge i.e. the mass of the source of the electromagnetic interaction. The c is the speed of photons and

gluons. The X is the mass of the torus/charge inside the core of baryons in which the large loops arise – they are responsible for the nuclear strong interactions. The $H^+ = X + Y - E_{binding\text{-}energy}$, where the Y is the source of the nuclear weak interactions in the baryons at low energy.

To give possibility for a quick verification of correctness of the ultimate formula, we write the needed values [1A]:

$m_{tachyon}$ = $3.752673 \cdot 10^{-107}$ kg,
η = $1.87516465 \cdot 10^{138}$ kg/(m s),
ρ = $8.3219243620109 \cdot 10^{85}$ kg/m^3,
$m_{closed\text{-}string}$ = $2.3400784191307 \cdot 10^{-87}$ kg,
$\hbar$ = $1.0545715483339 \cdot 10^{-34}$ J s,
$m_{neutrino}$ = $3.3349306182144 \cdot 10^{-67}$ kg (it is the particle mass that is not measured in experiments; in experiments is measured the geometric mean of the particle mass and wave mass so the experimental mass of lightest neutrino is about 0.057 eV [2]),
ρ_E = $1.10220055 \cdot 10^{28}$ kg/m^3,
c = $2.9979245801192 \cdot 10^{8}$ m/s,
$m_{bare(electron)}$ = $9.0988302032434 \cdot 10^{-31}$ kg,
X = 318.29553671300 MeV,
H^+ = 727.44012298929 MeV.

The left and right side of the ultimate formula is $6.9761159243710 \cdot 10^{-159}$ kg s/m^2.

8.

We must solve many other fundamental problems in particle physics and cosmology unsolved within GR and SM.

It is done within SST [4].

9.

For example, why hyperons are created due to the nuclear strong interactions whereas they decay due to the electroweak interactions (the answer that it is due to the properties of the strange quark does not solve the problem) [1A], [1D]?

If a carrier with a mass of m_i interacts with the core of baryons due to more than one type of interactions then we can apply following formula

$$\Sigma_i \, \alpha_i / m_i = const., \tag{2}$$

where α_i are the coupling constants.

The neutral pions are produced inside the core of baryons and there is obligatory the four-particle/object symmetry so the virtual quadrupoles of entangled neutral pions are very numerous inside the core and their mass is $m_{i,1} = 539.864$ MeV [1A]. They carry the nuclear weak interactions between the equator of the core of baryons and the condensate Y in its centre i.e. the range of this interaction is $A = 0.6974425$ fm [1A]. Assume that on the equator of the core appear quadrupoles with a mass $m_{i,2}$ composed of charged virtual bosons. Then, such charged bosons interact both weakly with Y and electromagnetically with the

torus/charge inside the core of baryons. We know that ranges of particles are inversely proportional to masses so applying formula (2) we can calculate mass and range B of the second quadrupole

$$(\alpha_{w(proton)} + \alpha_{em}) / \alpha_{w(proton)} = m_{i,2} / m_{i,1} = A / B = 1.38977, \quad (3)$$

where $\alpha_{w(proton)} = 0.0187229$ is the coupling constant for the nuclear weak interactions of baryons, whereas α_{em} is the fine-structure constant [1A]. From formula (3) we obtain $m_{i,2} = 750.29$ MeV and its range is $B = 0.5018395$ fm so $A / B = 1.38977$.

The second quadrupole can decay symmetrically on the equator to two parts or four parts – it leads to the Titius-Bode law for the electroweak interactions

$$R = A + d\,B, \quad (4)$$

where $d = 0, 1, 2, 4$. Such is the origin of the Titius-Bode law for the electroweak interactions. But the region of the nuclear strong interactions (it stretches from 0.465 fm to 2.958 fm) partially overlaps with the electroweak region (it stretches from 0.697 fm to 2.705 fm). The particles in the Titius-Bode states can interact with the core of baryons strongly so the region that stretches from 0.465 fm to 2.705 fm we can refer to as the strong-weak region whereas **the Titius-Bode law concerns the nuclear strong interactions as well**. Notice that the upper limit for the nuclear strong interactions is greater than for the electroweak interactions. It is the reason that hyperons are created due to the nuclear strong interactions (i.e. are created very quickly) whereas decay due to the electroweak Titius-Bode interactions (i.e. decay relatively very slowly).

We can see that all listed problems are solved within the Scale-Symmetric Theory (SST), therefore, we believe that SST is missing part of the ToE

$$\text{ToE} = \text{SST} + \text{GR} + \text{SM}$$

References

[1] Sylwester Kornowski (2015). *Scale-Symmetric Theory*
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[1C]: http://vixra.org/abs/1511.0284 (Chaos Theory)
[1D]: http://vixra.org/abs/1512.0020 (Reformulated QCD)
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