How Unsolved Problems in Orthodox Physics are Solved in the Scale-Symmetric Theory (SST)?

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Abstract: To make it easier to confront unsolved problems in orthodox physics with the solutions proposed in the SST, we grouped problems in the same way as it is done in Wikipedia. Here we have very roughly described the way of solving the problem and refer to the SST literature where you can find more detailed qualitative and quantitative descriptions. Emphasize that SST is derived ab initio.

1. Introduction

There are tens of unsolved fundamental problems in the orthodox physics i.e. in physics today widely accepted by the scientific community [1]. This suggests that we have to radically change the fundamentals of physics. Neither the Standard Model (SM) nor General Theory of Relativity (GR) can be the basis of the Theory of Everything (ToE). The Scale-Symmetric Theory (SST) shows that ToE must be based on scale-symmetric phase transitions of the initial inflation field (i.e. of the initial SST Higgs field) and on the origins of the relativistic invariants such as the SST tachyons (gravitational fields consist of such tachyons), the spin-1 SST entanglons (such superluminal objects are responsible for the quantum entanglement), gravitational constant G, half-integral spin $\hbar/2$, or elementary electric charge q [2].

Why GR or SM cannot be the fundamental theory in ToE?

Invariance of the speed of light in "vacuum" c is limited to selected phenomena only and equality of the inertial and gravitational masses does not concern the SST tachyons and entanglons [2]. Speed c is the speed of photons and gluons in relation to objects with which they are entangled. The not entangled photons or their carriers are moving with speed c in relation to the stable boundary of our Cosmos (radius of it is about 10,000 times bigger than the present-day radius of the Universe) i.e. there is the distinguished reference system [3].

Notice as well that in GR or SR spin is not invariant. SST shows that bare baryons or bare electrically charged leptons contain torus with toroidal and poloidal speed. It is built of entangled carriers of photons/gluons which must have resultant speed equal to c. Such structure does not appear in SM also. Spin of such structure is defined as follows

$$\text{Spin} = M_{Rel}\, v_{Toroidal}\, R_{Rel}\,, \tag{1}$$

where $M_{Rel} = M_O / (1 - v^2/c^2)^{1/2} = M_O/\beta$ is the relativistic mass of the torus, $v_{Toroidal}$ is the mean spin speed of the torus, and R_{Rel} is the relativistic mean radius of the torus. SST shows

that due to the quantum entanglement and due to the forced stability of physical tori, proportions in the tori of the bare fermions cannot change [2] so according to SR, due to the contraction of length, is $R_{Rel} = R_O\beta$. SST shows that the relation between v and $v_{Toroidal}$ is as follows

$$v_{Toroidal} = c\,\beta\,. \tag{2}$$

So SR with the SST limitations gives

$$Spin = M_O\,c\,R_O\,\beta \neq constant\,. \tag{3}$$

We can see that spin is a relativistic invariant only when we assume that the SR contraction of length is not a real phenomenon – SST shows that it is an effect of quantum entanglement.

When we neglect the internal structure of bare fermions (as it is in SM) then in theories must appear approximations, singularities/infinities, and mathematical tricks, for example, in the orthodox physics are used the mathematical indeterminate forms.

2. A very brief presentation of the SST incorporated from [4]

Two very simple formulae and 7 parameters only concerning the initial inflation field (i.e. the initial SST Higgs field) lead to 5 levels of Nature [2]. Within SST, we calculated more than one thousand quantities (the fundamental physical constants as well) which are consistent with experimental data – they concern particle physics, cosmology, nuclear and atomic physics, brain-mind theory, DNA or the Wow! signal, and so on.

The lowest level is the SST Higgs field composed of the impossible to observe non-gravitating tachyons. Their speed is $\sim 8\cdot 10^{88}$ times higher than the speed of light in "vacuum" *c*. Gravitational fields are the gradients in the Higgs field produced by masses. The SST tachyons are the classical objects so gravity is classical as well. In the initial tachyonic object, before the collision, the SST tachyons were in the rest and were packed to maximum so entropy of the initial Higgs field was very low.

The second level consists of the impossible to observe superluminal binary systems of closed strings built of the SST tachyons (the spin-1 entanglons). Rotating or not entanglons are responsible for the quantum entanglement and their speed is $\sim 2.4\cdot 10^{59}$ times higher than the *c*. The entanglons are the classical objects so quantum entanglement is classical also.

The third level is the gravitating Einstein spacetime (ES) composed of the neutrino-antineutrino pairs. The ES components are built of the entanglons – there are not free entanglons but they can be exchanged. SST shows that masses, weak charge and spin of neutrinos are the invariants. Speed of the ES components is *c* in relation to the system with which they are entangled. If not entangled (i.e. free – i.e. interacting gravitationally only) then their speed *c* is in relation to the stable boundary of our Cosmos. Elementary photons and gluons are the rotational energies of the ES components. Photons in nuclear strong fields behave as gluons whereas gluons outside such fields behave as photons so gluons are not confined. The ground state of ES behaves classically also i.e. the ES components when interact gravitationally only, are the classical objects. The Standard Model concerns the excited states of the third level of Nature so in SM dominates quantum mechanics that follows from the quantum entanglement and quantum coherence [4]. Rotational energies or/and quantum entanglement of the ES components cause that motion of them is more ordered – such phenomena decrease local pressure in ES – it forces inflows of additional ES components to such regions so their density increases. On the other hand, higher field density

forces creation of the virtual fields [4]. Quantum coherence is directly associated with the virtual fields [4].

The fourth level consists of the hadrons and electrically charged leptons. The bare electrically charged fermions consist of torus/electric-charge and central condensate both built of the ES components. The central condensate is responsible for the weak interactions whereas the loops or binary systems of such loops (pions) created inside the torus of bare baryons are responsible for the nuclear strong interactions.

The fifth level is one cosmological Protoworld that evolves in a cyclical manner. The Protoworld transforms into expanding universe, dark matter and dark energy [3].

3. How Unsolved Problems in Orthodox Physics are Solved in the Scale-Symmetric Theory (SST)?

To make it easier to confront unsolved problems in orthodox physics with the solutions proposed in the SST, we grouped problems in the same way as it is done in Wikipedia [1]. Here we have very roughly described the way of solving the problem and refer to the SST literature where you can find more detailed qualitative and quantitative descriptions.

3.1 General physics/quantum physics

3.1.1 Arrow of time (e.g. entropy's arrow of time): According to SST, the end of the SST inflation and the beginning of the observed expansion of the Universe were separated in time [3]. At the end of inflation there was created the stable boundary of our Cosmos [3]. The backward shock wave (created simultaneously with the Cosmos boundary) created in the centre of the Cosmos the Protoworld with the early Universe inside it. The phase transition from the shock wave to the Protoworld and early Universe is the reason that the Universe had very low entropy in the past. The early Universe was the spin-0 binary system of loops composed of the SST neutron black holes (NBHs) [3], [5]. The SST NBHs have nothing with the orthodox black holes because of lack of a central singularity. The spin speed on the equator of NBHs is equal to c. Due to the very high surface density of the torus inside the core of baryons (it is about 300 thousand times higher than surface density in the Einstein spacetime (ES); in SST, the ES concerns the Standard-Model (SM) interactions, not the gravitational interactions), both the ES inside NBH and NBH rotate with the same angular velocity so there does not appear relativistic mass and there is a spherical symmetry for gravitational potential. The NBH behaves as a crystal at very low temperature, the neutrons have parallel spins and they are practically free particles – it leads to conclusion that entropy of the SST NBH is very low. The inflows of dark energy (it consists of additional ES components) started the evaporation of NBHs and expansion of the early Universe. With time, the fusions of nucleons increase entropy of the Universe – it is the entropy arrow of time. According to SST, CP violations are a separate arrow of time. It follows from the fact that bare fermions contain tori with poloidal speed which causes that the tori create half-jet in spacetime – it defines the distinguished arrow of time [6]. Due to the non-gravitating tachyons the gravitational fields consist of (their speed is $\sim 8 \cdot 10^{88} c$) and the speed of quantum entanglement (speed of the spin-1 entanglons, which are responsible for the quantum entanglement, is $\sim 2.4 \cdot 10^{59} c$) [2] there the effect can not appear before the cause (causality), there is a single possible past, and the present moment is physically distinct from the past and future. Time is not an emergent property of consciousness. The quantum arrow of time

depends on direction of flow of virtual fields – a flow outwards a bare fermion is defined as +t whereas a flow towards the bare fermion is defined as –t [4].

3.1.2 Interpretation of quantum mechanics: There is the classical interpretation of quantum mechanics [4]. Due to the classical/superluminal quantum entanglement, quantum mechanics (QM) is non-local, causal and real. A particle as a whole cannot be simultaneously in different states so superposition is misinterpreted – different parts of the particle can be in different states. Wavefunction collapse or the measurement problem follows from the redirecting of an amount of the superluminal quantum entanglement of a system to a detector.

3.1.3 Grand Unification Theory/Theory of everything: Within SST we derived the basic physical constants ab inito [2]. Both the internal structure of the flat ES spacetime (it is discontinuous/discrete) and internal structure of bare particles (they are not mathematical points) lead to the symmetry group (gauge group of the SM). SST shows that spacetime has 3 spatial dimensions and 1 temporal dimension. Instead the higher spatial dimensions there are additional degrees of freedom [7], [2]. Because of the stable boundary of the Cosmos, the fundamental physical constants (i.e. gravitational constant, elementary spin and electric charge) are the invariants. Speed c is the speed of photons in relation to object with which they are entangled. Free photons (i.e. not entangled) are moving with speed c in relation to the stable boundary of the Cosmos. It means that there is in existence the absolute reference system. This causes that GR and SR are partially incorrect – for example, we should not observe a contraction of length [8]. Due to the SST tachyons and the SST entanglons, all SM particles are the composite particles [3]. There are only two truly fundamental objects which we cannot observe directly i.e. the SST tachyons and entanglons – it follows from the fact that they are the bare objects i.e. they cannot exchange entanglons with detectors. There is not in existence a stable particle with the Planck mass but rotating with maximal angular velocity an ES component decreases pressure in spacetime near it so there is a flow of ES towards it. Maximum mass of such flow is close to the Planck mass [9]. There are two additional fundamental forces but they cannot be observed directly. One force is a result of dynamic viscosity between tachyons and entanglons – it leads to gravity. The second force follows from the directional, superluminal quantum entanglement. The SST is the lacking part of Theory of Everything.

3.1.4 Yang-Mills theory: SST shows that partially the electroweak theory (EWT) and quantum chromodynamics (QCD) are not real theories. SST leads to very unstable ES condensates and loops with masses equal to the quark masses but they are created only as object-antiobject pairs [10] i.e. single quarks, even if confined, are not in existence. The confinement does not concern such “quark” pairs and gluons. The SST confinement concerns the relativistic pions near the bare baryons [3]. Such confinement follows from the fact that the core of baryons behaves as the SST black hole due to the strong interactions. To understand the SM interactions we must know internal structure and behaviour of the bare baryons i.e. of the core of baryons – there is the torus/electric-charge. It creates the loops and binary loops (i.e. pions) composed of gluons (gluons are the rotational energies of the ES components and outside the nuclear strong fields they behave as photons [3]). Such loops are responsible for the nuclear strong interactions. But the tori in bare fermions create as well the scalar ES condensates in their centres – they are responsible for the weak interactions. The ES condensates (i.e. the associations of the neutrino-antineutrino pairs) can rotate so the ES condensates can interact both weakly and electromagnetically. Notice that the origin of the weak and electromagnetic interactions is different. But in Paragraph **3.1.3** we showed that a rotating ES component creates around it a region with thickened ES – such region behaves as

a scalar ES condensate so the surrounding of gluon/photon can interact weakly. Energy of gluon/photon is equal to mass of the corresponding region with thickened ES multiplied by c^2 – such is the correct interpretation of the Einstein formula $E = mc^2$. We can see that there is not quantized mass gap for gluons/photons but the quantized masses of the tori in bare fermions cause that masses of the scalar ES condensates in centres of the tori are quantized i.e. there are quantized mass gaps for fermions. SST shows that the W and Z bosons are ordinary particles [11] and we should not formulate theory of weak interactions in connection only with W and Z bosons. We cannot correctly describe the behaviour of elementary particles using the Yang-Mills theory.

3.1.5 Physical information: Due to the SST tachyons, the superluminal entanglons, and lack of the orthodox black holes, there are not physical phenomena that could irrevocably destroy information. Quantum information is stored via physical quantities. Emphasize that there is the classical interpretation of quantum mechanics [4].

3.1.6 Dimensionless physical constants: They are calculated within SST ab initio [12]. SST shows that contrary to dimensional physical constants, dimensionless physical constants are not necessary.

3.1.7 Fine-tuned Universe: There is the additional SST process which facilitates the creation of nuclei of carbon. The tau-neutrino consists of three entangled smaller neutrinos [9]. Three entangled neutrinos are also in the charged pions. Such neutrinos and pions support the joining of three alpha particles in nuclear fusions – we know that nucleus of carbon-12 consists of three alpha particles.

3.1.8 Quantum field theory:
It is not possible to construct a quantum field theory in 4-D spacetime that includes interactions and does not resort to perturbative methods. It follows from both the fact that we cannot neglect the internal structure of bare fermions and that the mathematical descriptions of different interactions are very different and concern different parts of bare particles [2]. So when we do not apply the SST methods then unification of mathematical descriptions of different interactions forces the introduction of approximations and mathematical tricks.

3.2 Cosmology and general relativity

3.2.1 Problem of time: The quantum flow of time concerns the ES which is practically flat i.e. the density of dark energy is very low in relation to density of ES (today it is about 1 part in 10^{54} parts [3]). It causes that in quantum mechanics (QM) the flow of time is universal and absolute (time in quantum mechanics is a classical background parameter). But notice that today the SST dark energy expands with the Universe, more preciselly, initially amount of dark energy increased to a maximum and now, with time, density of dark energy decreases. On the other hand, gravitational fields are the gradients in the SST Higgs field produced by masses, i.e. density of gravitational field depends on distance from mass – it is the reason that in general relativity flow of time depends on the curvature of spacetime and the spacetime trajectory of the observer. These two concepts of time cannot be reconciled because properties of the Higgs field and ES are very different. Emphasize that the detected “gravitational

waves" in reality are the flows in ES and have nothing with gravitational fields i.e. with the gradients in the Higgs field [13], [14].

3.2.2 Cosmic inflation: SST shows that the orthodox theory of cosmic inflation is incorrect [2], [3], [15]. Inflation started due to collision of two cosmological objects (with very different sizes) composed of internally structureless pieces of space packed to maximum. Due to the dynamic viscosity, which is a result of smoothness of the pieces of space, the initial inflation field (i.e. the smaller object) transformed into the two-component spacetime [14]. There were created two boundaries: for the Higgs field and the inner boundary for the ES [3]. The non-gravitating tachyons the inflation/Higgs field consist(ed) of have infinitesimal spin in relation to the reduced Planck constant – it is the scalar field but due to the initial conditions there is cosmological manifold (it is not a rigid torus) [7]. It is not true that size of our Cosmos increases. The Universe is today isotropic because density of normal matter is infinitesimal in relation to density of the ground state of ES. To create a magnetic monopole, the ES components should be arranged as in the dark-matter (DM) structures. But from such DM strings or loops cannot be created stable torus i.e. stable bare monopole – it results from the fact that quantum entanglement in plane of the equators of the tori is much more energetic than in planes perpendicular to it. This follows from the fact that toroidal speed is significantly higher than poloidal one and from the fact that internal helicities of two tori with parallel spins both lying on the same straight line are opposite.

3.2.3 Horizon problem: The distant Universe is very homogeneous because of the superluminal quantum entanglement and the SST tachyons. The local anisotropies in ES are due to production of the scalar ES condensates i.e. due to the weak interactions [3].

3.2.4 Origin and future of the Universe: The origin of our Cosmos is described in Paragraph **3.2.2**. Due to the stable boundary of our Cosmos, the Universe evolves cyclically. Our Cosmos can be destroyed only because of a damage of the outer boundary of it.

3.2.5 Size of Universe: Radius of our inner Cosmos is about $2 \cdot 10^{30}$ m [3].

3.2.6 Baryon asymmetry: Baryon asymmetry results from the fact that the initial inflation field had left-handed helicity – such internal helicity have baryons while antibaryons are right-handed [2]. It caused that at the end of inflation there was produced more neutrons than antineutrons. Abundance of nucleons in the backward shock wave was much higher than antinucleons.

3.2.7 Cosmological constant problem (or vacuum catastrophe): Due to the phase transitions during the inflation, inside the ES components is frozen energy which is $\sim 4 \cdot 10^{42}$ times higher than the whole rest energy [2]. On the other hand, the frozen kinetic energy of all entanglons the lightest neutrino consists of is $\sim 0.6 \cdot 10^{119}$ times higher than the "observed" kinetic energy of the neutrino [2]. This is the reason that the zero-point energy of the "vacuum" not causes a large cosmological constant – the phase transitions during the inflation cancelled it out. Almost all energy of "vacuum" is frozen inside the ES components whereas the kinetic energy of the ES components, i.e. $E_{Kinetic} = N\ 2\ m_{Neutrino}\ c^2\ /\ 2$, where N denotes number of the ES components and $m_{Neutrino}$ is mass of neutrino, cannot be transformed into excited energy of the ES. In SST, we do not need a renormalization to set the vacuum energy to any value. We showed that in SST, contrary to quantum field theory, we do not need a renormalization constant introduced ad-hoc to solve the cosmological constant problem. To create the bare Protoworld we need rotational energy equal to the mass of the

cosmological torus inside the bare Protoworld (it leads to the zero-point energy) – mass of it was $8.59 \cdot 10^{51}$ kg [3]. After the decay of the bare Protoworld [3], this energy was evenly distributed in the virtual field of the bare Protoworld. Today, the radius of such field is about 2π times bigger than the radius of the Universe [3] i.e. is $2\pi \cdot 2.04 \cdot 10^{26}$ m – it is by an analogy to the virtual field of the resting electron: the de Broglie wave length $\lambda_{deBroglie}$ ($\lambda_{deBroglie} = 2\pi\hbar/(m_{electron}c) = 2.4263 \cdot 10^{-12}$ m) is about 2π times bigger than the equatorial radius of the bare electron $\lambda\!\!\!^{-}_{C,bare\text{-}electron} = 3.8661 \cdot 10^{-13}$ m [2]; we have: $\lambda_{deBroglie}/\lambda\!\!\!^{-}_{C,bare\text{-}electron} = 2\pi/a$, where $a = 1.0011596522$ is the ratio of the mass of electron to its bare mass [2]; the difference $a - 1$ is due to the radiation mass of the electron [2]. This leads to conclusion that density associated with the zero-point energy is 0.55 eV per cubic centimetre. With time, due to the expansion of the Universe, value of the zero-point-energy density decreases.

3.2.8 Dark matter (DM): The DM structures are built of the entangled ES constituents. A precondition for electromagnetic interactions is the ability to rotate the spin of Einstein's spacetime constituents. In the DM structures, i.e. in the DM strings between galaxies and the DM loops in rotating galaxies, polarization of such spins is forced, i.e. spins must be tangent to the DM strings and DM loops – it is the reason that the DM structures do not interact electromagnetically. When the bare Protoworld decayed, the remnant transformed into the DM structures because of its interactions with the baryonic-matter structures – such a mechanism leads to 4.91% of the baryonic matter and 26.46% of dark matter in the present-day Universe [3].

3.2.9 Dark energy: To create an object with mass M there must be rotational energy E equal to M i.e. the involved energy is 2E and that's how much the mass of the positive part of the virtual field of the mass M is. When the Protoworld had decayed, the positive virtual energy 2E was replaced for the free ES components, i.e. there was inflow of the ES components into the sphere occupied by the baryonic matter – such a mechanism leads to 4.91% of the baryonic matter and 68.63% of dark energy in the Universe [3].

3.2.10 Dark flow: At the beginning of the expansion of the Universe there were produced cascades of cosmological protuberances (protuberances containing galactic clusters) [3]. Most speedy objects in a cascade could move with radial speed even few times higher than the *c*. Protuberances with higher radial speed were quickly (in a cosmological scale) suppressed. But protuberances with radial speeds below c do not have to be quickly suppressed so we can observe them as the dark flows.

3.2.11 Axis of evil: The axis of evil is the result of motion of the Universe in relation to the distinguished reference frame i.e. in relation to the ground state of ES (or in relation to the stable boundary of our Cosmos) [16].

3.2.12 Shape of the Universe: Density of baryonic matter in the Universe is about 10^{55} times lower than density of the ground state of the Einstein spacetime so the Universe is flat but due to the dynamic viscosity, quantum entanglement, and exchanged ES components there are three flexible cosmological structures (cosmological torus plus central region with slightly shifted density of spacetime) [7].

3.3 Quantum Gravity

3.3.1 Vacuum catastrophe: See Paragraph **3.2.7**.

3.3.2 Quantum gravity: Quantum Mechanics (QM) and GR cannot be realized as a fully consistent theory because they concern the very different components of the two-component spacetime – gravity concerns the SST Higgs field whereas QM the Einstein spacetime [2], [17]. The only tangent points are the entanglons the ES components consist of.

3.3.3 Black holes, black hole information paradox, and black hole radiation: See Paragraph **3.1.1** and papers [5] and [3]. There are not in existence black holes with central singularity. The SST NBHs do not produce thermal radiation but when there is accretion disc then due to the dark-matter structures, they produce one or two half-jets [5]. Due to the superluminal objects (tachyons and entanglons) and the created DM structures on the inner surface of NBHs, information cannot be destructed inside NBHs.

3.3.4 Extra dimensions: Spacetime has not more than three spatial dimensions and one time dimension. Instead the higher spatial dimensions there are the higher degrees of freedom [7].

3.3.5 The cosmic censorship hypothesis and the chronology protection conjecture: According to SST, the smallest objects in our Cosmos, i.e. the non gravitating tachyons which do not produce a field around them, have physical invariant volume. On the other hand, there are not in existence pure vibrations or pure rotations i.e. energies separated from physical volume. It leads to conclusion that in cosmos cannot appear singularities i.e. theories that lead to singularities hidden behind an event horizon or to naked singularities are at least the incomplete theories. Due to the tachyons and superluminal entanglons, the closed timelike curves and backwards time travel are the scientific fiction. QM cannot be unified with GR within the same methods because they concern the very different fields – see Paragraph **3.3.2**.

3.3.6 Locality: Due to the superluminal entanglons, which are responsible for the quantum entanglement [2], there are the non-local phenomena in QM. Information can move in a non-local way. But notice that entangled particles must first be close to each other and can not move away from each other at a speed faster than *c*. Notice also that gravitational field around the smallest masses (i.e. produced by neutrinos) can not as a whole move at a speed faster than *c*. There is the two-component spacetime i.e. the SST Higgs field (it is a classical field) and the ES and only the ES components can be entangled [2], [14].

3.4 High-energy physics/particle physics

3.4.1 Hierarchy problem: According to SST, the SST Higgs field concerns gravity whereas the ES is associated with electromagnetic interactions. On the other hand, a constant of interaction is directly proportional to density of field which is responsible for the interaction [2]. The ratio of the constant for electromagnetic interactions of electrons to gravitational constant is very high ($\sim 4 \cdot 10^{42}$ [2]) and it is the reason that gravity is such a weak force. There are not in existence stable particles with mass close to the Planck mass. But

rotating with spin speed equal to the *c* the Einstein-spacetime component has rotational energy close to the Planck mass. Rotating ES component decreases pressure in ES around the component so there is a flow of the ES components towards the rotating ES component. Mass of the thickened ES is equal to the rotational energy – this means that the unstable thickened region can have mass close to the Planck mass [9]. Such unstable regions can be created in simultaneous collisions of many very energetic particles. On the other hand, the Higgs boson is a composite particle – it is a scalar which is the condensate of ES so it does not need quantum corrections on the order of the Planck scale [2].

3.4.2 Planck particle: See Paragraph **3.4.1**.

3.4.3 Magnetic monopoles: See Paragraph **3.2.2**.

3.4.4 Proton decay and spin crisis [2]: Due to the superstrong short-distance quantum entanglement, the bare baryons (i.e. the core of baryons) are indestructible. In the proton, there is also the relativistic pion but it is under the Schwarzschild surface for the nuclear strong interactions. This leads to conclusion that proton as a whole is indestructible. Notice that the neutron can decay to the proton, i.e. to the lower mass state, but it cannot be due to the nuclear strong interactions because the neutron as well is the SST black hole in respect of the nuclear strong interactions. In SST, there does not appear the spin crisis because the half-integral spin has only the torus/electric-charge in the core of baryons. Due to collisions of nucleons, there can appear particle-antiparticle pairs with masses of the constituents equal to masses of the quarks but it is untrue that free hadrons are built of real quarks [18].

3.4.5 Supersymmetry: The orthodox supersymmetry is not realized by Nature because of lack of vibrating flexible closed strings. But notice that the ES components are built of the spin-1 binary systems of superluminal closed strings with 10 degrees of freedom [7] In SST, the pions (bosons) are the superpartners of baryons (fermions).

3.4.6 Generations of matter: It is the science fiction. This is the case that the number of quarks with different masses is equal to number of different leptons. Within SST we calculated masses of all quarks [18] and leptons [2].

3.4.7 Neutrino masses: Masses of neutrinos are due to dynamic viscosity between the Higgs-field components (the SST tachyons) and the superluminal entanglons the neutrinos consist of. Neutrinos produce gradients (gravitational fields) in the Higgs field [2]. Neutrinos follow Dirac statistics [2]. The masses of electron-neutrino and muon-neutrino are the same while mass of tau-neutrino is three times higher – they are the relativistic invariants [9]. The CP violating phase is equal to π radians [9].

3.4.8 Colour confinement: According to SST, gluons outside the nuclear strong fields behave as photons – there is not in existence colour confinement for gluons [2]. Quarks are very unstable objects so to conserve total electric charge and spin of the nuclear strong fields, they are created as quark-antiquark pairs – there are not in existence single quarks so colour confinement for quarks has no sense [18].

3.4.9 Strong CP problem and axions: According to SST, CP violations are a separate arrow of time. It follows from the fact that bare fermions contain tori with poloidal speed which causes that the tori create half-jet in spacetime – it defines the distinguished arrow of time which concerns the weak interactions [6]. The strong CP problem follows from the fact

that the nuclear strong interactions are in plane of the equator of the torus inside the core of baryons so in such a plane does not appear a separate arrow of time – it causes that CP is not violated in nuclear strong interactions [19]. Axions are not the component of dark matter – see Paragraph **3.2.8**.

3.4.10 Anomalous magnetic dipole moment: The SST model leads to the muon anomalous magnetic dipole moment [2] which is consistent with experimental data.

3.4.11 Proton radius puzzle: The two different radii follow from the atom-like structure of protons described within SST [20]

3.5 Selected problems from other areas of physics

3.5.1 Galaxy rotation problem: The orbital speeds of stars for defined spiral galaxies follow from the weak interactions, via leptons, of the baryonic matter with the dark-matter loops [21].

3.5.2 Ultra-high-energy cosmic ray: The extreme-energy cosmic rays exceeding the GKZ limit are produced due to the four-object symmetry and the phenomena which take place in collapsing to neutron star a big star [22].

3.5.3 Space roar: The space roar follows from the motion of the very early Universe in relation to the ground state of ES and from a few other phenomena [23].

4. Summary

Here we present how the 40 basic problems unsolved within the orthodox physics are solved within the Scale-Symmetric Theory. The descriptions suggest that SST is indeed the lacking part of Theory of Everything. The physics which results from phase transitions of the SST inflation field is very fruitful.

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