

The Correct Interpretation of the Kaluza-Klein Theory

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Abstract: Here, within the Scale-Symmetric Theory (SST), the correct interpretation of the Kaluza-Klein theory (KK theory) is presented. In SST, the charges are the spinning tori whereas in KK theory they are the masses moving along circle-like fifth dimension. The most incredible fact is that when we abandon the international system of units then the product of the mass of the torus/charge of proton in SST and speed of light (i.e. the fifth momentum) is very close to the value of the electric charge of proton or electron i.e. there is possible the interpretation that electric charge is the motion of mass in the fifth dimension. Moreover, the fifth momentums for the quantum entanglement and electric charge of proton have the same values but physical meanings and densities of adequate radion fields are different. Spinning torus collapses to spinning circle. In reality, the fifth dimension is the additional degree of freedom which follows from the real structure of charges. The fifth-dimension simplification causes that we lose information about internal structure of charges i.e. the KK theory is an effective theory of the SST. Radions are the components of the fifth dimensions. The SST shows that gravitational radions are superluminal whereas electromagnetic radions are luminal i.e. we cannot unify the two different radion fields within the same methods and it concerns the generalizations of the KK theory also (for example, the Yang-Mills theories). The SST shows that the cylinder condition in the KK theory follows from the fact that there are the spinning tori/charges and spinning loops. The luminal electromagnetic radion field leads to photons but the superluminal gravitational radion field does not lead to gravitons and gravitational waves. Emission of gravitational energy, i.e. a decrease in inertial-mass density of the superluminal non-gravitating Higgs field, is due to increase in gravitational-mass density of a system or due to emission of gravitational mass which carries non-gravitating gravitational field.

1. Introduction

The General Relativity leads to the non-gravitating Higgs field composed of tachyons [1A]. On the other hand, the Scale-Symmetric Theory (SST) shows that the succeeding phase transitions of such Higgs field lead to the different scales of sizes/energies [1A]. Due to the saturation of interactions via the Higgs field and due to the law of conservation of the half-integral spin that is obligatory for all scales, 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 Einstein spacetime (it is the Planck scale), cores of baryons (it is the electric-charges/Standard-Model 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 non-gravitating tachyons have infinitesimal spin so all listed structures have internal helicity (helicities) which distinguishes particles from their antiparticles [1A]. SST shows that a fundamental theory should start from infinite nothingness and pieces of space [1A]. Sizes of pieces of space depend on their velocities [1A]. The inflation field started as the liquid-like field composed of non-gravitating pieces of space [1A]. Cosmoses composed of universes are created because of collisions of big pieces of space [1A], [1B]. During the inflation, the liquid-like inflation field (the non-gravitating superluminal Higgs field) transformed partially into the luminal Einstein spacetime (the big bang) [1A], [1B]. In our Cosmos, the two-component spacetime is surrounded by timeless wall – it causes that the fundamental constants are invariant [1A], [1B].

Due to the symmetrical decays of bosons on the equator of the core of baryons, there appears the atom-like structure of baryons described by the Titius-Bode orbits for the nuclear strong interactions [1A].

Applying 7 parameters only and a few new symmetries we calculated a thousand of basic physical (and mathematical) quantities (there are derived the physical and mathematical constants as well) consistent or very close to experimental data and observational facts (http://vixra.org/author/sylwester_kornowski). In SST there do not appear approximations, mathematical tricks, and free parameters which are characteristic for the mainstream particle physics and mainstream cosmology.

During the inflation [2], due to the Higgs mechanism [1A], [3], a significant part of the non-gravitating modified Higgs field transformed into the gravitating luminal Einstein spacetime. It consists of the neutrino-antineutrino pairs with unitary spin [1A]. The mass of a neutrino-antineutrino pair is very small (it is about $6.7 \cdot 10^{-67}$ kg [1A]) and its total weak charge is equal to zero so it is much difficult to detect the Einstein-spacetime components than the neutrinos.

The entanglons the Einstein-spacetime components consist of, due to their internal helicity, transform the chaotic motions of the tachyons into divergently moving tachyons [1A]. The collisions of tachyons cause that the Einstein-spacetime components produce gradients in the superluminal non-gravitating Higgs field i.e. produce the gravitational fields [1A].

To interpret correctly the Kaluza-Klein theory, most important are following facts.

1.1.

There is the two-component spacetime composed of the superluminal non-gravitating Higgs field and the luminal gravitating Einstein spacetime. The gravitating Einstein-spacetime components produce gradients in the Higgs field i.e. produce the non-gravitating gravitational fields. On the other hand, the fields responsible for the electromagnetic, weak and strong interactions consist of the Einstein-spacetime components.

1.2.

SST shows that the gravitational/Planck scale and the Standard-Model scale are different but they are dual.

The gravitational constant G depends on internal structure of the Einstein-spacetime components, on properties of tachyons and on inertial-mass density of the Higgs field [1A].

The G concerns the gravitational scale with characteristic length close to the Planck length ($\sim 10^{-35}$ m) [1A].

On the other hand, the fine-structure constant, $\alpha_{EM} = 1/137.036$, concerns the Standard-Model scale and follows from production of the electron-positron pairs by electric charges. In the Standard-Model scale are characteristic the Compton wavelength of electron and radius of electric charge of proton (respectively $\sim 0.387 \cdot 10^{-12}$ m and $\sim 0.697 \cdot 10^{-15}$ m) [1A].

But these two scales are dual i.e. in both scales there is torus/charge (the gravitational/weak charge in the gravitational scale and electric/strong charge in the Standard-Model scale) and condensate in centre of the torus (the condensate in the centre of the torus of baryons and the condensate in the centre of the tori of charged leptons are responsible for the weak interactions).

Neutrinos produce some analog to electromagnetic field. This analog is responsible for the confinement of the Einstein-spacetime components [1A]. Some analogs in neutrinos to the loops produced inside baryons that are responsible for strong interactions, are responsible for the quantum entanglement of the Einstein-spacetime components [1A].

1.3.

SST shows that the gravitational fields are curved whereas the electromagnetic fields are flat and polarized.

2. The physical meaning of the mathematical objects and their transformations in the Kaluza-Klein theory

2.1.

The Kaluza-Klein theory [4] is the classical 5-dimensional theory (4 spatial dimensions and 1 time dimension). The SST shows that in reality there is not in existence a fourth spatial dimension but there appears the additional fifth degree of freedom. The spinning tori/charges produce lines of forces in fields, and the lines of forces converge on circle inside the tori/charges. We can see that in an effective theory of the SST, instead the spinning tori/charges, which produce physical lines of forces, we can treat the charges as spinning loops carrying mass (spinning torus collapses to spinning circle). Such simplification causes that there disappears information concerning internal structure of charges and of lines of forces. Moreover, the spinning loop/"charge" we can treat as additional degree of freedom or motion of a mass along curved fifth dimension.

In the Kaluza-Klein theory, it is assumed that electric charges are motions of masses along curved fifth dimension (motions of masses along the circle). It leads to conclusion that the Kaluza-Klein theory (KK theory) is the effective theory of the Scale-Symmetric Theory. In KK theory, the electric charge is the fifth component of the four-momentum vector p^5 . Such model leads to conclusion that electric charge is the motion of a mass in fifth dimension.

The SST shows that loops composed of the components of fields are produced on the spinning circle/curved-fifth-dimension but as well on the equators of the tori. In the Kaluza-Klein theory, information about the loops on equators disappears. The loops produced by the tori/gravitational-"charges" the Einstein-spacetime components consist of, are responsible for the superluminal quantum entanglement, whereas the loops/photons produced by the tori/electric-charges the electron-positron pairs contain are responsible for the luminal electromagnetic interactions.

The stable-neutrinos/gravitational-"charges" (stable are the electron-neutrinos and muon neutrinos whereas the unstable tau-"neutrinos" consist of three different stable neutrinos [1A])

are the non-relativistic objects carrying the same gravitational mass so they all produce the same gravitational field – we can treat them as positive-gravitational-mass charges.

We can see that there are the gravitational-mass “charges” (smaller tori) and electric charges (greater tori). Due to the self-similarity of the different-size tori, when we neglect the very different speeds characteristic for superluminal gravity and luminal electromagnetism, we can partially unify gravity with electromagnetism as it is in the Kaluza-Klein theory, or we can partially unify gravity with Standard Model in some generalizations of the KK theory.

2.2.

Photons are the wave packets composed of rotating and entangled Einstein-spacetime components. In KK theory, the Einstein-spacetime components we can treat as binary systems of spinning circles with Planck size. The circles are the fifth dimensions. Since electromagnetic field is a polarized Einstein spacetime so in the KK theory we assume that electromagnetic field is the curving of fifth dimension.

Contrary to the Einstein-spacetime components, the tachyons (the bare, internally continuous objects) cannot be entangled and there appears the mean rotational energy only. It leads to conclusion that gravitons are not in existence.

There as well are not in existence gravitational waves. Existence of gravitational waves follows from the fact that without any justification, in the Ricci tensor there appears the d’Alembertian so the speed of light c as well. The SST shows that gravitational fields are associated with the superluminal non-gravitating Higgs field, not with luminal speeds.

Gravitational fields are non-gravitating. Emission of gravitational energy, i.e. a decrease in inertial-mass density of the modified Higgs field, is due to increase in gravitational-mass density of a system or due to emission of gravitational mass which carries non-gravitating gravitational field. Gravitational redshift can be realized via transfer of energy of photons to the tachyons the gravitational fields consist of – it causes that energy in the General Theory of Relativity is non-local.

2.3.

To define the metric tensor in the Kaluza-Klein theory, we need an additional unidentified scalar field which we refer to as the radion or dilaton, whereas to define the stress-energy tensor we need density of the radion field.

What are the radions in SST? In electromagnetism, due to the four-particle symmetry [1A], the luminal binary systems of the neutrino-antineutrino pairs are the scalars and from such scalars are built the electromagnetic circles/fifth-dimensions. In gravity, due to the four-particle symmetry, the superluminal binary systems of the entanglons are the scalars and from such scalars are built the gravitational circles/fifth-dimensions.

Within the Kaluza-Klein theory we cannot describe properties of the radions because the loops/fifth-dimensions are reduced to circles. The SST shows that unification of electromagnetism and gravity within the KK theory is impossible because there simultaneously appear two different radions i.e. luminal and superluminal. The same concerns the generalizations of the KK theory.

2.4.

Is there some symmetry between the electromagnetic interaction and gravity?

According to the Kaluza-Klein theory, we can mathematically change the fifth dimension on arbitrary another dimension and the equations of this theory should not change. We can see that it is impossible. The gravitational fifth dimension is not the electromagnetic fifth dimension. Just circumferences, spin speeds and internal structures of these fifth dimensions are very different. There are two different radion fields.

The SST shows that instead the Kaluza-Klein tower that follows from the standing waves in the extra compactified dimensions, there are interacting identical circles/fifth-dimensions.

In the KK theory, due to the standing waves with wavelength, λ^5 , the quantized electric charges we can obtain multiplying integer and fifth-dimensional momentum i.e. $q = n p^5$. Since $p^5 = h / \lambda^5$, we obtain

$$U^5 m = h / \lambda^5 = c q / G^{1/2}, \quad (1)$$

where U^5 is fifth velocity whereas m is particle mass. It leads to $\lambda^5 \sim 1.13 \cdot 10^{-28}$ m. The origin of this value is unknown. On the other hand, in the SST this value is close to the geometric mean of the circumferences of closed string in entanglon (it is the gravitational radion) and the equator of the torus of electron ($\sim 1.20 \cdot 10^{-28}$ m).

The most incredible fact is that when we abandon the international system of units then the product of the mass of the torus/charge of proton in SST, $X = 318.2955$ MeV (i.e. $X = 5.6741 \cdot 10^{-28}$ kg [1A]), and speed of light (i.e. the product is the fifth momentum) is very close to the value of the electric charge of proton or electron q

$$p^5 = U^5 m = c X = 1.70 \cdot 10^{-19} \text{ kg m / s}, \quad (2a)$$

$$q = 1.60 \cdot 10^{-19} \text{ C}, \quad (2b)$$

i.e. there is possible the interpretation that electric charge is the motion of mass X in the fifth dimension with luminal speed c ($q \rightarrow p^5$).

Entanglons are the binary systems of the superluminal closed strings composed of tachyons and are responsible for the quantum entanglement [1A]. We can treat such closed string as quantum-entanglement charge so the entanglons are the quantum-entanglement charge-anticharge pairs. Linear speed of the superluminal closed strings is $U_{CS}^5 = 0.7269253 \cdot 10^{68}$ m/s whereas its inertial mass is $m_{CS} = 2.3400784 \cdot 10^{-87}$ kg [1A]. Calculate the fifth inertial momentum for the closed string moving along the fifth dimension inside torus of the gravitational “charge”

$$p_{CS}^5 = U_{CS}^5 m_{CS} = 1.70 \cdot 10^{-19} \text{ kg m / s}. \quad (3)$$

We can see that the fifth momentums for the quantum-entanglement charge and the electric charge of proton have the same value. But physical meanings and the densities of the adequate radion fields for these two interactions are very different [1A]. But the equality of the fifth dimensions shows that a partial unification is possible.

2.5.

In the Kaluza-Klein theory appears the cylinder condition (the partial derivative of the 5D metric \check{g}_{ab} is equal to zero) – then the field equations are much simpler

$$\partial \check{g}_{ab} / \partial x^5 = 0. \quad (4)$$

The SST shows that the cylinder condition follows from the fact that there are the spinning tori and spinning loops.

2.6.

It is very important to interpret correctly the replacement of the circle group in the Kaluza-Klein theory (the fifth dimension is closed and periodic), first, by the gauge group $U(1)$ and, next, by a general Lie group. Such generalizations are called Yang-Mills theories on a flat spacetime. Since Kaluza-Klein theory concerns simultaneously the curved geometry (gravity) and flat geometry (electromagnetism) whereas Yang-Mills theories concern flat geometry so the replacement means that Yang-Mills theories neglect gravity. Within such theories we cannot unify gravity with Standard Model. Just the Yang-Mills theories neglect the real properties of gravitational fields (curved, superluminal, non-gravitating, only gradients without gravitons).

The SST shows that weak interactions follow from exchanges of condensates composed of the Einstein-spacetime components (in an effective theory, it is a condensate of the gravitational fifth dimensions). Strong interactions follow from exchanges of loop or groups of loops produced inside the torus/charge (in an effective theory it is one or groups of the electromagnetic fifth dimensions). The SST shows that the electric charges placed in strong fields, instead photons produce gluons [1A]. Just in strong fields electric charges behave as strong charges as it is in, for example, proton [1A]. But SST shows that outside the strong fields the gluons behave as photons [1A]. We can see that unification of the four interactions within the same methods is impossible and it concerns the Yang-Mills theories as well. And it is not because of our incompetence – just Nature behaves in such complex way. Unification of gravity with strong and electroweak forces by using the symmetry group of the Standard Model, $SU(3)\times SU(2)\times U(1)$ is impossible.

2.7.

The SST shows that there are only the two basic yet not detected particles i.e. the Einstein-spacetime components (the neutrino-antineutrino pairs) with a mass of $6.7\cdot 10^{-67}$ kg and the Higgs-like boson with a mass of 17.1 TeV [1A].

3. Summary

Here, within the Scale-Symmetric Theory (SST), the correct interpretation of the Kaluza-Klein theory (KK theory) is presented.

In SST, the charges are the spinning tori whereas in KK theory they are the masses moving along circle-like fifth dimension. The most incredible fact is that when we abandon the international system of units then the product of the mass of the torus/charge of proton in SST and speed of light (i.e. the fifth momentum) is very close to the value of the electric charge of proton or electron i.e. there is possible the interpretation that electric charge is the motion of mass in the fifth dimension.

Moreover, the fifth momentums for the quantum entanglement and electric charge of proton have the same values but physical meanings and densities of adequate radion fields are different. It leads to conclusion that partial unification of quantum entanglement and electromagnetism is possible.

Spinning torus collapses to spinning circle. In reality, the fifth dimension is the additional degree of freedom which follows from the real structure of charges. The fifth-dimension simplification causes that we lose information about internal structure of charges i.e. the KK theory is an effective theory of the SST.

Radions are the components of the fifth dimensions. The SST shows that gravitational radions are superluminal whereas electromagnetic radions are luminal i.e. we cannot unify the two different radion fields within the same methods and it concerns the generalizations of the KK theory also (for example, the Yang-Mills theories).

The SST shows that the cylinder condition in the KK theory follows from the fact that there are the spinning tori/charges and spinning loops.

The luminal electromagnetic radion field leads to photons but the superluminal gravitational radion field does not lead to gravitons and gravitational waves. Emission of gravitational energy, i.e. a decrease in inertial-mass density of the superluminal non-gravitating Higgs field, is due to increase in gravitational-mass density of a system or due to emission of gravitational mass which carries non-gravitating gravitational field.

For gravity and electromagnetism the fifth momentums and densities of adequate radion fields are different so partial unification of these two interactions is possible only within the Scale-Symmetric Theory.

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