

The Correct Interpretation of the Kaluza-Klein Theory

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Abstract: Here, within the Scale-Symmetric Everlasting Theory (S-SET), the correct interpretation of the Kaluza-Klein theory (KK theory) is presented. In S-SET, the charges are the spinning tori whereas in KK theory they are the masses moving along circle-like fifth dimension. 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 S-SET. Radions are the components of the fifth dimensions. The S-SET 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 S-SET 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 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.

1. Introduction

The Kasner metric [1] is a solution to the vacuum Einstein equations and in the Scale-Symmetric Everlasting Theory (S-SET), [2] and [3], we apply this metric to the modified Higgs field composed of the non-gravitating, non-relativistic, bare, superluminal pieces of space (tachyons). The three additional laws of conservation lead to the scale-symmetric physics. Due to the four succeeding phase transitions, there are in existence the five scales: the tachyon scale, the superluminal-quantum-entanglement scale, luminal Planck scale (or gravitational scale) concerning the Einstein-spacetime components, observed-particles scale (or the Standard-Model scale) and cosmological scale.

During the inflation [4], due to the Higgs mechanism [5], 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 [3]. The mass of a neutrino-antineutrino pair is very small, about $6.7 \cdot 10^{-67}$ kg [3], and its total weak charge is equal to zero so it is much difficult to detect the Einstein-spacetime components than the neutrinos.

The superluminal binary systems of closed strings (i.e. the entanglons responsible for the quantum entanglement) the Einstein-spacetime components consist of, due to their internal helicity, transform the chaotic motions of the tachyons into divergently moving tachyons [3]. The collisions of tachyons cause that the Einstein-spacetime components produce gradients in the modified Higgs field i.e. produce the gravitational fields [3].

Most important to interpret correctly the Kaluza-Klein theory are the following facts.

1.1.

There are the two very different spacetimes i.e. the modified Higgs field composed of tachyons and the luminal Einstein spacetime. The gravitating Einstein-spacetime components produce gradients in the superluminal 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 gravitating Einstein-spacetime components.

2.1.

Notice as well, that the gravitational 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 superluminal Higgs field. The G concerns the gravitational scale with characteristic length close to the Planck length ($\sim 10^{-35}$ m) [3].

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. For the Standard-Model scale, the Compton wavelength of electron and radius of electric charge of proton are characteristic (respectively $\sim 0.387 \cdot 10^{-12}$ m and $\sim 0.697 \cdot 10^{-15}$ m) [3].

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 [5]. Some analogs in neutrinos to the loops produced inside baryons, which are responsible for strong interactions also, are responsible for the quantum entanglement of the Einstein-spacetime components [5].

3.1.

Notice as well, 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 [6] is the classical 5-dimensional theory (4 spatial dimensions and 1 time dimension). The S-SET [3] shows that in reality there is not in existence a fourth spatial dimension but there appears the additional 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 S-SET, 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 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 Everlasting Theory. In KK theory, the electric charge is the fifth component, p^5 , of the four-momentum vector. Such model leads to conclusion that electric charge is the motion of a mass in fifth dimension.

The S-SET 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 contain, 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 neutrinos/gravitational-‘charges’ 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 duality 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 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 as well. The S-SET shows that gravitational fields are associated with the superluminal 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.

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 S-SET? In electromagnetism, due to the four-particle symmetry [3], the luminal binary systems of the Einstein-spacetime components are the scalars and from such scalars are built the electromagnetic circles/fifth-dimensions. In gravity, due to the four-particle symmetry [3], 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 S-SET 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 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 S-SET 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, $q = n p^5$. 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 S-SET this value is close to the geometric mean of the circumferences of closed string in entanglon (it is the gravitational radion) and Compton wavelength of electron multiplied by 2π (it is associated with the electromagnetic interactions) ($\sim 1.20 \cdot 10^{-28}$ m).

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

$$\partial \check{g}_{ab} / \partial x^5 = 0. \quad (2)$$

The S-SET 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 S-SET 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/strong-charge (in an effective theory, it is one or groups of the electromagnetic fifth dimensions). The S-SET shows that the electric charges placed in strong fields, instead photons produce gluons [3]. Just in strong fields electric charges behave as strong charges as it is in, for example, proton [3]. 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 S-SET shows that there are only the two basic yet not detected particles i.e. the Einstein-spacetime components with a mass of $6.7\cdot 10^{-67}$ kg and the Higgs-like boson with a mass of 17.1 TeV [3].

3. Summary

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

In S-SET, the charges are the spinning tori whereas in KK theory they are the masses moving along circle-like fifth dimension. 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 S-SET.

Radions are the components of the fifth dimensions. The S-SET 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 S-SET 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 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.

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