

# How to Eliminate the Messy Mathematical Methods from Physics and Cosmology?

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**Abstract:** The gauge invariance of equations follows from constancy of charges. There appear arbitrary functions so to obtain quantized values we must apply approximations, mathematical tricks and free parameters. The second messy mathematical method applied in physics follows from the wrong assumption that the bare particles are sizeless and that there are in existence interactions with infinite range (it follows from the massless carriers of interactions). In such method, to obtain theoretical results consistent with experimental data, there must appear the mathematical indeterminate forms so they are incoherent as well. Such messy method cannot be eliminated via vibrating flexible strings, as it is in the M/string theory, because such assumption cannot lead to constancy of physical constants. What we should do to eliminate the arbitrary functions, sizeless bare particles, infinite ranges of forces and flexible strings? What is the difference between microscopic and macroscopic times? And some extension to the General Relativity is the answer to these questions. The quantum entanglement and locally broken symmetries cause that the Universe becomes more and more complex.

## 1. Introduction and motivation

The gauge invariance of equations follows from constancy of charges. We can say that the gauge invariance is associated with the laws of conservation of charges. Instead some vector potential  $A$  and scalar potential  $\varphi$  we can apply the modified quantities

$$A' = A + \text{grad } f, \quad (1)$$

$$\varphi' = \varphi - (1/c) \partial f / \partial t, \quad (2)$$

where  $f$  is an arbitrary function.

Due to the arbitrary function,  $f$ , there is big number of solutions (big number of different gauge fields) which conserve charges. It causes that to obtain theoretical results consistent with experimental data, i.e. consistent with quantized values, there sooner or later in the gauge theories containing the arbitrary function  $f$ , must appear approximations, mathematical tricks and free parameters. Of course, the gauge theories are partially useful because they lead to

symmetries (sometimes to broken symmetries) and next to the laws of conservation. But it looks as a lucky hit, not as coherent theory. Moreover, such mathematical methods never will lead to the complete internal structures of the charges so as well to the complete internal structure of spacetime and other fields. It causes that we cannot properly/unmistakably describe the interactions of charges with spacetime and other fields. There appear many wrong assumptions and interpretations.

The second messy mathematical method applied in physics follows from the wrong assumption that the bare particles are sizeless and that there are in existence interactions with infinite range (it follows from the massless carriers of interactions). In such method, to obtain theoretical results consistent with experimental data there must appear the mathematical indeterminate forms as, for example,  $\infty - \infty = \text{arbitrary-constant}$ . It causes that theories with such assumptions are mathematically incoherent so there appears the mathematical trick i.e. the renormalization. Such messy method cannot be eliminated via vibrating flexible strings, as it is in the M/string theory, because such assumption cannot lead to constancy of physical constants.

Ultimate theory should simultaneously lead to the origin of physical constants, to internal structure of space and to internal structure of bare charges and it is in the fruitful Scale-Symmetric Everlasting Theory (S-SET), [1], [2].

What we should do to eliminate the arbitrary functions, sizeless bare particles, infinite ranges of forces and flexible strings?

The General Relativity (GR) with the upper limit for speed  $c$  concerns the Principle-of-Equivalence objects i.e. objects which inertial mass is equal to gravitational mass. So the fundamental question is: Can there be in existence non-gravitational inertial-mass-only pieces of space moving with superluminal speeds? And some extension of the GR “says” YES [3]. Just such extension leads to physical/nontransparent volumes without fields – they are the bare objects/tachyons. In S-SET, the gas composed of the tachyons is the modified Higgs field and it was the inflation gas. The kinetic and rotational energies are carried by the pieces of space so in such theory cannot appear singularities and infinite ranges – just renormalization is eliminated.

Next, we can apply the simplest dynamics of fluids. There appear the superluminal closed strings with half-integral inertial-only spin. The half-integral spin is copied in greater and greater structures composed of more and more tachyons. Due to the half-integral spin, masses, radii and speeds of such structures are quantized. They lead to the internal structures of bare charges. It is the S-SET. This theory simultaneously leads to the origin of physical constant, internal structures of charges, spacetime and possible fields and finite ranges of gravity and electromagnetism. Just in this theory the all messy mathematical methods are eliminated.

Why range of gravitational interactions is finite? The gravitational fields are the gradients in the modified Higgs field produced by the Einstein-spacetime components. The range is finite due to the collisions of the tachyons – it is about  $2 \cdot 10^{36}$  m. Photons are the rotational energies of the Einstein-spacetime components.

### **Why closed strings, not balls/condensates-of-tachyons?**

In fluids can appear vortices/closed-strings. The tachyons rotate so the closed strings have internal helicity. Balls/condensates-of-tachyons cannot have internal helicities. Just tori are the simplest mathematical objects which can have internal helicity. To conserve the zero-internal helicity of the Higgs field, the closed strings appear as the pairs with opposite internal helicity of components of a pair. We can see that the succeeding phase transitions break local symmetries whereas global symmetry is conserved. Broken symmetries are needed to our existence.

### **Why not the Riemannian supermetrics?**

Due to the succeeding phase transitions, the succeeding scalar/radion fields have very different properties so unification of gravity and Standard Model within the same mathematical methods is impossible.

### **Why unification of gravity and Standard Model within quantum physics is impossible?**

Gravity is associated with the classical non-gravitating modified Higgs field whereas Standard Model with the Einstein spacetime which gravitates. Properties of these two fields are very different so unification is impossible.

### **Why complete ground unification is impossible?**

It is due to the succeeding phase transitions. The partial theories are connected via a channel and the Scale-Symmetric Everlasting Theory is the channel. Within the S-SET we solved all basic problems not solved within the mainstream theories. Moreover, the S-SET shows the all limitations for the partial theories. We can say that S-SET is the Holy Grail of physics and cosmology.

### **Why ten dimensions of the closed strings?**

In reality, the ‘ten dimensions’ are the degrees of freedom to describe position, shape and possible motions of a closed string composed of tachyons. We need  $x$ ,  $y$ , and  $z$  to describe initial position of the centre of a closed string, its two radii, linear speed (time), toroidal speed, poloidal speed and two angular velocities to describe rotation of spin of the closed string in relation to the linear velocity and spin i.e. we need 9 spatial degrees of freedom and 1 time degree of freedom.

### **What is the difference between the microscopic and macroscopic times?**

Usage of time-dependent equations to individual bare particle is useless. It is because behaviour of a quantum particle is non-deterministic. It is due to the fact that a quantum particle disappears in one place and appears in arbitrary other one, and so on. Just the quantum physics is the statistical theory so we can say that quantum physics is deterministic only statistically. We can say only about motion of a statistical picture/object representing a quantum particle i.e. about changes in time of the wave functions. But even then the quantum time is wrongly defined. It follows from the fact that in micro-world there are produced different virtual and real pairs and different fluctuations in the Einstein spacetime and turbulent motions which change the local mass densities so local times (local units of time) as well. Just quantum particle has volume so we have simultaneously many different units of time concerning the same quantum particle. The solution to the time-dependent equations in the quantum physics, are only approximate. Generally, such equations are useless.

So what is an alternative? We should seek the statistically stable states and we can do it considering the phase transitions – it is done in the Scale-Symmetric Everlasting Theory.

Equations dependent on time are useful only in deterministic world i.e. macro-world. It follows from the fact that dominating part of nucleons, about  $100\% \cdot 727/939 \approx 77\%$ , at the today density of the Einstein spacetime, behaves in a deterministic way [2]. Emphasize that the classical part of nucleons produce quantum particles. But due to the classical part, collections of interacting atoms behave classically. To collections of interacting atoms we can apply time-dependent equations.

The Schrödinger equation dependent on spatial coordinates only, leads to the statistically stable shapes of the wave functions so such solutions are correct.

We can say about the good defined relativistic time only in relation to deterministic objects.

We can use the Uncertainty Principle, which ties energy of an object and its lifetime, because it leads to statistical shape concerning the lifetime.

### **Why with time the Universe is more and more complex?**

According to the S-SET, our Cosmos appeared due to collision of two internally symmetrical pieces of space i.e. the initial entropy was lowest. But due to the succeeding phase transitions of the initial Higgs field, there appeared the internally left-handed matter and right-handed antimatter and quantum entanglement. It causes that there can appear particle-antiparticle pairs but creation in the Einstein spacetime two vortices with opposite internal helicities causes that in the left-handed vortex is produced more matter (protons) than antimatter (antiprotons). It is the locally broken symmetry. Such locally broken symmetries and the quantum entanglement are characteristic for different scales. It causes that with time the Universe is more and more complex i.e. distribution of the free and bound Higgs-field components is more and more complex.

### **References**

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