Quantum Physics in the Lacking Part of Ultimate Theory

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Abstract: Here within the lacking part of ultimate theory, i.e. the Everlasting Theory, I derived the fundamental equation of the Matrix Quantum Mechanics i.e. the commutator. It follows from the phase transitions of the fundamental spacetime that are based on the half-integral-spin constancy. The fundamental equation results from the entanglement that leads to the infinitesimal transformations. In reality, the Matrix Quantum Mechanics that describes excited states of fields, i.e. the quantum particles, is timeless and non-local i.e. non-deterministic. But the Matrix Quantum Mechanics leads to the time-dependent, so deterministic, wave functions that are characteristic for the Statistical Quantum Mechanics. It is the reason why the wave functions appear in the equations of motion. The Statistical Quantum Mechanics or the Quantum Theory of Fields, are the semiclassical/semi-quantum theories. The presented here extended Matrix Quantum Mechanics leads to the methods applied in the Quantum Theory of Fields and points the limitations.

1. Introduction

The lacking part of ultimate theory, i.e. the Everlasting Theory, is based on two fundamental axioms [1]. There are the phase transitions of the fundamental spacetime composed of the superluminal and gravitationally massless pieces of space (the tachyons). The phase transitions follow from the saturated interactions of the tachyons and lead to the superluminal binary systems of closed strings responsible for the entanglement, lead to the binary systems of neutrinos i.e. to the Einstein-spacetime components, to the cores of baryons and to the cosmic objects that appeared after the era of inflation but before the observed expansion of our Universe. The second axiom follows from the symmetrical decays of bosons that appear on the surface of the core of baryons. It leads to the Titius-Bode law for the strong interactions i.e. to the atom-like structure of baryons.

Due to the entanglement, there is the superluminal interpretation of the Matrix Quantum Mechanics formulated by Heisenberg and Pauli [2]. Moreover, Nature launched the defensive system to eliminate turbulences and nonlinearity from the quantum fields [2]. This means that the fully quantum mechanics should be in very good approximation the linear theory.

The binary systems of closed strings, which are responsible for the entanglement [1], are the non-Principle-of-Equivalence "particles" i.e. they have inertial mass but they are the gravitationally massless particles [1]. They are the components of the Einstein-spacetime components [1]. The gravitational constant G is directly associated with the Einstein-spacetime components which size is close to the Planck length whereas the non-Principle-of

Equivalence "particles" responsible for the entanglement, have size much smaller than the Planck length [1]. We can see that the free "particles" responsible for the entanglement have broken contact with a wave function that defines possible states of a system. We can say that such "particles" are the imaginary particles and it causes that there appears the imaginary unit i = sqrt(-1) [1].

Here within the Everlasting Theory, I derived the fundamental equation of the Matrix Quantum Mechanics i.e. the commutator. It follows from the phase transitions of the fundamental spacetime that are based on the half-integral-spin constancy [1]. The fundamental equation results from the entanglement that leads to the infinitesimal transformations. In reality, the Matrix Quantum Mechanics that describes excited states of fields, i.e. the quantum particles, is timeless and non-local i.e. non-deterministic. But the Matrix Quantum Mechanics leads to the time-dependent, so deterministic, wave functions that are characteristic for the Statistical Quantum Mechanics. It is the reason why the wave functions appear in the equations of motion. The Statistical Quantum Mechanics or the Quantum Theory of Fields, are the semiclassical/semi-quantum theories. The presented here extended Matrix Quantum Mechanics leads to the methods applied in the Quantum Theory of Fields and points the limitations.

The spins of the bare fermions follow from properties of the tori [1]. For a distant observer the tori look in approximation as loops. The carriers of the photons and gluons are the binary systems of half-integral-spin fermions [1]. There appear the vector bosons as well that are the loops [1]. We can see that the Matrix Quantum Mechanics should start from the definition of commutator applied in the ring theory

$$[A, B] = AB – BA, \tag{1}$$

where A and B are some quantities associated with a ring.

2. Calculations

The phase transitions based on the spin constancy lead to following interpretation of the Uncertainty Principle for a vector loop composed, due to the entanglement, of two half-integral-spin loops. It can be a photon or gluon or neutrino-antineutrino pair or electron-positron pair, and so on. The Heisenberg Uncertainty Principle for such loop looks as follows (the directions of the half-integral spins in a pair overlap whereas the senses are parallel)

$$E_{loop}\, T_{lifetime} = \hbar, \tag{2}$$

where $E_{loop} = m_{loop}c^2$ defines the mass of a loop (I will call the E the mass of a loop) whereas $T_{lifetime}$ is its lifetime. In this formula constant is only the reduced Planck constant $\hbar$. This means that there can arise many different loops for which mass is inversely proportional to lifetime. This is the reason that we can say about central values of mass and lifetime and their deviations.

There can be a loop/system composed of n entangled unitary-spin loops. Denote the energy/mass of the loop labelled by n by E_n whereas its lifetime by T_n. Then we obtain

$$(i\, E_n)\, T_n = \hbar. \tag{3}$$

The imaginary unit "i" follows from the imaginary inertial-mass associated with the entanglement. The photons are the rotational energies carried by entangled Einstein-spacetime components. The Einstein-spacetime components behave as the unitary-spin loops. The initial configuration/distribution of the rotational energies, due to the superluminal entanglement, changes stepwise with time. Due to the entanglement, there are not trajectories of the rotational energies. They disappear in some places and appear in other places, and so on. Similar is for an electron. A bare electron consists of entangled Einstein-spacetime components. It has shape and size so it can disappear as a whole in some region and appear in another, and so on. Moreover, the bare electron produces the virtual electron-positron pairs that as well are entangled with the source i.e. the bare electron. The virtual pairs behave as the unitary-spin loops. This leads to conclusion that due to the superluminal entanglement, configuration of an electron changes stepwise with time as well. The same concerns a loop/system composed of entangled loops. For the superluminal entanglement are responsible the unitary-spin binary systems of closed strings the Einstein-spacetime components consist of. Inertial mass of one binary system of closed strings is in approximation $5 \cdot 10^{-87}$ kg [1]. This mass is very, very small so the changes in mass of the components of a quantum system are indeed in a good approximation infinitesimal. Due to the infinitesimal transitions, spin of a loop can change by $\pm 1\hbar$. A component of a system can interact with all other components. The total change in spin of the quantum system due to the infinitesimal transitions, for a fixed configuration, must be equal to the spin of the system. Due to the rotational energies of the binary systems of the closed strings, the transitions of the rotational energies can be not infinitesimal. We must emphasize that due to the entanglement the changes in mass always are infinitesimal whereas it does not concern the massless rotational energies. Define a change (an amplitude) in mass under the infinitesimal transition from loop labeled by n to loop labeled by k by $E_{n,k}$ whereas a change (an amplitude) in lifetime due to the same transition by $T_{n,k}$. The set of the all $E_{n,k}$ elements is the matrix. The same concerns the $T_{n,k}$. Formula (3) for such system looks as follows

$$(i\, E_{n,k})\, T_{n,k} = n\hbar, \qquad (4)$$

where n denotes the number of entangled loops whereas the pairs n,k label the amplitudes concerning masses and lifetimes. Such is the correct interpretation of the Heisenberg matrices. There can be matrices for other physical quantities such as energy, position, velocity, square of velocity, and so on. But for interactions described within the time-independent Matrix Quantum Mechanics most important is formula (4).

A measurement of, for example, lifetime of a system changes its configuration of mass so the matrices for mass and lifetime does not concern the same configuration. This means that these two physical quantities do not commute.

The generality of the derivation of the commutator will not be limited when we will start from the simpler formula (3). Calculate value of the commutator defined by formula (1) for $A = E_n$ and $B = T_n$. Assume that some observed/interacting system consists of n entangled unitary-spin loops that spins are parallel but there can be more loops that we can group in pairs and the spins of the constituents of the pairs are antiparallel. Then for the whole system labelled by n we obtain

$$(i\, E_n)\, T_n = n\hbar. \qquad (5)$$

Assume that a component of the system emits the superluminal unitary-spin binary system of closed strings so the change in spin is $m = n \pm 1$. Mass of the system decreases i.e. $E_m = E_n - E$ whereas lifetime is longer $T_m = T_n + T$. Due to the entanglement the changes are infinitesimal so $T \rightarrow 0$ and $E \rightarrow 0$. After the emission is

$$(i\, E_m)\, T_m = m\hbar. \qquad (6)$$

Calculate the value of the commutator

$$[E_n , T_m] = E_n T_m - T_n E_m = \hbar\{n(T_n + T)/T_n - (n \pm 1)T_n/((T_n + T)\}/i. \qquad (7)$$

For $T \rightarrow 0$ or $E \rightarrow 0$, i.e. under infinitesimal transformation on the lifetime and mass of the system, we obtain

$$[E_n , T_m] = -(\pm \hbar/i) = \pm i\hbar. \qquad (8)$$

It is easy to notice that equation (8) is valid for all quantum particles, i.e. for all values of n, when the changes in lifetime and mass are infinitesimal. Lifetime of a loop is equal to its period of spinning.

On the base of equation (4), we can rewrite equation (8) as follows

$$[E_{n,k} , T_{m,l}] = \pm i\hbar. \qquad (9)$$

The equation (9) is the fundamental equation in the Matrix Quantum Mechanics. This equation follows from the entanglement.

Denote the matrix $E_{n,k}$ by t_α, the matrix $T_{m,l}$ by t_β whereas ±1 by $\varepsilon_{\gamma\alpha\beta}$, where $\varepsilon_{\gamma\alpha\beta}$ is +1 if γ, α, β is an even permutation or –1 if γ, α, β is an odd permutation. Then, for matrices that are the spin 1 (i.e. $1\hbar$) representation of the Lie algebra of the rotation group, we can rewrite equation (9) as follows

$$[t_\alpha , t_\beta] = i\, \varepsilon_{\gamma\alpha\beta}\, t_\gamma. \qquad (10)$$

It is the fundamental equation applied in the non-Abelian gauge theories [3]. The gauge invariance we obtain assuming that the Lagrangian is invariant under a set of infinitesimal transformations on the matter fields. It is some analogy to the infinitesimal transformations on the masses of the loops in a set of entangled loops.

We can see that presented here the Matrix Quantum Mechanics based on the entanglement and constancy of spin of the loops in a set of entangled loops leads to the methods applied in the Quantum Theory of Fields (QTFs). Why we must apply the infinitesimal transformations in the Quantum Physics? It follows from the very small inertial mass of the carriers of the entanglement i.e. of the binary systems of closed strings. What is the physical meaning of the elements of the matrix $E_{n,k}$? The n and k number the entangled loops in a system so the $E_{n,k}$ are the amplitudes of transitions between different or the same loops in the system. Their squares define the rates of the transitions. But the QTFs is the incomplete theory due to the one weak point. Within this theory we neglect internal structure of the bare fermions. This causes that there appear the singularities and infinite energies of fields. The infinities are eliminated due to the procedure that we refer to as the renormalization. This procedure follows from the incorrect formula which can be written symbolically as follows: $\infty - \infty = a = \text{constant} \neq 0$. The "a" can denote, for example, the mass of bare electron. It leads to conclusion that in reality the bare electron is not a sizeless point what is neglected in the QTFs and General Theory of Relativity (GR). The renormalization partially eliminates the wrong initial condition but we still neglect the internal structure of the bare particles, for example, the shapes and their internal helicities that are very important in the theory of strong and weak interactions. This causes that the QTFs is the messy theory. The phase transitions of the fundamental spacetime, described within the Everlasting Theory, lead to the internal structure of the bare particles and it is the reason why I call this theory the lacking part of ultimate theory. Moreover, only this theory describes origin of the fundamental physical constants that are the free parameters in the QTFs and GR.

What is the correct interpretation of the wave function? Due to the superluminal entanglement of the Einstein-spacetime components, in this spacetime can appear the quantum particles composed of the Einstein-spacetime components. The initial configuration/distribution of the entangled constituents of a quantum system changes with time. We can say that some configuration disappears and appears the next and so on. There are not continuous trajectories of the components of the quantum system between the succeeding configurations. The succeeding configurations depend stepwise on time. But in an approximation we can say about a time-dependent statistically averaged distribution that is coded by the wave function of the quantum system. In reality, due to the superluminal entanglement, for a defined time, the positions of the components of the quantum state are well-defined. Due to the entanglement we find the particle in the place of measurement if there is at least one constituent of the entangled constituents the quantum system consists of. The act of measurement and entanglement cause that the selected or all energies/masses carried by the constituents of the quantum system or quantum particle appear in one of the allowed quantum states. Due to the stepwise dependence on time, the equations of motion for a wave function are only some approximation of the quantum reality i.e. it is some statistical approximation. The idea of existence of many separated but parallel worlds is incorrect whereas the idea that quantum system or particle consists of many entangled the Einstein-spacetime components and that detection even of one entangled component causes transition of the quantum system or particle to one of the allowed quantum states is correct.

3. Summary

Here within the lacking part of ultimate theory, i.e. the Everlasting Theory, I derived the fundamental equation of the Matrix Quantum Mechanics i.e. the commutator. It follows from the phase transitions of the fundamental spacetime that are based on the half-integral-spin constancy. The fundamental equation results from the entanglement that leads to the infinitesimal transformations. In reality, the Matrix Quantum Mechanics that describes excited states of fields, i.e. the quantum particles, is timeless and non-local i.e. non-deterministic. But the Matrix Quantum Mechanics leads to the time-dependent, so deterministic, wave functions that are characteristic for the Statistical Quantum Mechanics. It is the reason why the wave functions appear in the equations of motion. The Statistical Quantum Mechanics or the Quantum Theory of Fields, are the semiclassical/semi-quantum theories. The presented here extended Matrix Quantum Mechanics leads to the methods applied in the Quantum Theory of Fields and points the limitations.

References

[1] Sylwester Kornowski (3 December 2012). "The Everlasting Theory and Special Number Theory".
http://www.rxiv.org/abs/1203.0021 [v2].

[2] Sylwester Kornowski (28 February 2013). "Particle Physics and Cosmology Need New Methods".
http://www.rxiv.org/abs/1302.0156.

[3] Steven Weinberg (1996). "The Quantum Theory of Fields".
Volume II, Modern Applications.
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