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Deterministic Entanglement Leads to Arrow of Time, Quantum Mechanics, Freewill and Origin of Information

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Abstract: Here, applying the Scale-Symmetric Theory, we show that the quantum entanglement is deterministic but cannot be observed directly by detectors so in Quantum Mechanics (QM) there appear the probabilities and uncertainties. It is the reason that QM is the probabilistic theory. The transition from the classical equation of motion via the Poisson brackets to the commutators and equation of motion in the Heisenberg image suggests that the QM emerges from a classical and deterministic theory and that quantum behaviour is not a fundamental property of Nature. We described as well the Type-General-Relativity (Type-GR) basic arrow of time and the Type-Standard-Model (Type-SM) arrow of time - the difference causes that unification of GR and SM within the same methods is impossible. There are two different arrangements of spins of the Einstein-spacetime components which lead to electric charges and mental solitons. Freewill results from a war for dominance of different parts of the mental solitons - it looks as a few attractors (a few solutions) of a function (to the same problem). Global information is defined by the distribution of the free and bound non-gravitating tachyons all object in our Cosmos consist of and by the infinitesimal changes in their momentums and angular momentums.

1. Introduction

The two basic incorrect assumptions, i.e. that the bare particles are the sizeless points that can possess physical properties such as mass, spin or charge and that spacetime is not grainy, cause that in the mainstream theories appear singularities and infinities – it leads to conclusion that they are incomplete and mathematically incoherent because of the indeterminate mathematical forms that appear in them. The Scale-Symmetric Theory (SST), [1], is the lacking part of the Theory of Everything that causes that the singularities and infinities do not appear and causes that mathematical description of all basic problems is very simple.

The General Relativity (GR) 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 [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 (the entanglons) responsible for the quantum entanglement, stable neutrinos and luminal neutrino-antineutrino pairs which are the components of the luminal Einstein spacetime (it is the Planck scale), cores of baryons, and the cosmic structures that evolution leads to the dark matter, dark energy and expanding universes [1A], [1B]. The non-gravitating tachyons have infinitesimal spin so all listed structures have internal helicity (helicities) which distinguish particles from their antiparticles [1A].

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].

2. Deterministic entanglement and quantum mechanics

The non-gravitating tachyons, the entanglons, and the neutrino-antineutrino pairs (so neutrinos as well) are the non-quantum objects i.e. they cannot disappear in one place and appear in another one, and so on [1A]. Quantum behaviour of particles is characteristic for excited states of the Einstein spacetime components and neutrinos and concerns energies transferred between them by the unobserved superluminal entanglons that are the non-Principle-of-Equivalence (nPoE) objects.

We can see that the quantum entanglement is deterministic but cannot be observed directly by detectors so in Quantum Mechanics (QM) there appear the probabilities and uncertainties. It is the reason that QM is the probabilistic theory.

The entanglons cannot be detected directly but we can measure the changes in properties of systems that follow from exchanges of them. We must emphasize that quantum entanglement is for Nature deterministic but our detectors cannot control the all exchanges of entanglons in a macroscopic systems so we can say only about quantum statistical determinism.

The Scale-Symmetric Theory shows that the Quantum Mechanics emerges from the deterministic/classical theory.

Dirac in September 1925 noticed that commutator $[A, B] = AB - BA$, is similar to the Poisson bracket which appears in the classical mechanics when the equation of motion is formulated in the Hamiltonian representation

$$dF / dt = \partial F / \partial t + \{F, H\}, \tag{1}$$

where the F is an arbitrary function depending on positions, momentums and time calculated for moving point in phase space, the H is the Hamiltonian function, whereas $\{F, H\}$ is the Poisson bracket.

To quantize a classical system we write the Hamiltonian equation using the Poisson brackets and next replace the Poisson brackets for the commutators

$$\{A, B\} \rightarrow [A, B] / (i \hbar). \tag{2}$$

The commutators define the changes in the time-depending dynamic variables that follow from the motions of points in the phase space for which the dynamic variables are calculated. The Scale-Symmetric Theory shows that the changes follow from the classical entanglement. The time-depending dynamic variables $\Omega_{Heisenberg}$ are defined as follows [3]

$$\Omega_{Heisenberg} = e^{iHt / \hbar} \Omega_{Schrodinger} e^{-iHt / \hbar}. \tag{3}$$

Then the equation of motion in the quantum mechanics looks as follows [3]

$$d\Omega_{Heisenberg} / dt = \partial\Omega_{Heisenberg} / \partial t + [\Omega_{Heisenberg}, H] /(i \hbar). \quad (4)$$

This equation we can obtain directly differentiating the formula (3) [3].
There are the two interpretative postulates in the Schrödinger image:

2.1
Each dynamic variable can be defined by some linear operator Ω_S i.e. $\Omega_S(a_1\psi_1 + a_2\psi_2) = a_1\Omega_S\psi_1 + a_2\Omega_S\psi_2$, where a_i are some numbers whereas ψ_i are the wave functions. The Ω_S can be an operator of position or differential operator.

2.2
In an exact measurement of a dynamic variable we can obtain only one eigenvalue of the Ω_S operator. It leads to conclusion that all the eigenvalues must be the real numbers.

We can notice that in reality the transition from the classical equation of motion via the Poisson brackets to the commutators and equation of motion in the Heisenberg image suggests that the Quantum Mechanics emerges from a classical and deterministic theory and follows from the real properties of detectors, not from the factual properties of Nature.

Emphasize that some stable objects that mass density is much higher than spacetime and fields can behave classically. It follows from the fact that such object cannot disappear in one place and appear in another one, and so on. For example, according to SST, the torus/electric-charge in the core of baryons behaves classically but it produces the quantum virtual or/and real particles. But interactions of increasing number of such classical parts cause that more and more massive objects behave more and more classically. It is the reason of the transition from a quantum description to classical one.

3. The basic arrow of time
The basic information concerning the problem of time we can find in following paper [2].
SST shows that the stable neutrinos are the lightest particles producing gravitational fields. Gravitational fields are the gradients in the superluminal non-gravitating Higgs field. When an object is closer and closer to a gravitating mass then number density of tachyons is lower and lower. When we accelerate a gravitating mass then its mass increases and number density of tachyons in a fixed distance from the mass is lower and lower. It leads to conclusion that in GR we can define units of time as the mean time between collisions of tachyons in local volumes. We can see that in GR we cannot say about a global time in a dynamic system but we can define global running unit of time for, for example, the whole expanding Universe. With time, mean mass density of the expanding Universe decreases so the global gradient is less and less “steep” i.e. the mean number density of tachyons inside the Universe increases i.e. the GR global time is going faster and faster – it is the Type-GR basic arrow of time which is directly associated with the superluminal non-gravitating Higgs field.
The global time in the QM depends on the mass density of the luminal Einstein spacetime (quantum behaviour is characteristic for the excited states of this spacetime). SST shows that today mass density of the Einstein spacetime is about 55 powers of ten higher than mass/energy density of our Universe without spacetime [1A]. It leads to conclusion that in the Standard Model (SM), in very good approximation, the global unit of time is invariant so we can introduce the time-dependent equations but they do not lead to exact solutions. The infinitesimal changes in the global unit of time cause that there appears the Type-SM arrow of time (with time, such time is going slower and slower).

The very different properties of the two components of spacetime (the superluminal non-gravitating Higgs field directly associated with GR and the luminal gravitating Einstein spacetime directly associated with SM) cause that unification of GR and SM within the same methods is impossible. SST shows that the irreversible splitting into the GR and SM took place already at the end of the inflation.

4. Freewill

SST shows that due to the quantum entanglement, there are two different arrangements of the Einstein-spacetime components (of the neutrino-antineutrino pairs) [1C]. In the electric charges the spins of the pairs are perpendicular to surface defined by the exchanged entanglons, whereas in the mental solitons the spins are aligned along line defined by the exchanged entanglons [1C].

Our minds are built of the mental solitons [1C]. It is our memory. They are produced due to the current decays and circuit breakers in nervous system in our brains. Due to the quantum entanglement and magnetic interactions, the identical parts in different mental solitons are attracting each other so there is a war for domination. There can be more than one solution of such war so it leads to the freewill – it looks as a few attractors (a few solutions) for one function (to the same problem). We can see that freewill is nondeterministic but follows from a deterministic theory.

There is a brain-mind feedback that is the result of the mental-soliton war.

5. Information

The two-component spacetime and the all other objects and fields in Nature are built of the tachyons which mean rotational and mean kinetic energy are invariant. It leads to conclusion that information is defined by the distribution of the free and bound tachyons (it is the main part of the global information) and by the infinitesimal changes (in relation to the mean values) in their momentums and angular momentums.

6. Summary

Quantum Mechanics follows from the fact that detectors cannot observe directly the exchanges of the superluminal entanglons responsible for the quantum entanglement. It means that QM is the observational theory, not a theory which describes the factual behaviour of Nature. The quantum entanglement is deterministic but cannot be observed directly by detectors so in Quantum Mechanics (QM) there appear the probabilities and uncertainties. It is the reason that QM is the probabilistic theory. The transition from the classical equation of motion via the Poisson brackets to the commutators and equation of motion in the Heisenberg image suggests that the QM emerges from a classical and deterministic theory and that quantum behaviour is not a fundamental property of Nature.

We described as well the Type-GR basic arrow of time and the Type-SM arrow of time. The difference between the two types of time causes that unification of GR and SM within the same methods is impossible. The Scale-Symmetric Theory shows that the splitting on GR and SM took place already at the end of the inflation.

There are two different arrangements of spins of the Einstein-spacetime components which lead to electric charges and mental solitons. Freewill results from a war for dominance of different parts of the mental solitons – it looks as a few attractors (a few solutions) of a function (to the same problem).

Global information is defined by the distribution of the free and bound non-gravitating tachyons all object in our Cosmos consist of and by the infinitesimal changes in their momentums and angular momentums.

References

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