

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

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Abstract: The Everlasting Theory, i.e. the lacking part of ultimate theory, describes the deterministic entanglement characteristic for the Einstein-spacetime components from which the observed matter consists of. Such entanglement leads to the fundamental arrow of time. The exchanged superluminal binary systems of the closed strings, that are responsible for the entanglement, cannot be detected directly. It causes that there appear the uncertainties in the quantum mechanics and experimental data. 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 more fundamental level of the quantum physics describes a classical/deterministic theory. The matter-mind asymmetry follows from the torus-circle asymmetry but the matter and the mental structures are built of the same elements i.e. of the Einstein-spacetime components. Due to the entanglement, we can show that the free will follows from the brain-mind resonance. The vibrations in a mind create the magnetic quanta that are some analog to the phonons produced in crystals. Only selected magnetic quanta can induce electric currents in the nerve systems. The freewill is a part of deterministic theory. Due to the classical/deterministic beginning of our cosmos there is obligatory the law of conservation of information. Before the inflation, the unit of time was equal to zero i.e. the space was timeless.

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 (protoworlds) 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.

On the base of the Everlasting Theory here I describe the four very difficult problems i.e. the origin of fundamental arrow of time, origin of the uncertainties in the Quantum Mechanics, origin of free will and information. The presented explanations lead to conclusion that most important is the entanglement characteristic for the Einstein-spacetime components. All descriptions lead to conclusion that our cosmos started from deterministic state.

The superluminal binary systems of closed strings carrying the unitary spin I will refer to as the bi-circlons. The bi-circlons are responsible for the entanglement. Radius of the circlons is

approximately 10^{-45} m i.e. is much smaller than the Planck length whereas its mass is about 10^{-87} kg [1] what causes that the transformations forced by the exchanges of the bi-circlons are indeed infinitesimal.

2. The basic arrow of time

The entanglements between the Einstein-spacetime components are produced especially when distance between the components is 2π times greater than the external radius of neutrinos [1]. It is very difficult to destroy such entanglement even after decay of particles (for example, of entangled photons), after emission of photons or/and electrons by atoms, after decay of atomic nuclei, and so on. Even dark matter or dark energy can be partially entangled. The entanglement was produced especially during the era of inflation. At the beginning of expansion of our Universe there was maximum number of entangled photons [1]. With time, the entangled photons have decayed into the smaller entangled photons containing less and less the elementary photons [1]. We can calculate the mean lifetimes for the entangled photons so for the carriers of photons, i.e. for the entangled Einstein-spacetime components, as well. The carriers responsible for entanglement, i.e. the bi-circlons, cannot be observed directly but the Everlasting Theory shows that they must exist. In the expanding Universe, the number of entangled the neutrino-antineutrino pairs decreases i.e. there is tendency to fragment. It is the basic arrow of time in our Universe.

There are the other irreversible processes in Nature as well. They all produce the past-future asymmetry. For example, the dark energy expands with the Universe so with time changes its energy density. When mass density of a cosmic object increases then local density of the modified Higgs field [1] decreases i.e. the time is going slower and slower i.e. the unit of time lasts longer and longer. The irreversible processes change entropy of a system. But we must notice that there is the difference between a gravitating system and non-gravitating system. In gravitating system order means simplicity (low entropy) whereas disorder means complexity (high entropy). In non-gravitating system, for example, when perfect liquid composed of tachyons transforms into gas, the entropy increases because order transforms into disorder (just in the gas can appear the fluctuations).

3. The classical origin of uncertainties in quantum mechanics

We use the detectors to observe the quantum particles. Such particles and the detectors consist of entangled the Einstein-spacetime components i.e. between the parts of a quantum particle and parts of a detector are exchanged the binary systems of closed strings i.e. the bi-circlons. In generally, all interacting objects composed of the Einstein-spacetime components are less or more entangled. A detector sees a quantum particle when these two objects interact i.e. they as well exchange the bi-circlons. Number of exchanged bi-circlons can change with time. On the other hand, detectors built up of the Einstein-spacetime components cannot "see" the components of the Einstein-spacetime components i.e. detectors cannot "see" the exchanged bi-circlons and their energies. The detectors can measure rotational energies carried by the free or bound components of the Einstein-spacetime. The exchanged bi-circlons change the state of the quantum particles and detectors. Such changes cannot be seen by the detectors. It leads to the uncertainties in the experimental data.

The uncertainties that appear in experimental data follow from the deterministic exchanges of the bi-circlons. We can say that the deterministic theory describing the internal structure and interactions of the Einstein-spacetime components leads to the quantum mechanics because detectors of the quantum particles cannot see the energies exchanged via the classical carriers of the entanglement. It leads to conclusion that only applying the quantum mechanics we can describe the experimental data. We cannot build up a detector free from experimental uncertainties but we can formulate classical theory that leads to the quantum mechanics and

that describes the origin of the experimental uncertainties. Of course, such theory only indirectly can be verified experimentally. The entanglement is the abstract level of Nature similarly as the virtual particle-antiparticle pairs.

The Quantum Mechanics shows which interactions and part of Nature we can investigate experimentally but it does not mean that we cannot decipher the Nature in every respect i.e. we can find the lacking part of ultimate theory.

The Everlasting Theory shows that at the base of the Quantum Mechanics is the deterministic/classical theory. Due to the entanglement, the quantum theory cannot fully and objectively describe the reality but it is and will be the best theory applied in the experimental physics. Just Nature itself defined the uncertainties of measurements.

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

$$dF/dt = \partial F/\partial t + \{F, H\} \quad (1)$$

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

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

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 Everlasting Theory shows that the changes follow from the entanglement. The time-depending dynamic variables $\Omega_{\text{Heisenberg}}$ are defined as follows [2]

$$\Omega_{\text{Heisenberg}} = e^{iHt/\hbar} \Omega_{\text{Schrodinger}} e^{-iHt/\hbar}. \quad (3)$$

Then the equation of motion in the quantum mechanics looks as follows [2]

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

This equation we can obtain directly differentiating the formula (3) [2].

There are the two interpretative postulates in the Schrödinger image:

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.

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 more fundamental level of the quantum physics describes a classical and deterministic theory.

Of course, in the Quantum Theory of Fields we apply the other methods as well to find the symmetries and the laws of conservation. We write the Lagrangian function invariant under infinitesimal transformations of the matter fields. The Everlasting Theory shows that such transformations follow from the entanglement and lead to the fundamental equation applied in the non-Abelian gauge theories [3] in which appear some matrices. For example, in the original Yang-Mills theory [4] the matter fields were the doubled of the fields of the proton and neutron, the matrices were the three isospin matrices whereas the $SU(2)$ group of rotation of the vector of isospin was the non-Abelian gauge group. But there appeared the problem that the strong field should consist of massless vector mesons carrying unitary isospin. In the modified Quantum Theory of Fields appear the ghost loops and vector mesons carrying mass.

But the Everlasting Theory shows that the Yang-Mills interpretation of the strong field is partially correct. Just at first there appear in the Einstein spacetime inside the core of baryons, the massless vortices/loops of energy that spin is unitary [1]. They are the ghost loops. Such a vortex/loop, which components are entangled, decreases local pressure in the Einstein spacetime what forces the flows in it in such a way that the local mass density increases. It causes that the massless vector vortices/loops acquire their mass. This mass is equal to the massless energy of a vortex/loop. It is the mechanism that transforms the ghost “strong” field that appeared in the original Yang-Mills theory into the real strong field.

4. Freewill is a part of deterministic theory

Charges are the tori composed of the binary systems of particles that spin is unitary and perpendicular to surface of a torus [1]. The electric charges consist of the entangled Einstein-spacetime components that can produce the electromagnetic quanta that are the rotational energies of the Einstein-spacetime components. On the other hand, a thought is a tangle of circles composed of the Einstein-spacetime components which spins are tangent to the circles. Such circles are electrically neutral and can produce the magnetic field only [1] (the circles have mass so they produce the gravitational field as well but we neglect these very weak interactions). Moreover, the circles in a thought are entangled due to the exchanges of the bi-circlons between the Einstein-spacetime components the circles consist of. Entangled are as well the same elements in different thoughts. We can say that mind composed of thoughts is a stable structure in which number of thoughts increases due to the activity of brain excited by the senses. Due to the entanglement, the interactions of the same elements in different thoughts induce their vibrations. Such vibrations produce magnetic quanta which are the rotational energies of paired the Einstein-spacetime components in such a way that they are the zero-spin objects. Electric energy of such pairs is equal to zero.

The free will is determined by structure and contents of mind and structure of brain. Most important are the number and quality of the thoughts a mind consists of. The vibrations of the entangled elements of the thoughts create the magnetic quanta (we can call them the mindons as an analog to the phonons produced in crystals or pions in atomic nuclei) that can or cannot create electric currents in the nerve system in a brain. The choices follow from the structure of brain and mind that changes when we learn, for example, a language or we school in patience, politeness, and so on. We can see that the choices are acquired i.e. the choices follow from the mind-brain resonances. Intensities of the resonances can be different. A choice is defined by intensity of resonance whereas intensity is defined by structure of mind and brain whereas structure of a brain follows from the DNA code and our experiences. It is impossible to eliminate some wrong thoughts from mind. We can only produce correct thoughts in mind in such a way the intensity of the new resonance could dominate. We, of course, can destroy the part of brain associated with the wrong resonance but it handicaps the mind-brain interactions and does not eliminate the wrong thoughts from the eternal mind. We can see that we can evolve our eternal mind only via the brain-mind activity.

We can see that difference between the electromagnetic and mental/magnetic-only activity follows from the torus-circle asymmetry or more precisely from the different arrangements of the spins of the entangled Einstein-spacetime components i.e. the spins can be perpendicular to the surface of a torus or tangent to a circle.

Notice also that due to the entanglement the freewill is not incompatible with determinism. Free will is a part of a deterministic theory. Every event is determined by a prior cause. The vibrations of the same elements of thoughts can appear due to a brain activity caused by the senses or due to the permanent exchanges of the bi-circlons responsible for the entanglement. The vibrations produce the magnetic quanta that can or cannot induce electric currents in nerve system. It is the choice. Information carried by the mindons does not disappear. Just

there is needed adequate intensity of a mindon to create electric current in nerve system. Since personal choices depend on structure of brain and experiences of human beings then there are the limitations for the freedom of the will.

Structures of brains and associated minds are different so probability of transition of the mindons from one person to others is very low but possible when differences in structures are small and magnetic energies of mindons are sufficiently high.

5. Metaphysical/discrete/abstract levels of Nature

The Everlasting Theory shows that our cosmos is deterministic i.e. every event is determined by a prior cause. Before the inflation there was a very big piece of timeless space. Some tremendous collision with other piece(s) of timeless space caused that the piece(s) of space transformed into very energetic liquid and next into gas composed of superluminal and rotating small pieces of space i.e. tachyons. Mean unit of time in such spacetime is defined as the mean time between the collisions of the tachyons. The phase transitions of such a liquid-like and, next, a gas-like spacetime in the era of inflation partially transformed it into the Einstein spacetime composed of the neutrino-antineutrino pairs. The photons are the rotational energies of the Einstein-spacetime components i.e. the speed of light c is characteristic for the Einstein-spacetime components. Creation of the Einstein spacetime stopped the superluminal expansion. The initial conditions, so the basic physical constants as well (they are the reduced Planck constant and gravitational constant), can be invariable only if the shock wave that appeared during the inflation had produced a timeless wall around our cosmos. We can see that such cosmos should be deterministic due to the deterministic behaviour of the tachyons.

The phase transitions lead to the quantum mechanics that follows from the fact that the bi-circlons responsible for the entanglement cannot be detected directly - it leads to the uncertainties in the quantum mechanics. If we want to describe experimentally the Nature then the Quantum Physics is essential. But entanglement shows that there is the deterministic sublevel of this theory.

The deterministic beginning of our cosmos suggests that the free will as well should have a deterministic explanation. Just brain chooses only selected vibrations that appear in mind due to the spontaneous or forced entanglement. In reality, due to the deterministic beginning of our cosmos there are many limitations for the freedom of the will. The sun produces photons which frequencies are different whereas a dye, due to its internal structure, absorbs the selected frequencies. Similarly is for the mind-brain system: due to the entanglement, the mind produces magnetic quanta which frequencies are different whereas the brain associated with the mind absorbs the selected frequencies. It is the deterministic choice. There is needed some specific code in DNA the free will could appear. In deterministic world such code appeared due to the tremendous number of produced the different precursors of the DNAs [1].

There are following metaphysical/discrete/abstract levels of nature.

1.

The virtual/undetectable particle-antiparticle pairs [1]

For region occupied by a virtual pair the mean mass density is the same as the spacetime or fields from which components are produced the virtual pairs. This means that mass of virtual particle is positive or equal to zero whereas for virtual antiparticle is negative or equal to zero respectively. Lifetime of such virtual pairs is very short. We cannot measure the local fluctuations for which mean mass is equal to zero but due to the motions and arising entanglements between the components of spacetime or field(s) such processes are possible.

2.

The groups of symmetry that connect the particles with spacetime or/and field(s)

Symmetries lead to the laws of conservation.

3.

The interpretation of the groups of symmetry on the base of the internal structure of spacetime or/and field(s)

4.

The dynamic of sets of the binary systems of closed strings (bi-circlons) that lead to the possible phase transitions that define the internal structure of the Einstein spacetime, fields and particles [1]

5.

The mechanism of production of the binary systems of closed strings [1]

6.

The definitions of space and time [1], [5]

7.

The origin of pieces of space and their motions

Abstract thinking in physics is difficult because it is working-out a 4-dimensional (4D means 3 spatial dimensions and 1 time dimension) cross-picture and mathematical puzzles. Mathematics is needed to verify quantitatively cohesion of partially overlapping the 4D sub-pictures (which parts are moving) in experiments. This causes that we need the definitions of physical quantities and mathematical equations/laws describing motions forced or not by interactions but such laws must follow from partially overlapping the 4D sub-pictures.

It is impossible to write an ultimate mathematical equation to solve all problems because some problems need different mathematical methods but the different mathematical methods similar to the 4D sub-pictures should partially overlap. For example, probably we never will be able to include the mathematical description of the bare fermions (there is the torus and ball in its centre [1]) in the Lagrangian invariant under the infinitesimal transformations characteristic for the entanglement (such Lagrangian is applied in the Quantum Theory of Fields). There can be the ultimate 4D picture of Nature plus the different mathematical methods to prove mathematical cohesion of the ultimate picture.

There is the abstract part of Nature that cannot be investigated experimentally. For example, from experiments follows that photons can be entangled but the carriers of the entanglement cannot be detected because their sizes are much smaller than the Einstein-spacetime components the detectors are built of. Just we know that the carriers of entanglement are in existence but we cannot investigate their properties directly in experiments. Their properties must follow from the lacking part of ultimate theory and the correct mainstream theories. For example, the Everlasting Theory [1] and the basic equation applied in the Quantum Theory of Fields lead to conclusion that spin of the carriers of the entanglement should be unitary but it cannot be measured directly in experiment. The components of the gravitational fields, i.e. the free tachyons [1], cannot be observed directly in experiments as well. Just the bi-circlons and tachyons cannot create a path in detectors or shows a point of collision.

6. Information

Due to the deterministic beginning of our cosmos there is obligatory the law of conservation of information. Just there are only the free and bound tachyons and due to the timeless wall surrounding our cosmos the initial conditions and physical laws cannot change with time. When we assume that all tachyons are identical and their surface is spherical then the today total information of all tachyons is defined by their distribution, momentums and angular momentums of all tachyons. The two last physical quantities can change infinitesimally only so the distribution of the tachyons is most important. But we must remember that there was the phase transition from the perfect gas composed of tachyons to the Einstein-spacetime [1]. We can neglect the inertial mass of the free tachyons in relation to the gravitational mass of

the Einstein-spacetime components. Just almost all mass is the gravitational mass that is equal to the total inertial mass of the bound tachyons. Only in the annihilations of the neutrino-antineutrino pairs we can destroy the gravitational mass but to do it is needed tremendous mass density i.e. higher than about 10^{38} kg/m³ [1]. Then, neutrinos decay into the bi-circlons.

We can assume that histories of the protoworlds [1] should be the same or differences in the histories should be infinitesimal. The history of some universe created by the associated protoworld is coded in the eternal minds. Probability that the minds from the earlier universes will be in our surroundings is very low but not equal to zero. There is probability not equal to zero that some minds from the former universes can communicate with some people. It shows that there is the possibility to know the future events but it is very difficult to locate an event in time.

7. Summary

The Everlasting Theory, i.e. the lacking part of ultimate theory, describes the deterministic entanglement characteristic for the Einstein-spacetime components from which the observed matter consists of. Such entanglement leads to the fundamental arrow of time.

The exchanged superluminal binary systems of the closed strings (bi-circlons), that are responsible for the entanglement, cannot be detected directly. It causes that there appear the uncertainties in the quantum mechanics and experimental data. 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 more fundamental level of the quantum physics describes a classical/deterministic theory.

The matter-mind asymmetry follows from the torus-circle asymmetry but the matter and the mental structures are built of the same elements i.e. of the Einstein-spacetime components. Due to the entanglement, we can show that the free will follows from the brain-mind resonance. The vibrations in a mind create the magnetic quanta that are some analog to the phonons produced in crystals. Only selected magnetic quanta can induce electric currents in the nerve systems. The freewill is a part of deterministic theory.

Due to the classical/deterministic beginning of our cosmos there is obligatory the law of conservation of information.

Our cosmos started from classical/deterministic state i.e. each effect has a cause. Our cosmos is predictable in Newtonian mechanics because the quantum particles contrary to the detectors applied in the experimental physics “see” the bi-circlons responsible for the entanglement. Before the inflation, the unit of time was equal to zero i.e. the space was timeless.

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