Quantum entanglement

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Abstract : The causes and effects of the properties of a particle and wave are presented, when a quantum of space-matter, an electron, a photon, passes through one and two slits. The causes and effects of the tunnel passage of a quantum through any potential barrier. And the properties of entangled particles are presented, as quantum properties of space-matter.

Content

There are many interpretations of the passage of a photon and an electron, as quanta, through two slits. In one case, a diffraction pattern is observed on the screen. In another case, when recording the passage of quanta through a slit, there are two spots on the screen opposite each slit. There are also facts of the birth of entangled particles with amazing properties, on the basis of which the most incredible properties and prospects are built. There are the indicated facts, there is a mathematical description of them, but there are no answers to the questions: WHY is this so? We will present these experimental facts, with answers to the questions WHY, within the framework of the axioms of dynamic space-matter.

1. Double-slit quantum passage

Let us consider the experiment of a quantum passing through two slits. $\text{НОЛ}(Y\pm=e)$ electron , similar to the quantum $\text{НОЛ}(Y\pm=\gamma)$of a photon. We descend from the properties, the quantum of dynamic space-matter. Recall that we are talking about space-matter within the dynamic angle of parallelism of straight lines. Moving along the beam, AC, we do not see dynamic space inside the dynamic angle of parallelism OX. We are talking about another technology of the theories themselves. Euclidean space in the axes XYZ no longer works.

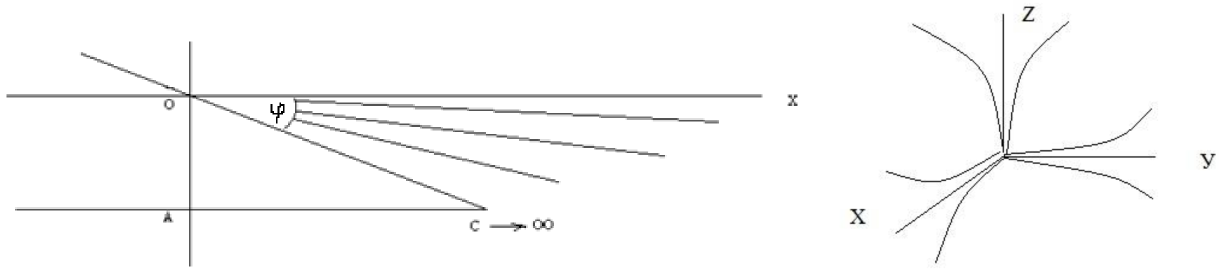

Fig.1 dynamic space of a bundle of parallel straight lines

We have already considered the properties of such space-matter. Space-time is a special case of a fixed or zero angle of parallelism. Then: $(Y\pm=\mathrm{e}^-)=(\boldsymbol{X}+=\nu_e^-)(Y-=\gamma^+)(\boldsymbol{X}+=\nu_e^-)$**,** for an electron we will obtain a model of such a quantum, with a virtual photon $(\gamma)$and with certain parameters. Exactly the same model of a photon $(Y\pm=\gamma^+)=(\boldsymbol{X}+=\nu_2^+)(Y-=\gamma_2^-)(\boldsymbol{X}+=\nu_2^+)$in a physical vacuum.

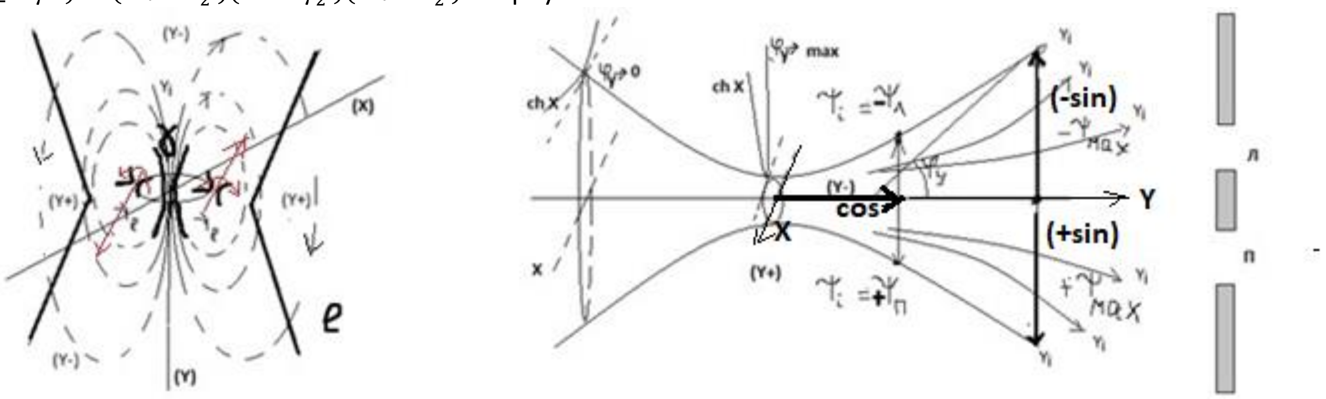

Fig.2 model of an electron (photon) quantum

Here: $(Y-)$a field of parallels, with a limit $cos\ \varphi_{\mathrm{Y}\ max}=\frac{\mathrm{w_e}}{\mathrm{c}}=\frac{1}{137.036}=\alpha$, an angle of parallelism, and in each fixed wave function (ψ_i), the $(-\psi_л)$"left" or $(+\psi_п)$"right" wave function is determined, with respect to the motion to the left and right slits. When fixing $(-\psi_л)$the "left" wave function, we speak of its collapse, and at the same time we know exactly the state of $(+\psi_п)$the "right" wave function without fixing it. For $(\pm\psi)$ wave $(\psi=YY_0)$ function, $i\psi=\sqrt{(+\psi)(-\psi)}$we obtain $i\psi e^{ax}e^{i\omega t}=i\psi e^{ax+i\omega t}$, the Dirac equation function and its $\{e^{a(x)}\equiv \mathrm{ch}\left(\frac{\mathrm{X}}{\mathrm{Y_0}}\right)\}$, parameters with constant extremals $(a'(x)=0)$of the dynamic function $(a(x)\neq const)$, without scalar bosons of gauge fields. The ratio of the $(p=\frac{\pi\psi_i^2}{\pi\psi_{max}^2})$cross-sectional areas $(Y-)$of the electron (or photon) trajectory is the probability of the quantum state at a fixed point, during the collapse of $(\psi_i)$the wave function. In essence, we are talking about the probability of finding the area of a circle: $(s = \pi\psi_i^2)$, with the limiting angle of parallelism, $cos\ \varphi_{Y\ max} = \frac{1}{137.036} = \alpha$, in the admissible maximum section $(s = \pi\psi_{max}^2)$of the trajectory $(Y -)$. In the dynamic section $(Y -)$of the trajectory, that is, in the plane of the circle of dynamic radius $(\psi_{max} \to \psi_0 \to \psi_{max}) = (K_Y)$in quantum relativistic dynamics of dynamic $(\frac{\partial a(X)}{\partial x_\mu} \equiv f'(x) = 0)$functions $a(X) \neq const$, the wave function $i\psi e^{i\omega t} \equiv i(cos\ \omega t + i\ sin\ \omega t)$also performs rotations. In this case: $(i\ sin\ \omega t) = \sqrt{(+\ sin\ \omega t)\ (-\ sin\ \omega t))}$. We speak of spin in quantum relativistic dynamics. And in the dynamics$(\psi_{max} \to \psi_0 \to \psi_{max})$ wave function, we speak about the dynamics of the angle of parallelism $(cos\ \varphi_{Y\ max})$on $(Y -)$the trajectory of $(Y\pm = e^-)$an electron or photon quantum, as a probability cloud on its wavelength. At near-zero angles of parallelism, in quantum relativistic dynamics, the electric field $cos\ (\varphi_Y \to 0) \to 1$of the electron on its mass trajectory $(Y- = e)$disappears $(Y+ = e)$. In this case, the quantum of space-matter $i\psi e^{ax} e^{i\omega t} = i\psi e^{ax + i\omega t}$, in the form: $e^{ax} \equiv ch\frac{X}{Y_0}$, and $e^{i\omega t} \equiv cos\ (\varphi_Y)$, the Indivisible Region of Localization of the probability cloud, remains unchanged in the quantum $\text{НОЛ} = \left(ch\frac{X}{Y_0\uparrow} \to 1\right)(cos\ (\varphi_Y \to 0) \to 1)$, relativistic dynamics. And in such, near zero $(Y +) \to 0$, in a charged state, the electron can pass through any potential barriers. In Euclidean axiomatics, with a zero $(cos\ (\varphi_Y = 0) = 1)$ angle of parallelism, $(Y +)$there is no dynamics of such charge fields and such a representation is impossible.

Now, in such Criteria of Evolution of the $(Y\pm = e)$electron quantum, we will consider its properties when passing one or two slits. Note that the wave function characterizes the dynamics of all parameters, including energy and momentum. And it gives the probability of manifestation of certain (with the uncertainty principle) Evolution Criteria. So, the wave function of the electron, from the Dirac equation goes first to one slit. It (ψ_i) collapses in any criteria and then goes as$i\psi = \sqrt{((-\psi_л)(+\psi_п)}$ particle-wave, in a "paired" state of "entangled" $(-\psi_л)(+\psi_п)$wave functions. Further quantum$(Y \pm)$ electron (photon) hits the screen along the projection axis of the slit, at the width of the maximum wave function, with probability $\left(p = \frac{\pi\psi_i^2}{\pi\psi_{max}^2} \neq 0\right)$. Now $(Y\pm = e)$a quantum, for example, of an electron, approaches two slits with its "left" $(-\psi_л)$and "right" $(+\psi_п)$parts $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$, in any $(\psi_0 \to \psi_i \to \psi_{max})$ state, with probability $(p = \frac{\pi\psi_i^2}{\pi\psi_{max}^2} \neq 0)$. The question is, in which slit and how will the electron pass, on $(Y- = e)$the trajectory. The trajectory $(Y- = e)$of the electron (as well as the photon) itself has uncertainty in space within $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$the wave function, which is in superposition $(-\psi_л)(+\psi_п)$of the left and right parts in the direction of the quantum's motion on the trajectory $(Y -)$in front of the left and right slits. At the same time, there is no straight Euclidean $(\varphi = 0)$line on $(Y -)$the trajectory and this is the decisive factor. There is any other (Y_l)line with a non-zero $(\varphi \neq 0)$angle of parallelism, within $(Y -)$the trajectory. Therefore, the electron (photon) will always pass either into the left or into the right slit, with the collapse of $(\psi_i)$the wave function. If there is a collapse of the "left" $(-\psi_л)$wave function, the electron (photon) quantum $(Y \pm)$goes into the left slit, and the electron goes into the right slit, with the collapse of the "right" $(+\psi_п)$wave function. There is no division $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$ wave function, an indivisible and stable quantum of an electron (photon). In both cases, the left and right slits will pass $(\psi_i)$the wave function in the form of a probability wave, with a deviation of one or another $(\varphi \neq 0)$angle of parallelism, forming a point on the screen. A set of points on the screen gives a graph of the probability density distribution. The angle of parallelism $(\varphi \neq 0)$corresponds to the probability of $(\psi_i)$the wave function. Different (φ_i)angles of parallelism are different probabilities $(\psi_i)$of the wave function. And in both cases, a wave with the effect of interference of mechanical waves will emerge from each slit. And this is not a physical wave with oscillations of fields. This is a mathematical wave of collapse of the wave function. In fact, the interference effect here is caused not by the addition of the extremals of the wave crest, as in the case of water, but by the angle of parallelism of $(\varphi \neq 0)$the quantum $(Y -)$trajectory, which in turn determines the probability of $(\psi_i)$the wave function. There are no superpositions of the maxima or minima of the wave itself, similar to the superposition of the crests of waves on water. There are hits on the screen point of single quanta with one or another probability during the collapse of $(\psi_i)$the wave function. A multitude of electrons (photons) pass a slit with different (ψ_i)wave functions along the wavelength of a quantum of space-matter. And on the screen, this is the interference of probability waves, as a collapse (fixation) $(\psi_i)$of the wave function. In this case, the probability of getting to the central axis of the screen from the left and right slits is as if doubled, when passing through the left or right slit of the wave function in an entangled state $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$. At the maximum probability $(\psi_{max})$of the wave function, if the left $(-\psi_л)$part takes $(Y -)$the trajectory of the indivisible energy, the quantum momentum to the left slit, then the right part $(+\psi_п)$, of the same energy, momentum, appears on the central axis of the screen, and vice versa with the right part, in the right slit. Here we answer not the question HOW, in mathematical models, but the question WHY, that is, what is the physical meaning, content, cause and effect. Therefore, the central axis is always brighter than the left or right part of the whole picture, with the effect of interference of the "probability wave". The displacement $(Y -)$of the trajectories to the left or right of the central axis on the screen is determined by the angle of parallelism $(\varphi \neq 0)$of the quantum $(Y -)$trajectory, the collapse of only the "left" $(-\psi_л)$or only the "right" $(+\psi_п)$wave function, in the "entangled" $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$, (simultaneous) their state.

If we record the passage of a quantum of space-matter, $(Y \pm = e^-)$an electron or a real (not virtual) $(Y \pm = \gamma)$photon of a light beam, in the left or right slit, a collapse (fixation) of the indivisible energy, momentum, the entire $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$wave function occurs. That is, the electron (photon) is already defined as an indivisible particle, with a subsequent trajectory already as a particle. The subtleties of the issue are that the wave function is fixed (in collapse) simultaneously by both $(-\psi_л)$its left $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$and right $(+\psi_п)$parts. In this case, $(Y -)$the trajectory is built along the axis of the corresponding slit, and then the quantum of space-matter gets to the screen as a left or right point on the screen. There are no other options here, and this does not contradict the symmetries of interactions, as arguments. The most interesting thing is that after fixation in the left or right slit with the subsequent movement of particles to the left or right point on the screen, the electron or photon retains its $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$wave function as a probability wave of subsequent interactions. And it is not about whether we looked at the particle or not. If "Schrödinger's cat is dead, then it is dead", no options. Such properties do not depend on whether we "look" at the situation or not, and do not depend on the consciousness of the observer. This is a property of the quantum of space-matter itself, and with a certain probability of "entangled" states $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$ wave function. The recorded data that this is a particle recorded in a slit, or a wave on a screen, are saved or erased. That is, the conditions of the collapse of the wave function change, but the unchangeable properties of the wave function itself remain, as "probability clouds" of its properties. We are talking about the unchangeable and indestructible properties of the quantum of space-matter itself. They cannot be "erased", and if some properties are recorded, others do not disappear. Matter cannot disappear. And here the given analogies are impossible, such as: properties or a phenomenon "exists only when we look", or "virtual reality" and other unfounded fantasies. The properties of a quantum of space-matter always exist. This is matter, and it does not disappear. The question of where, when, how, and with what probability are other questions.

2. Quantum entanglement

Wave function $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$in an entangled state, or $i\psi e^{ax+i\omega t}$in the Dirac equation

$$\left[i\gamma_\mu \frac{\partial \overline{\psi}(X)}{\partial x_\mu} - m\overline{\psi}(X)\right] + i\gamma_\mu \frac{\partial a(X)}{\partial x_\mu}\overline{\psi}(X) = 0$$

satisfies the wave function $(-\psi_л = e^-)$of the electron and $(+\psi_п = e^+)$positron simultaneously, in the "Dirac sea" $\psi = Ae^{i\omega t} = Ae^{-\frac{i}{\hbar}(Wt+pr)}$. And Dirac was sure of the existence of the positron, as his equation says. Moreover, if the wave function $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$describes the proton, then the antiproton also exists, and so on. Moreover, in the "Dirac sea", the electron-positron pair exists, or is born, as they say today, in an "entangled", simultaneous state. It is important to understand here that entangled particles are born in one quantum field, according to the conditions of admissible symmetries.

A) hidden parameters.

We will talk about the properties of the electron and proton as indivisible quanta of space-matter in their models. Electron: $(Y \pm = e^-) = (\boldsymbol{X} \pm = \nu_e^-)(Y \mp = \gamma^+)(\boldsymbol{X} \pm = \nu_e^-)$, and proton:$(X \pm = p^+) = (\boldsymbol{Y} \pm = \gamma_0^+)(\boldsymbol{X} \mp = \nu_e^-)(\boldsymbol{Y} \pm = \gamma_0^+)$ and photon $(Y \pm = \gamma^+) = (\boldsymbol{X} + = \nu_2^+)(Y - = \gamma_2^-)(\boldsymbol{X} + = \nu_2^+)$. Their wave functions are 2 $(\boldsymbol{X} \pm = \nu_e^-)$neutrinos for the electron and 2 $(\boldsymbol{Y} \pm = \gamma_0^+)$**" dark photons"** for the proton, rotating $rot_Y G(X + = \nu_e^-)$around $rot_X E(Y + = \gamma_0^+)$the axis $(Y -)$and$(X -)$ trajectories of the quantum, respectively. This is like the spin of the entire quantum of an electron or proton in this case. The important thing is that two quanta $2(\boldsymbol{X} \pm = \nu_e^-)$ neutrino for an electron or 2 $(\boldsymbol{Y} \pm = \gamma_0^+)$" dark photons" for a proton, these are the "two sides" $(-\psi_л)(+\psi_п)$of the "entangled" wave functions, in the form of $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$the full wave function of an electron or proton. Each of the entangled wave functions $(-\psi_л)(+\psi_п)$has its own probability of manifesting properties on$(Y -)$ or $(X -)$ trajectories of the quantum, respectively, as if with opposite spins relative to the Euclidean line, as the trajectory of the quantum. This also applies$(Y \pm = e^-)$ electron, and $(Y \pm = \gamma^+)$ photon. In the circle of the cross-section $i\psi(e^{i\omega t} \equiv \cos i\omega t + i\sin i\omega t)$of these trajectories, in Bell's experiments, manifestations of the properties of the general $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$wave function of an electron or proton are recorded or not. And these properties are recorded with the probability of "entangled" $(-\psi_л)(+\psi_п)$wave functions. And this probability will be different at different angles of rotation of the sensors in the experiment. These are like "hidden parameters" about which we know nothing in advance. These are entangled wave functions. We cannot say that at the point of fixation, or collapse of entangled wave functions, the quantum of $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$the Dirac equation will come $(-\psi_л))$or $(+\psi_п)$the wave function, in a previously known state. We do not know this, and cannot know in principle. These parameters are hidden, but not because they do not exist. They are always there (Einstein is right, "The Moon is always there"). These are the properties of the quantum of space-matter. They do not disappear. But we cannot say for sure that these parameters are predetermined at the moment of collapse of the general $(i\psi)$wave function. And we know nothing for sure, the position $(-\psi_л)$or $(+\psi_п)$in space-time, on$(Y-)$ or $(X-)$ trajectories of a quantum, electron and proton respectively, in this case. It could also be any other quantum of space-matter, with $i\psi = \sqrt{(-\psi_л)(+\psi_п)}$a wave function $\psi = Ae^{i\omega t} = Ae^{-\frac{i}{\hbar}(Wt+pr)}$.

B) entangled particles.

Much has been said and written about HOW it “works”. We will answer the question WHY it “works” this way. We talked about “entangled” $(-\psi_л)(+\psi_п)$wave functions. If we say that each of them corresponds to a particle, then we are talking about entangled particles. And here there are key conditions for the birth and evolution of entangled particles. The first condition is that entangled particles are born in one, single quantum field. The second is the criteria for their dynamics, which are opposite in admissible symmetries. This is the main thing. Let us consider, for example, an analogue of the quantum $(\mathrm{X}-)$ field of a proton, with entangled $(\mathrm{Y}\pm)$ dark photons or electrons in a single $(\mathrm{X}- = \mathrm{Y}+)$ space-matter. For example, we will talk about two $(\mathrm{Y}\pm)$ quanta born in one $(\mathrm{X}-)$quantum field at points 1 and 2, in a sphere.

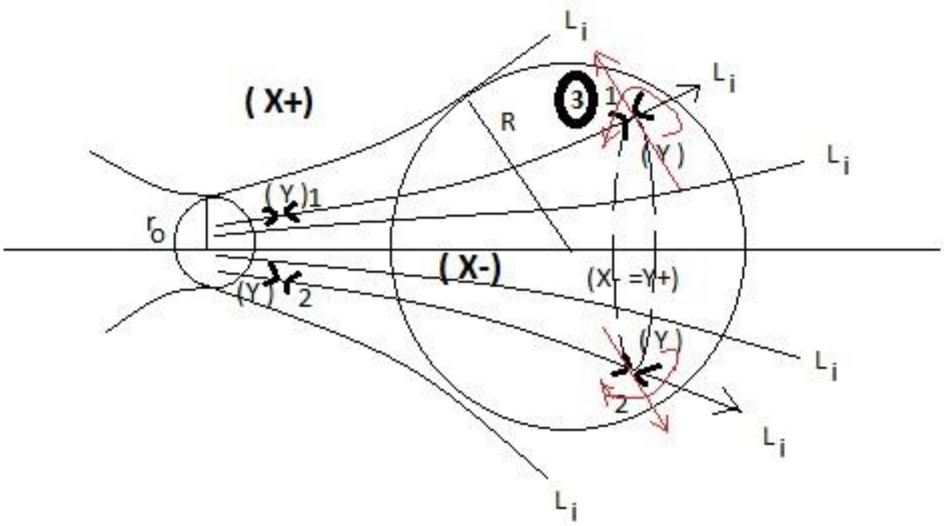

Fig. 3. Model of entangled particles.

Let $(\mathrm{Y}\pm)$ the quanta of space-matter be born in one quantum $(\mathrm{X}-)$field with Euclidean isotropy of parallel (L_i)straight lines in the sphere of $(r_0 \leftrightarrow R)$non-stationary Euclidean space-matter, with a dynamic $(\varphi \neq const)$ angle of parallelism. These $(\mathrm{Y}\pm)$ quanta, in $(\mathrm{X}-)$the field, for example, of a photon or an electron in this case, are born in some admissible symmetry of the general state. Knowing the state (for example, the spin) of one quantum, knowing their admissible symmetry, we know exactly and speak about the state of another quantum. They say that when one $(-\psi_1)$wave function collapses, "information is instantly transmitted" to another entangled quantum, which learns that it needs to collapse into the state of $(+\psi_2)$the wave function, both in the modulus of probability and "in the direction" in the admissible symmetry. Moreover, it “recognizes” instantly at “monstrous $(R \to \infty)$ distances” in a dynamic sphere with Euclidean isotropy. This is what is observed and recorded in experiments. The key point is that entangled particles do not transmit any information to each other. This is embedded in their properties, whether we see or record them in space-time or not. It must be said that in Euclidean space we do not see anything from the properties of dynamic space-matter, except for the “probability cloud”.

And here we answer the question WHY it “works” like this. The classical scheme says that if we, with a certain particle (3), influence a particle (1), which changes its properties, then “this information is instantly transmitted” to the entangled particle (2), which synchronously, that is, instantly, also changes its properties to the opposite. Let’s say right away that these are facts of reality and properties of dynamic space-matter. They exist. Moreover, if each entangled particle has its own trajectory (L_i), then there will be many such entangled particles in the quantum $(\mathrm{X}-)$field. But there is no transfer of information between entangled particles. This really works if particle (3) changes the properties of particle (1) by changing the general and unified $(\mathrm{X}-)$field in which entangled particles (1) and (2) are born, then the properties of particle (2) change to the opposite (in symmetries). Roughly speaking, it is as if we pull a tablecloth on a table with some object (3), moving a cup (1) towards us, let's say: we change the state of cup (1). In this case, cup (2) on the same table will also change its state. Cup (1) does not transfer any information to cup (2), and there is no effect of object (3) on cup (2). In other words, by influencing particle (3) through a quantum $(\mathrm{X}-)$field on particle (1), changing its properties, for example, changing its potential (acceleration on a length). Then the quantum $(\mathrm{X}-)$field itself changes the properties of particle (2). It is impossible to change the properties of a quantum $(\mathrm{X}-)$field, only in the location of the particle (1). This is a quantum field, it is not divided. In the axioms of dynamic space-matter, we talk about the Indivisible Region of Localization of a quantum of space-matter. This is a non-local change of properties for particles (1) and (2), by means of the entire $(\mathrm{X}-)$field. That is WHY "it works this way". Any interpretations in the "Euclidean" space-time about teleportations, transmission of superluminal information, contacts, and so on, to put it mildly, are incorrect and have no arguments. We considered the properties of the space-matter of the Universe. We considered the properties of a multi-level physical vacuum, and according to the formulas of Einstein's theory and quantum relativistic dynamics (it is fashionable to talk about the quantum theory of relativity), so in these theories superluminal speeds are allowed in a multi-level physical vacuum. And these are the realities that we do not yet see. But there are consistent theories, and there are calculation formulas.

1. Quantum computing

Let us consider what can be done with entangled particles at the speed of light transmission of information or influence. What conditions are needed to create such entangled particles and influence entangled particles. These are codes, ciphers, quantum computers, how it works and how realistic it all is. As already noted, entangled particles must be born in one quantum of space-matter. In addition to stable photons, electrons, protons, the nucleus of a stable atom, like the atom itself, are also quanta of space-matter. The second point is the background of the state and influence on entangled particles. For example, orbital electrons of identical atoms, on identical orbits, have identical energy levels. This is a set of wave functions. By irradiating a group of atoms with coherent photons (laser) and achieving some emergent properties of one orbital electron, we know exactly the states of the entire set of wave functions of orbital electrons of the entire group of atoms. Such a state of orbital electrons of a group of atoms can be programmed by the energy of laser irradiation. We can do this in this or that space, now or later in time. Many other groups of atoms, these are many other programs of their irradiation. We can record with a laser and remove such emergent properties as information, and we are already talking about quantum computers, in physically permissible properties.

Topic artificial intelligence of a quantum computer is very interesting. The key point is a quantum state with the uncertainty principle (wave function) $\psi = Ae^{i\omega t} = Ae^{-\frac{i}{\hbar}(Wt+pr)}$ and an entangled state, as properties of a quantum field. In addition to the physical principles of creating entangled probabilities of quantum states in a set of initial parameters, with the choice of the correct solution for the input information, we also need a mathematical formalism of such dynamics ("thinking"), giving a clear and unambiguous result in a macrosystem. The idea is that such a wave function should be "grown" in a set of wave functions of a set of initial parameters. This can be done by creating a wave function always less than one, as the ratio of the permissible range of energy distributed in any algorithms to the maximum, introducing them, for example, as the coefficients of the "basis vectors" of the state matrix. We kind of form “consciousness” (being close to Knowledge). You can choose anything for the basic multidimensional "unit vectors". For example, a set of currencies, a set of people. If we talk about physics or information of a quantum computer, then this is, say, the state of a set of entangled (in identical atoms, on identical orbits) orbital electrons (their wave functions) or "removable" of their acquired emergent properties, after the impact of information input by a laser. But the input wave function, as information, "resonates" with the "correct" element of such, for example, a set of matrix minors or other state calculation algorithms, even with a low probability. Although in a set of wave functions it is possible to choose the maximum (by energy) and work with such an extremum. In resonance, their ratio gives "1", which is translated into a conventional binary system as a control signal in a set of combinations of an ordinary computer's macrosystem, with a clear and unambiguous result. The energy distribution itself by the elements of the system state set is input by sensors or calculated by distribution algorithms or state conditions. Well, this is like an idea, which of course still needs to be worked out for specific cases.