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ENERGY AND INFORMATION IN THE UNIVERSE

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ABSTRACT

In the article, the Universe is considered as a huge computer that calculates its future. The promising approach of Professor Seth Lloyd allows the interaction of objects with each other and with energy fields of any nature to be described as elementary logical operations in which quantum bits, the elementary units of quantum information, change their values. However, the question arises whether it is legitimate to assume that Seth Lloyd's quantum technologies, by means of which he records and processes information in a quantum computer, similar to the mechanism by which the Universe performs these operations in nature? In nature, the Universe performs these operations based on the effect of resonance, as predicted by Nikola Tesla in his theory of "global resonance".

***KEYWORDS**: Mass, Energy, Information, Resonance, Computer*

1. INTRODUCTION

In my article, I speak in defense of the thesis of self-sufficiency of the physical world, i.e. the thesis that the reasons for the existence of the world and the reasons for everything that happens are in it. Until the illusory nature of our world is proven, scientists have hoped to understand the laws of the universe. At the same time, the physical world should not be limited to the framework of the now prevailing scientific paradigm. Extreme skepticism that prevails today in theoretical physics is connected with agnosticism. The reason for this is the crisis of the scientific paradigm that prevails today in physics. Neither the standard cosmological model of ΛCDM (Λ- Cold Dark Matter) nor the Standard model of SM interactions of elementary particles can adequately explain the irreversible processes of the evolution of the Universe. The reason for this is the general theoretical base chosen for both standard models. Researchers need a new strategy, it is necessary to step over the prohibitions and dogmas of Einstein's Special and General Relativity and the outdated Bohr principle of "complementarities", which prohibits even thinking about the internal structure of an elementary particle [1].

2. SETH LLOYD'S TECHNOLOGIES IN THE QUANTUM COMPUTER OF THE UNIVERSE

In the traditional physical description of the universe, the major factor is energy. However, it has recently become clear that information is just as important. Information sets the form that a substance takes and determines the transformations to which energy is subjected. Baryonic (ordinary) and dark matter create the observed density of matter in the Universe $\rho v = (0.721 \pm 0.025)\cdot 10^{-29}$ g /cm³ and connects all objects of the Universe in one information field [2]. In the infinite universe, energy and information are equal partners. Ultimately, information and energy complement each other: energy causes physical systems to change, and information indicates in which direction changes will occur. Each molecule, atom, and elementary particle, and even more macroscopic objects, are capable of storing information. The acts of the interaction of objects with each other and with energy fields of any nature can be described as elementary logical operations in which quantum bits change their values — elementary units of quantum information. The paradoxical but promising approach of

Seth Lloyd makes it possible to elegantly solve the problem of the constant complication of the universe [3]. The universe is constantly processing information - being a huge quantum computer, it always calculates its own future. The universe is the biggest thing there is and the bit is the smallest possible chunk of information. The universe is made of bits. Every molecule, atom, and elementary particle registers bits of information. Every interaction between those pieces of the universe processes that information by altering those bits. That is, the universe computes, and because the universe is governed by the laws of quantum mechanics, it computes in an intrinsically quantum-mechanical fashion; its bits are quantum bits. The history of the universe is, in effect, a huge and ongoing quantum computation. It is only in the last years, however, with the discovery and development of quantum computers, that scientists have gained a fundamental understanding of just how that information is registered and processed. Building on recent breakthroughs in quantum computation, the professor Seth Lloyd shows how the universe itself is a giant computer and that further progress in understanding physics can be achieved by considering entropy as an informational, rather than a thermodynamic phenomenon [13]. Every atom and elementary particle stores these bits, and every collision between those atoms and particles flip the bits into a new arrangement and effortlessly spins out beautiful and complex systems, including galaxies, planets, and life itself. The quantum computational model of the universe explains a variety of observed phenomena not encompassed by the ordinary law of physics. In particular, the model shows that the universe automatically gives rise to a mix of randomness and order, and to both simple and complex systems. The ability of the universe to calculate explains one of the greatest mysteries of nature: how from very simple laws of physics arise complex systems, such as living beings. These laws make it possible to predict the future, but only as a probability, and only in general terms. The quantum-computational nature of the universe is such that the specific details of the future always remain unpredictable. Quantum technologies — technologies of controlling matter at the atomic level — have received remarkable development in recent years. Now we have fairly stable lasers, fairly accurate production methods, and fast electronics — all this allows us to perform calculations at the atomic level. To realize any physical system from the point of view of its bits, it is necessary to understand well the mechanism by which each element of this system records and processes information. And then the question arises whether it is legitimate to assume that Seth Lloyd's quantum technologies, by means of which he records and processes information in a quantum computer, similar to the mechanism by which the Universe performs these operations in nature. In his book "Time, chaos, quantum", Nobel Prize laureate Ilya Prigogine revealed the mechanism by which matter is born in the Universe and how energy is associated with matter and information in the large-scale Poincare's systems (LSP) [4].

3. RESONANCES AND THE BIRTH OF MATTER IN THE LARGE-SCALE POINCARE'S SYSTEMS

The quantum vacuum is a global field of oscillators' super-positions with the continuum of frequencies. In contrast to the field, a particle oscillates with the same fixed frequency. In front of us, there is an example of the non-integrable Poincare system. Resonances will occur whenever the frequency of the field and the particle are will coincide. The evolution of dynamical systems (the particles) up to the self-organized matter depends on available resonances between degrees of freedom. This was a conclusion by Nobel Prize winner Professor Ilya Prigogine in their monograph the "Time, Chaos, Quantum" [4]. They revived an idea by N. Tesla on a theory of global resonance. Nevertheless, if the Tesla's resonance theory of the matter birth in the ether had been based on an intuition of the ingenious experimenter, then in case of I. Prigogine, this theory acquired rigorous mathematical view. Proved by Poincare the non-integrable dynamical systems and the theory of resonant trajectories by Kolmogorov-Arnold-Moser allowed Prigogine to conclude that the mechanism of resonance interaction of particles in large-scale Poincare systems (LPS) was "essentially" mandatory and not probabilistic.

With increasing communication parameters, there is an increase in the likelihood of resonance outcomes. It is such LPS dynamic systems, to which systems of particle interaction with the space environment and with each other belong. Nobel Prize winner I. Prigogine wrote, “If the systems are independent, then for coherence and self-actualization, there would be simply no place as all dynamic movements would essentially be isomorphic movements of free (non-interacting) particles. Fortunately, the LPS in nature prevail over other systems.” [4]. In the general case, in a nonlinear oscillator, even with a sinusoidal external action, extraordinary effects are possible. The dynamics of the system can turn out to be extremely complex, similar to random, and in this case a regime of dynamic stochasticity arises in the system. The average motion of the system at an isolated nonlinear resonance is similar to the behavior of an electron in a potential well. Several resonances correspond to several potential wells. The overlapping of resonances means that there is such a convergence of neighboring wells, when the system can move from well to well and, under certain conditions, leave them. With such transitions, a new type of instability of nonlinear systems appears - stochastic instability [5]. Let's consider this mechanism in more detail. If the oscillator is linear, then in the representation $\omega^2(x) = \omega^2o + \alpha x + \beta x^2 + ...$ of the square of the natural frequency in the form of a power series in terms of the oscillation amplitude, we restrict ourselves to only the first term, and when an external periodic force acts on the oscillator, the only main effect is observed - linear resonance . In this case, the smaller the losses in the oscillator, the sharper and higher the resonance curve. What will change if the frequency depends on the amplitude of the oscillations? Let the frequency of the external action be equal to the frequency of rotation along one of the phase trajectories near the center. Then the system draws energy from an external source, and initially small fluctuations increase. This means that the particle moves sequentially to those phase trajectories that correspond to a high energy, but, since the oscillator is not isochronous, a different frequency corresponds to high energies. As a result, the system goes out of resonance and, starting from a certain amplitude, the oscillator stops noticing the external force. Thus, the exit from the resonance occurs due to the nonlinear frequency shift $\omega = \omega(x)$. What new effects appear in the behavior of a nonlinear oscillator at resonance? In a linear oscillator, there are resonances only at a frequency close to its own, i.e. $\Omega=\omega_0 \pm\varepsilon$, where ε is a small addition. For a non-linear oscillator, there is resonance at the harmonics as well; for example, quadratic nonlinearity leads to the appearance of spectral components 2Ω, 4Ω, etc. in the nonlinear system. (anharmonicity of vibrations). Therefore, if for example $2\Omega=\omega_0$, then the system will have a resonance at the harmonic of the external force. A regime of dynamic stochasticity appears in the system. If the dynamics of a particle in an oscillator is usually understood as a completely deterministic process, the entire past and future of which is uniquely determined by the equations of motion and initial conditions, then the concept of stochasticity is associated with some kind of randomness, some kind of uncertainty. Is it possible for a strictly deterministic process to be random at the same time? Yes, perhaps L. Sapogin answers in Unitary Quantum Theory (UQT). His physical and mathematical studies show that this is not only possible, but under certain conditions and inevitable [8]. Consider the behavior of electrons in a potential well in Lev Sapogin's theory [1]. In the UQT, the equation with an oscillating charge is essentially Newton's equation for the movement of a charge in an external potential, but the amount of charge depends on time, speed and coordinates [1]. When solving the problem of a harmonic oscillator, in addition to the usual stationary solutions, 2 more new solutions arise (Fig. 1), which were named Crematorium and Maternity Home. In the first solution, the particle oscillates in a potential well with an exponential decrease in energy, and in the second solution, its energy increases (for a parabolic well, it is unlimited).

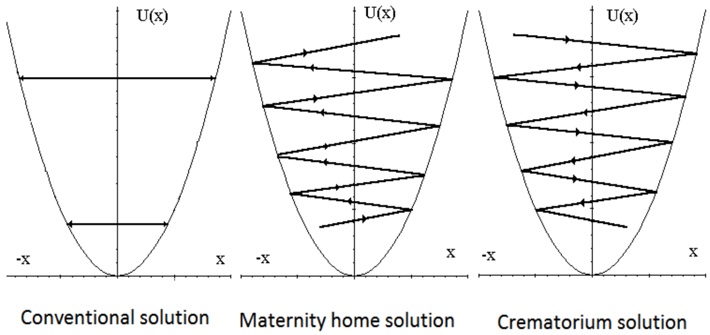

Figure 1: UQT Solutions for Particle Oscillations in a Potential Well.

The autonomous movement equation in the case of a potential well in the shape of hyperbolic secant U(x) = -Up such(x^2) will look as follows:

$$m\frac{d^2x}{dt^2}+\frac{4U_0Qx\cos^2\left(-mx\frac{dx}{dt}+\varphi_0\right)\sinh(x^2)}{\cosh^2(x^2)}=0 \tag{1}$$

- where *x* is the coordinate of the particle as a function of time;
- M, Q, φ_0 is mass, charge and initial phase of the particle.
- It turns out that the nature of the trajectory of a particle under the same initial conditions depends very strongly on the initial phase [1].

At $\varphi_0 = 0.1$, the particle rolls into the hole and is reflected with greater energy. Under the same initial conditions and at $\varphi_0 = 0.2$, an oscillation of a particle in the well with almost the same energy is observed, and at $\varphi_0 = 3.2$, an increase in oscillations inside the well (Maternity Home) is observed up to an energy sufficient to exit the well [1]. It should be noted that for dynamic stochasticity in systems without dissipation, the main thing is nonisochronism. Indeed, the effect of increasing or decreasing the energy of electron oscillations due to environmental disturbance (physical vacuum) depends by its phase. The phase depends on the frequency, which, due to isochronism, changes under the influence of perturbations. In the case of a single resonance, as mentioned above, the system can get out of it. But if there are many resonances (at least two), a complex picture of the system's motion arises due to their interaction. Now, depending on the phase of the perturbation, the system can either move further into the region of the next resonance and eventually leave the well, or return back. This state of the system is called "resonance overlap" [5]. Where does the electron in the potential well get additional energy, thereby violating the law of conservation of energy? L. Landau and M. Lifshitz in their classic book "Field Theory" write the following about this: "The question may arise of how electrodynamics satisfying the law of conservation of energy can lead to an absurd result in which a free particle increases its energy. The roots of this are in the infinite electromagnetic "own mass" of elementary particles" [6]. I will allow myself to disagree with the classics. In new physics, the recognition of the polarization of the quantum vacuum (dark matter) in the theories of quantum electrodynamics (QED) and quantum chromodynamics (QCD) leads to the violation of symmetries, conservation laws and prohibitions in the Standard Model. The fifth fundamental interaction between baryonic and dark matter (the fifth force) causes a rejection of the paradigm of the evolution of a closed Universe and requires a revision of all laws of conservation and symmetry [7]. Nobel Prize laureate I. Prigogine, studying the dynamics of systems development and, in particular, the growth of entropy, found that "in a steady state, the active influence from the outside on the system is insignificant, but it can be of great importance when the system passes into a nonequilibrium state. In this case, the system becomes non-integrable, time loses its invariance and its behavior is probabilistic"[4].

4. LEO SAPOGIN'S UNITARY QUANTUM THEORY AND INSTANTANEOUS QUANTUM TELEPORTATION

Einstein proclaimed, without any reason, that in nature there can be no speeds greater than the speed of light, which allegedly refutes the principle of causality, but this is completely wrong. The principle of causality, one of the most general principles of physics, which establishes the permissible limits for the influence of physical events on each other, prohibits the influence of a given event on all past events ("an event-cause precedes an event-effect in time", and the future does not affect the past). But a stronger relativistic principle of causality also excludes the mutual influence of events separated by a space-like interval, for which the very concepts of "earlier" and "later" are not absolute, but change places with a change in the frame of reference. Mutual influence of such events would be possible only for the frame of reference, in which there is an object moving at a speed exceeding the speed of light in vacuum. Therefore, the well-known statement about the impossibility of superluminal motions within the framework of the theory of relativity follows precisely from the relativistic principle of causality and can be disavowed [8]. It is curious that Einstein, assuming that information in quantum theory can spread faster than light, did not like quantum theory with all his heart. This contradicts the basic postulate of the theory of relativity, which says that nothing can move faster. But it turned out that the quantum world refuses to obey Einstein. NASA scientists in 2020 for the first time demonstrated a working "quantum teleportation" by transmitting qubits (units of quantum information) over long distances. The qubits were transmitted at faster-than-light speeds over a distance of 43.5 km.

Recent publications report experiments in quantum teleportation (state transmission) of one or even two degrees of freedom of quantum particles (Science and Technology University in Hefei, China) and observations of wave and corpuscular properties of quasi-particles (Federal Polytechnic School of Lausanne, Switzerland). University first performed simultaneous quantum teleportation with two degrees of freedom of a single photon, namely of spin state and orbital angular momentum. The experiment involved three photon pairs in quantum-entangled state. One was hyper-entangled, i.e. tangled both in polarization- and photon orbital angular momentum states, acting as a quantum teleportation channel, and the two remaining were used to measure and prepare the quantum state. Measures for the initial photon (in state teleportation) together with state measures for one in the hyper-entangled couple were transmitted to the recipient through the classical channel. Using the data, the recipient could take the hyper-entangled second photon pairs to the quantum state of the initial photon, thus accomplishing teleportation. The quantum fidelity far above the classical level indicated complete teleportation. On this basis, physicists from China announced the successful creation and testing of new prototypes of quantum computers. Researchers from the Shanghai Institute of Microsystems and Information Technology of the Chinese Academy of Sciences, the National Research Center for Parallel Computing and Technology, and specialists from the China University of Science and Technology in Hefei (hereinafter referred to as CSTU), including Professor Pan Jianwei, participated in the work. "Quantum supremacy is a scientific concept that says that a quantum computer can do things in some areas beyond the capabilities of non-quantum or classical computers, but it will never replace classical computers," said Yuan Lanfeng, researcher at CSTU. Today, researchers at Shanghai University have developed a quantum computer that is 10 billion times faster than Google's Sycamore computer. Meanwhile, experts note that such machines do not yet have practical application in life, since they are created to solve specific problems and it is impossible to program them for other purposes yet. At the moment, scientists do not know how to manage a large number of qubits, and there are only a few dozen of them in quantum computers. But in conventional computers, the amount of RAM is several gigabytes, that is, tens of billions (!) Bits. A quantum computer from Shanghai manages 60 qubits.

The essence of the work of a quantum computer is that this computing device uses the phenomena of quantum mechanics (quantum superposition, quantum entanglement) to transmit and process data. Unlike a conventional one, a quantum computer operates not with bits (either 0 or 1), but with qubits that have values both 0 and 1 at the same time (remember Schrödinger's cat), achieving significant superiority over the processing of tasks by conventional computers. The idea of a quantum computer was put forward by Richard Feynman back in 1981. The corpuscular-wave dualism was successfully overcome in Lev Sapogin's UQT and made it possible to explain a number of experimental data obtained recently (quantum teleportation of individual properties of particles, corpuscular-wave dualism of quasiparticles, and tunnel effect). The approach in which a particle is considered as a wave packet of some unified field is called unitary. Hence the name of the new wave theory [1]. The instantaneous quantum teleportation of particles by Sapogin is easily explained by the fact that the wave packet periodically appears and disappears during its movement in the Universe, and the corpuscular-wave interaction of an electron with a quasiparticle, when the electron receives an additional discrete energy increment $\Delta E = \pm n\hbar\omega$, can be explained by the fact that the wave packet can split into two unequal fragments with larger and smaller amplitudes, while there will be no change in the frequency of the fragments, since all processes are linear, that is, they do not depend on the amplitude. In the L. Sapogina's Unitary Quantum Theory (UQT) , during tunneling, a particle should approach the potential barrier in the phase when the amplitude of the wave packet is small, and the particle in the absence of charge overcomes the barrier, "not noticing" it [1].

5. CONCLUSIONS

In the article, the promising approach of Professor Seth Lloyd, which made it possible to describe the interaction of objects with each other and with energy fields of any nature as elementary logical operations, is supplemented by resonance as a necessary condition for the birth of matter in the Universe and an explanation of quantum teleportation from the standpoint of Lev Sapogin's Unitary Quantum Theory.

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