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Frozen time

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Abstract: *The article is an answer to the call of Professor Lee Smolin, an American theoretical physicist, to find a way to unfreeze time - to imagine the time without turning it into space. The time represented by two-component numbers and, in particular, complex numbers allows us to describe reality in its dynamics. Based on the mathematical apparatus of modern projective geometry, the article proposes to combine the coordinate space and the space of impulses into a single geometric design, considering them in the framework of the five-dimensional continuum (two coordinates time and three spatial coordinates).*

Keywords: *multilayer space, base, layer, complex time, imaginary cyclical time, real cosmological time, dark matter, dark energy.*

1. Introduction

Lee Smolin is an American theoretical physicist, a faculty member at the Perimeter Institute for Theoretical Physics, an adjunct professor of physics at the University of Waterloo writes: "We must find a way to unfreeze time - imagine the time without turning it into space. I have no idea how to do this. I cannot imagine the mathematics that cannot imagine the world, as if it were frozen in eternity." [1]. The complex time, consisting of imaginary cyclic time and the actual cosmological time in space, consisting of a base and a layer, offers the researcher a way to overcome the stationary approach of the symmetric invariant equations of Einstein's STR and GRT in describing reality and to propose a new mathematical apparatus for describing evolutionary processes in the Universe starting from birth particles and ending with the evolution of stars and galaxies [2].

2. Frozen Time in the Four-Dimensional Flat Minkowski-Einstein Continuum

Stephen Hawking proposed introducing the imaginary time $\tau = ict$ into the metric of general relativity. If in the Euclidean space the metric has the form $ds^2 = dx^2 + dy^2 + dz^2$, then in general relativity the metric has the form $ds^2 = c^2dt^2 - (dx^2 + dy^2 + dz^2)$ and for imaginary time c^2dt^2 goes over to $-d^2\tau$. In this case, the differences between time and space in the interval ds^2 of the GR metric disappear [3]. This is frozen time. In the standard model A.Fridmana universe on a large scale can be considered homogeneous and isotropic. Then the metric takes the simple form:

$$ds^2 = c^2dt^2 - R^2(t)dl^2 \tag{1}$$

where dl^2 is spatial element, which may correspond to the zero curvature, either positive or negative curvature (spherical or hyperboloid);

R (t) is the radius of the universe, corresponding to the limiting distance achievable for astronomical observations.

The standard model establishes the relationship between the radius of the universe R (t) and the curvature of space on the one hand and an average density of mass - energy, which is denoted σ, and the pressure P.Instead of R (t) is often administered to the Hubble function:

$$H = \frac{1}{R}\frac{\partial R}{\partial t} \tag{2}$$

The ratio between P and density σ is given by the equation of state.

Therefore, in the standard model there are only two independent variables: density function σ and the Hubble H. To define them, you need two equations, which gives Einstein's theory. One of the equations binds Hubble function H with a density of σ; the second equation expresses the adiabatic space evolution of the universe. Adiabatic means that between the environment and the elementary volume in Einstein's General Relativity Theory no heat exchange:

$$dQ = 0 \tag{3}$$

In Einstein's General Relativity Theory, irreversible processes are absent, the entropy of the universe remains constant. Herewith, the true cosmic time, included in Newton’s Second Law, disappeared from consideration. In the standard cosmological model ΛCDM total energy of the universe is assumed to be zero. It can, therefore, be assumed that H = 0. Therefore, considering the wave function of the universe, from the Schrodinger equation:

$$H\Psi = ih\frac{d\Psi}{dt} \tag{4}$$

It follows that $d\Psi / dt = 0$; the wave function does not depend on the time (equation $H\Psi = 0$ equation is often called the Wheeler – DeWitt Equation). This is a paradox. The cosmological time is excluded from consideration in the flat Minkowski space [4].

Proposed by mathematicians tests for constructing a discrete model of the world: the r-model of Ahmavaar, the geometry of the causal sets of Rafael Sorkin, the quaternion geometry of David Finkelshtein, Penrose's twistor program in order to provide an alternative description of Minkowski's space which emphasizes the light rays rather than the points of space-time did not find sufficient physical justification. As a result, the elementary spinor structure of matter (elementary particles) turned out to be in the center of attention of the Penrose twistor program[5]. However, in the theories of authors, postulated the axioms of systems of relations are, which indicates the a priori incompleteness of the theory, and physical processes are considered from the perspective of an observer. The incompleteness of the theory may be the result of a subjective approach and the lack of experimentally sound physical data. Numerous versions of String Theory are at an impasse, and primarily because they are based on Einstein's STR and GTR, and also based on imaginary frozen time [1].

3. Not Frozen Time in Five-Dimensional Continuum (Two Temporal Coordinates and three Spatial Coordinates)

In Einstein's General Theory of Relativity, the discrete linear cosmological time, which was part of Newton’s second law, was excluded from consideration [4]. Einstein proposed a new interpretation of acceleration. The acceleration, which Newton explained in terms of gravitational and inertial interaction, is considered in GRT as the result of curved space-time, as a result of which the disappears for real cosmological time. This is a paradox. A group of researchers, according to observations using the Habble Space Telescope -HST space telescope in 1998, established the accelerated expansion of galaxies in the visible part of the Universe. In 2011, researchers were awarded the Nobel Prize for this discovery. Cosmological antigravity in the standard ΛCDM (Λ- Cold Dark Matter) model is described by linear force depending on the distance:

$$Fe = (c^2 / 3) \cdot \Lambda \cdot R, \tag{5}$$

where Λ is Einstein’s cosmological constant and R is the distance [6].

If the deformation arising in the elastic spring or in the elastic intergalactic medium (dark energy) would is proportional to the force applied to the body of $F = k \cdot r$ (Guka's law), space-time will represent straight lines that go from the observer to infinity. Obeying this law cosmological time is linear and discrete, this is the so-called Eddington's arrow of time, which describes the real processes of evolution of each object of the Universe individually, for the entire period of time from its birth to disappearance. Wherein, time is two-dimensional. The duality of time was noted by Nobel laureate I. P. Prigozhin in his book Time, Chaos, Quantum. He wrote: “We need to go beyond the concept of time as a parameter that describes the movement of individual systems. Inharmonic oscillators (classical and quantum), time is uniquely related to the laws of motion, but in non-integrable systems, time plays a dual role. If stable stationary systems are associated with the concept of determinate cyclic time, then for unstable, developing systems, the concept of probabilistic vector time is applicable.” [4]. This means that the system can further develop at a new level or disappear. This shows the discreteness in time. Harmonious oscillators include the planets of the solar system. For them, cyclic time is measured by the number of revolutions made around its own axis and around the sun. A discrete linear time determines the time of their evolution and disappearance. Using the theory of linear measures of sets, professor of St. Petersburg University I.N. Taganov proved that if the state of physical processes is always measured with finite uncertainty (the Heisenberg uncertainty relation between the coordinates and momentum of a particle and the time and energy of particles in the microworld), then the moments of physical time can be represented only by two-component numbers and, in particular, complex numbers. In the book "Physics of Irreversible Time" I.N. Taganov suggested that the spiral with variable pitch and diameter in pseudo-Euclidean three-dimensional space can serve as a geometric way of complex physical not frozen time [7]. The Argentine philosopher and physicist Professor Mario Bunge introduced the complex time Te into electron theory:

$$Te = (t + i\tau) \tag{6}$$

Where t is the electron's existence time in a given orbit in an atom, and τ is a constant cyclic time equal to the electron spin period.

Minkowski's flat space, as well as an attempt to generalize it to the case of accelerated motions, i.e., Einstein's GRT space-time, cannot be accepted as basic geometric models for describing the not frozen dynamic evolving world in which we live. Based on the mathematical apparatus of modern projective geometry, scientists come to new, more general conservation laws inherent in the physics of open systems. Moreover, in the five-dimensional continuum, a synchronous interdependence of the change in the state of the system (body) is provided when describing its motion in the momentum representation with a description of its motion in the coordinate representation. First of all, this is the theoretical justification of a space having bundles Xm (Xn) for the geometrization of dynamical systems. The basis of the representation of a layered space is: the base is a n-dimensional differentiable manifold Xn (base-coordinate space), and the layer is a m-dimensional manifold (layer is a momentum space). The return of the system to its initial state is crucial in the formation of the concept of "base" and allows you to describe the behavior of the system (classical and quantum oscillators) by symmetric, invariant equations Einstein's GRT. This state of the system corresponds to the concept of a time horizon during which we can predict the behavior of the system, its development path. The system's transition to a qualitatively new level, during which the system becomes non-integrable, irreversible processes prevail in it, and time loses the invariance property and its behavior is probabilistic, the vector character corresponds to the concept of "layer" [2]. If we recall the existence of a layered space consisting of a base and a layer, we can assume that the four-dimensional Minkowski – Einstein world describes precisely and only the "base" where symmetric and invariant equations reign and the system is in a stationary integrable state. The limitedness of the General Theory of Relativity does not give scientists the right to drive physical reality into the Procrustean bed of Einstein's invariant, symmetric solutions. The imaginary part of the complex time — cyclic time — corresponds to this state [2]. The five-dimensional continuum proposed in the article, which includes two temporal coordinates and three spatial coordinates, absorbed all the advantages of the Kaluza five-dimensional world over the flat four-dimensional Minkowski continuum, revealed the connection of the macrocosm, including temporal representations, with microcosm, charge and mass of elementary particles, with the presence of the space environment (dark energy and dark matter), with the existence of vector and scalar fields. His predecessor can be considered the Eddington's Five-Dimensional Continuum (Uranoid), which includes, in addition to the four-dimensional continuum of Minkowski the fifth time coordinate [8]. Eddington's Uranoid is the object under study environment (the entire universe is composed of elementary particles). It contains, in addition to the four dimensions of the continuum Minkovsky (x1, x2, x3, t), the fifth - time t0. "The E-frame provides a fifth direction perpendicular to the axes x1, x2, x3, t; and the position vector can be extended t0:

$$X = E15\, ix1 + E25\, ix2 + E35\, ix3 + E45\, t + E05\, t0, \tag{7}$$

where according to the reality conditions t0 should be real" [8].

Consider the advantages of the five-dimensional continuum, which includes two dimensions of time and three dimensions of space in front of the five-dimensional continuum of Kalutza, which includes one dimension of time and four spatial dimensions.

First, in the five-dimensional Kaluza theory, even the author himself was not clear about the physical meaning of the fifth coordinate. Here are the final words from Kaluza's article: "It's still hard to come to terms with the idea that all these relationships, which can hardly be surpassed by the degree of formal unity achieved in them, are just a capricious game of deceptive randomness. But if it is possible to show that behind the assumed interconnections there is something more than an empty formalism, then this will be a new triumph for Einstein's general theory of relativity "[9]. We managed to show that the fifth coordinate (pseudo-spatial fourth in Kaluza) is the time of the system evolution (t), divided into sections - time horizons (T). The time of the horizon is the time during which we can predict the behavior of the system, its development trajectory, and further then the initial state of the system can no longer serve as a basis for prediction. The fifth dimension has a special status. It does not allow the Universe to be inscribed in the Procrustean bed of symmetric, invariant solutions of Einstein's theory. The proposal of Einstein and Bergman to improve the Kaluza theory, to close the fifth dimension and to represent the world cyclic, closed or compactified by the fifth coordinate leads to the wrong law of decreasing gravitational forces in the five-dimensional world [10]. But if we allow the fifth coordinate to be singled out (in particular, the metrics are independent of the fifth coordinate), then the same 5-dimensional solutions of the Einstein equations yield a different solution, resulting in $F_r \sim 1/r^2$ and not contradicting the experiment [11].

Secondly, why are the manifestations of the additional dimension so limited, that is, why the fifth dimension remains practically unobservable? In the Kaluza theory, there is no answer to this question, although in it all electromagnetic phenomena can be interpreted as manifestations of the fifth dimension. The condition of cylindricality in the fifth dimension, necessary for obtaining the tensor of the electromagnetic field strength, was achieved in the five-dimensional Kaluza theory by postulating the independence of all geometrical quantities from the fifth coordinate. In later interpretations of the Kaluza theory, the dependence of quantities on the fifth coordinate is allowed, but the period of cyclic dependence is extremely small $T=10^{-31}$s and practically does not appear in the formulas used. The reason for the non-observability of the fifth dimension is explained by the property of the cyclical nature of the world in the fifth coordinate with a very small period. But all these explanations are suitable for the world closed in the fifth coordinate [11]. However, the author of the evolutionary paradigm of the Universe, the laureate of the Nobel Prize I.R. Prigogine established that "isolated, closed systems evolve to chaos, and open systems evolve to ever higher forms of complexity." [4]. Thus, closing the fifth coordinate of Einstein dooms the Universe to degradation. From our positions in the above explanations, there was a substitution of concepts. The Minkowski cyclic, invariant time replaced the evolutionary, non-invariant time of the fifth coordinate. We will return spatial and temporal measurements to our places and try to answer the second question, based on our five-dimensional continuum. The independence of values from the fifth coordinate is possible only on time intervals T, forming time horizons. In these areas, the system is in a stationary, equilibrium state, it is integrable, all its main parameters retain their values and time is cyclical and invariant. A completely different picture is observed at the boundaries of time horizons. There, the system moves to a qualitatively new evolutionary level, while the system is in a non-equilibrium, non-stationary state, it is non-integrable, irreversible processes prevail in it, it searches for a new equilibrium state to which the new values of the basic parameters will correspond. It is at the junctions of the time horizons that the dependence of the continuum values on the fifth coordinate should be expected. In this case, time loses the invariance property and becomes probabilistic, that is, the system can either develop further in new capacity or cease to exist. The energy needed by the system for evolutionary transformations, it receives from the outside from the cosmic environment of the Universe (dark energy and dark matter) [2]. If you look at the principle of relativity from the point of view of the laws of symmetry and the conservation laws arising from them (the famous Noether's theorem and its subsequent generalizations), it becomes clear what role they play in establishing the laws of Nature. Each symmetry in the Standard Model has its own conservation law. For example, symmetries with respect to time shifts (that is, the fact that the laws of physics are the same at every moment of time) corresponds to the law of conservation of energy, symmetries relative to shifts in space correspond to the law of conservation of momentum, and symmetries about rotations in it (all directions in space are equal) - the law of conservation of angular momentum. Conservation laws can also be interpreted as prohibitions: symmetries prohibit changes in the energy, momentum, and angular momentum of a closed system during its evolution. It is believed that the laws of physics do not change with uniform rectilinear motion. This statement is called the principle of relativity. Einstein made an attempt to extend this principle to any, including accelerated forms of motion, but failed. It turned out that the new symmetries inherent in accelerated motions lead to new, more general conservation laws inherent in the physics of open systems. The participation of quantum vacuum (dark matter) in all interactions causes a rejection of the paradigm of the evolution of a closed system and requires a review of all conservation laws and symmetries. Further development of pseudo-Euclidean three-dimensional space may lie in the way of taking into account the variety of processes associated with the rotation of bodies. First of all, because Newton's geometry is Euclidean's geometry, it's Cartesian rectangular coordinates. In order to take into account rotational effects, it was necessary to combine the Cartesian coordinate system with the six angular coordinates of Euler. Academician Gennady Shipov managed to do this in his theory of "Physical Vacuum" [12]. It turned out that in the framework of such mechanics it was possible to explain experiments in which the law of conservation of energy in open systems is violated.

4. Conclusion

So, in order to unfreeze world, it is necessary to recognize the existence of two types of time: real physical time, which is a characteristic of facility or the system and conditional cyclic time invented by a person to organize his practical activities, it always flows uniformly (24 hours in earth days). The most ridiculous mistake of the theory of relativity is that Einstein speaks about the variability of the conditional time course, while it is not at all capable of changing. The substitution of time real conditional and vice versa is the reason for many misconceptions in modern science. This conclusion suggests that the mathematical apparatus of the invariant reversible equations of Einstein's STR and GRT, excluding real cosmological time in the four-dimensional flat Minkowski-Einstein continuum, reflects a frozen static Universe. In order to unfreeze it, to show in development, it is necessary to return to the world of irreversible processes of the five-dimensional continuum (two temporal coordinates and three spatial coordinates). For a long time, it was believed that the coordinate space and the space of impulses can be connected with each other only through Fourier transforms. However, their interconnection turned out to be obvious and not trivial, and it can be described in a unified way by choosing the correct geometric space, which should serve as a model for describing the dynamics of particles and fields.

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