Ambivalence of Time

Oleksandr Nikolenko

Institute of Time Nature Explorations, Russia-Ukraine

E-mail: adntempo51@gmail.com

(Received 06 April 2016, Accepted 28 May 2016, Published 08 June 2016)

Abstract

The physical nature of Time is researched. Time is considered as a set of phenomena that can be divided into two fundamentally different, but interrelated groups (time sides). The first group is connected with the metric properties and topological concepts of space-time manifold, the integral part of which is Time. This side of time integrates it with spatial dimension. The second group includes physical properties connected with spontaneous time coordinate increment of massive particles (the flow of time). It provides the variation of systems and the development of physical processes in the environment. The difference between time and space can be seen here. Thus, time ambivalence (duality) is shown. Time ambivalence is one of the key temporology principles. It is impossible to build an adequate time theory without considering it.

***Keywords*:** The nature of time; the ambivalence of the time; the physical properties of time, the theory of relativity.

The nature of Time has always been the subject of controversies, philosophical and physical investigations. However, by now we do not have neither a common Time theory (temporology) nor even the definition of the very subject of the investigations – Time. One of the reasons of inadequate temporology status lies in the fact that researchers do not consider the most important property of Time – its ambivalence. As a result, fundamentally different sides of Time get mixed imprecisely and it causes a number of contradictions. Let's look at the situation in detail.

The necessity of physical definition of Time can be seen in the fact that the related to it variables *t, dt…* appear in the relationships of physics (except for statics) noticeably more often than any other variable. The presence of the stream of Time is an integral condition of the variability of any systems without exception. This defines the fundamental character of Time.

Notwithstanding the great number of publications on the nature of time of both philosophical and physical character [1-9], there is still no eligible physical definition of this fundamental natural phenomenon. It is only possible to rely on two definitions that were given in the context of classical mechanics and theory of relativity.

In classical mechanics, this definition was introduced by Newton. He stated it in the following way [10].

"*Absolute, true and mathematical time, of itself, and from its own nature flows equably without regard to anything external, and by another name is called duration: relative, apparent and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time ....*"

The Newton Time is absolute and flows equably without regard to anything external. It is not related to space. These are both extent (as one-dimensional continuum of instants) and duration (as separated interval in such extent). The flow of time is always uniform and is related to motion.

Relativistic mechanics has organized a revolution in understanding of time nature. This revolution can be well seen in the famous quote of *Hermann Minkowski:*

"*The views of space and time which I wish to lay before you have sprung from the soil of experimental physics, and therein lies their strength. They are radical. Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality*."

In this view, Time and Space represent an integral part of space-time manifold. As is well-known, such idea of time proved to be extremely fruitful and contributed to Albert Einstein's General theory of relativity. At the same time, with such approach one well-sensed property of time is lost – its flow, causing the dynamics of physical systems. Universe models based on it become static. As a result, the notion of Past and Future go beyond physics and are announced as illusions. Einstein wrote a letter to Besso's family: "… *for us, physicists believe the separation between past, present, and future is only an illusion, although a convincing one*." [11].

Minkowski and Einstein's approach to the notion of time is based on the experimental data and thereby must be used in the definition of Time. However, there are some reasons to believe that such definition is incomplete. In fact, unlike Newton, Einstein rejects that the flow of time is in physical existence. However, it contradicts the fact that all the events around us happen solely at a specific moment in the Present, and this moment experiences continuous shift on the time base towards Future. Minkowski and Einstein's approach is based on establishing a certain identity between time and space dimensions of space-time manifold.

At the same time, in the records of any type of metrics of space-time manifold, time and space coordinates always enter in a different way: time coordinate sing x^0 is always opposite to space coordinate sign $x^1x^2x^3$. Consequently, it could be said that time dimension of space-time manifold is metrically separated, and there is no absolute identity between them. This metric time separation is connected with one surprising property: in the record of coordinate tuple (x^0,x^1,x^2,x^3), that determines the position of a particle of matter in space-time manifold, metrically separated time coordinate always experiences continuous and monotonic increment. Thus, this property prevents space from full and unconditional merging with time in one single entity as Minkowski wanted.

The increment of time coordinate gives the possibility to achieve the most important property of the surrounding world - variability of systems. We do not consider the variability of physical systems an illusion, thus the increment of time coordinate cannot be an illusion either. It should be emphasized that such increment covers the particles (and systems) that have mass. This allows assuming that the presence of mass is connected with the increment of time coordinate process, and it is thus connected with metrical properties of space-time. In other words, the mechanism of time coordinate increment of particles should include the necessity of nonzero mass of the particle. This conclusion is confirmed by the unalterable fact that the flow of proper time is present only by the nonzero mass particles. The particles with zero mass (particularly photons) do not experience the flow of proper time.

The increment of one of the coordinates (time) in the coordinate tuple testifies the presence of the motion process connected with the flow of time phenomenon. Just as it can be described by

devices (speedometer or odometer) when moving in space, the motion connected with time can be described with the help of a clock. Although, the physical clock is not always reliable enough [12].

Physical Time can be characterized by the following wording: *"Physical Time is set of metric allocated measurement (dimension) as a part of space-time manifold; and a complex of the physical phenomena providing spontaneous, continuous, monotonous increase coordinates of the material particles in coordinate tuple in this dimension."*

Thus, it is possible to link time with two fundamentally different properties. First, with extent (dimensionality in space-time manifold) and the intervals of such extent, i.e. metrical and topological properties that bind time and space together. Second, with the property of forced increment of time coordinate, which distinguishes time from space. Such duality of Time can be called *ambivalence*. The mix of these two fundamentally different sides of Time has led to quite a great confusion in arguments about the nature of Time.

The monotonic and continuous increment of metrically detailed time component in coordinate tuple gives the possibility to display the properties of the variability of systems. In fact, the point is in the phenomenon of motion or the flow of time. If the point is in the proper time of a particle, this definition is real only for tardyons that have mass. If the first side of Time is reflected quite fully in the theory of relativity, the second one – the mechanism of continuous increment of massive particles time coordinates or, in other words, the flow of time for them, - is not absolutely clear. The attempts to introduce this phenomenon as the product of consciousness withdraw us to the sphere of something fundamentally incognizable, and consequently these attempts are not constructive.

REFERENCES

[1] H. Reichenbach, *The direction of time*, (University of California Press, Berkeley), 1956
[2] H. Reichenbach, *The Philosophy of Space and Time*, (Dover Publications, New York), 1958
[3] G. J. Whitrow, *The Natural Philosophy of Time* (Clarendon Press, Oxford), 1980
[4] A. M. Bich, *Fundamentals of the Theory of Time*, (Znaniya Ukraine, Kiev), 2005
[5] S. Hawking, *The Universe in a Nutshell*, (Amfora, SPB), 2007
[6] A. K. Gutz, *Elements of the theory of time*, (LKI, Moscow), 2011
[7] L. Smolin, *Time Reborn: From the Crisis in Physics to the Future of the Universe*, (Houghton Mifflin Harcourt, Bjston-New York), 2013
[8] O. Nikolenko, "On the reasons and features of the current of time in pseudoeuclidean spaces", *Physics of consciousness and life, cosmology and astrophysics*, **13(4)**, 42-55 (2013)
[9] O. Nikolenko, "Paradox in time travel, not associated with the violation of causality", *Physics Essays*, **28**, 11 (2015)
[10] I. Newton, *The Principia: Mathematical Principles of Natural Philosophy*, (University of California Press), 1999
[11] A. Einstein, "Letter to Michele Besso's Family", Ref. Bernstein, Jeremy., A Critic at Large: Besso. The New Yorker (1989)
[12] O. Nikolenko, "Physics Essays: The Non-Relativistic Paradox of Physical Clock", *App. Phys. Res.,* **8(2),** 57-59 (2016)