Time is a Numerical Order of Material Change

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Prologue

"Time has no independent existence apart from the order of events by which we measure it".
Albert Einstein

Abstract

Experimental data confirm material change i.e. motion run in space. There is no experimental evidence time being part of the space. Time is what we measure with clocks. With clocks we measure numerical order $t_1, t_2 ... t_n$ of material change. Material change n is followed by material change $n+1$, material change $n+1$ is followed by material change $n+2$ and so on. Material change $n+1$ s "after" material change n equivalently as natural number 2 is "after" natural number 1. Numerical order $t_1, t_2 ... t_n$ of material change runs in a space only and not in time. There is no time existing behind numerical order of material change. In space "past", "present" and "future" exist only as a numerical order of material change. Fundamental unit of numerical order $t_1, t_2 ... t_n$ of material change is a Planck time t_p. According to the formalism $X_4 = i * c * t_n$ time t_n is only a component of X_4 that we obtain with clocks. X_4 is spatial too. Space is not 3D + T. Space is 4D. 4D space is a medium of an immediate information transfer by phenomena with numerical order zero $t_n = 0$.

Key words: space, time, space-time, numerical order of material change, run of clocks, immediate physical phenomena

Introduction

Let's take photon moving from on the distance d between point A and point B of space. Distance d is composed out of Planck distances l_p: $d = \sum l_{p1} + l_{p2} ... + l_{pn}$. The smallest distance photon can do on the way from A to B is l_p. Numerical order of motion from l_{p1} to l_{p2} is a Planck time t_p. Photon is moving exclusively in space and not in time. In space "before" and "after" exist only as a numerical order $t_0, t_1, t_2 ... t_n$ of a physical event: t_{n-1} is "before" t_n equivalently to natural number $n-1$ is "before" natural number n. Numerical order of material change we measure with "ticking" of a clock where t_0 represents beginning of the measurement, t_n end of the measurement.

Velocity v of a material change is derived from its numerical order t_n: $v = \dfrac{d}{t_n} ms^{-1}$.

Frequency γ of material change is derived from its numerical order t_n: $\gamma = \dfrac{1}{t_n} s^{-1}$.

In Special Theory of Relativity forth coordinate X_4 of space is spatial too. X_4 is a product of imaginary number i, light speed c and numerical order t_n of an event: $X_4 = i * c * t_n$. It is more correct to imagine cosmic space as a four-dimensional $4D$ space than $3D + T$ where fourth dimension is time. Time is numerical order of material change

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that we measure with clocks. Fundamental unit of numerical order $t_0, t_1, t_2 ... t_n$ of material change that run in space is Planck time $t_p = 5,39124 * 10^{-44} s$ and is derived from the light speed: $t_p = \dfrac{c}{l_p}$ where l_p is a Planck distance. Planck time t_p exists in the universe as a fundamental physical unit that governs numerical order of material change (1).

From mathematical point of view velocity v and frequency γ of material change are functions of their numerical order t_n that runs in a timeless space:

$$v = (f)t_n$$

$$\gamma = (f)t_n$$

Space is space and time is time

In paper "Time and Classical and Quantum Mechanics: Indeterminacy Versus Discontinuity "Lynds discuss that between time and space there is always a difference: "The fact that imaginary numbers when computing space-time intervals and path integrals does not facilitate that when multiplied by i, that time intervals become basically identical to dimensions of space. Imaginary numbers show up in space-time intervals when space and time separations are combined at near the speed of light, and spatial separations are small relative to time intervals. What this illustrates is that although space and time are interwoven in Minkowski space-time, and time is the fourth dimension, time is not spatial dimension: time is always time, and space is always space, as those i' s keep showing us. There is always a difference. If there is any degree of space, regardless of how microscopic, there would appear to be inherent continuity i.e. interval in time" (2).

In this paper is shown difference between space and time is following: time is a numerical $t_0, t_1, t_2 ... t_n$ order of material change that runs in space. According to the formalism $X_4 = i * c * t_n$ time t_n is only a component of X_4 that we obtain with clocks. X_4 is spatial too. Space is not 3D + T. Space is 4D.

Time as Fundamental Arena can be eliminated

In paper "The Mathematical Role of Time and Space-Time in Classical Physics" Newton C. A. da Costa and Adonai S. Sant'Anna shows that time as fundamental physical arena in which material change run can be eliminated: "We use Padoa''s principle of independence of primitive symbols in axiomatic systems in order to discuss the mathematical role of time and spacetime in some classical physical theories. We show that time is eliminable in Newtonian mechanics and that spacetime is also dispensable in Hamiltonian mechanics, Maxwell''s electromagnetic theory, the Dirac electron, classical gauge fields, and general relativity" (3).

In this paper time is presented as a numerical order t_n of material change we measure with clocks. Fundamental arena in which material change runs is space. Time is merely a mathematical quantity (numerical order) of material change.

"Killing time" is not necessary

In paper "Killing time" James F. Woodward discuss that time as we experience it is not part of fundamental reality: "Theoretical consequences of the gravitational

origin of inertial reaction forces, that is, Mach's principle, are explored. It is argued that Mach's principle leads to the conclusion that time, as we normally treat it in our common experience and physical theory, is not a part of fundamental reality; the past and future have a real, objective existence, as is already suggested by both special and general relativity theory. A laboratory scale experiment whereby Mach's principle, and thus radical timeless ness, can be established is mentioned" (4).

In this paper is shown "killing of time" is not necessary. We need exact understanding of how time and space are interrelated. Time is numerical order of material change in space that itself is timeless: time is not part of the space, space is 4D. Past, present and future physically exist only as numerical order of material change that runs in timeless space. One can move in space only and not in time. Hypothetical travel in time is not possible.

Recent neurological research shows we experience flow of numerical order of material change that run in timeless 4D space through psychological time "past-present-future". Temporal experience of material change "one after other in time" is result of neuronal activity of the brain. In physical reality "one after other" exists only in a sense of numerical order of material change.

"Traditionally, the way in which time is perceived, represented and estimated has been explained using a pacemaker–accumulator model that is not only straightforward, but also surprisingly powerful in explaining behavioural and biological data. However, recent advances have challenged this traditional view. It is now proposed that the brain represents time in a distributed manner and tells the time by detecting the coincidental activation of different neural populations (5).

We live in a timeless universe where "before" and "after" exist only in a sense of numerical order of change that we measure with clocks.

Time as numerical order of material change resolves Zeno Problems on motion

Zeno problems of motion confronted in terms of space and time are agitating human reason for centuries. Here we see that motion exists in space only and not in time. With clocks we measure numerical order of motion. Achilles surpasses Tortoise in space only and not in time. Velocity v of both runners is derived from the numerical order of their motion. You imagine Achilles at the point A, Tortoise at the point T. Between A and T there is a distance d. When they start running into the same direction we activate a stopwatch. When Achilles is surpassing Tortoise we stop stopwatch. On the stopwatch we see $t_n = 10 \sec$. Achilles has passed 10 meters, his speed is $v = 1 ms^{-1}$. Tortoise has passed 1 meter, its $t_n = 10 \sec$, velocity is $v = 0,1 ms^{-1}$. At the starting points the distance d between Achilles and Tortoise was 9 meters. Achilles runs distance $d_1 = 10\,m$. Tortoise runs distance $d_2 = 9\,m$. They both move in space only and not in time. Clock is a measuring device for numerical order $t_0, t_1, t_2 ... t_n$ of their motion. Their velocities $v_a = \dfrac{d_1}{t_n}$ and

$v_t = \dfrac{d_2}{t_n}$ are derived from numerical order of their motion.

Progress in understanding of time in last 100 years

Isaac Newton founded classical mechanics on the view that space is something distinct from body and that time is something that passes uniformly without regard to whatever happens in the world. By Newton time passes in the space and is not part of the space. Absolute, true, and mathematical time, from its own nature, passes equably without relation the anything external, and thus without reference to any change or way of measuring of time. Newton has regarded space and time as real entities with their own manner of existence as necessitated by God's existence (more specifically, his omnipresence and eternality).

For existence of space as Newton's view it there is no doubt. Space is a physical medium in which matter exists. For his view on time there is no experimental evidence. Time running in space on it own was never experimentally detected. On that fact my consideration is that such a time does not exist. Time that exists is the time we measure with clocks. With clocks we measure numerical order of material change i.e. motion in space. In physical world time is exclusively a mathematical quantity. In this sense mathematic is a part of physical universe. Changes of the universe have numerical order from 1 to 2, 3 and so on. We measure this order with clocks. Universe is not changing in time, on the contrary time as a numerical order of change run in the universe. Universe is timeless. With clock we measure velocity of material change. In Newton this velocities are absolute in a sense that clocks run with equal velocity in entire universal space.

In the Special Theory of Relativity (SR) Einstein has described electromagnetic phenomena with a formalism of four-dimensional space created by German mathematician Hermann Minkowski. In his formalism fourth coordinate is $X_4 = i * c * t_n$. As in Newton physics also in SR we measure with clocks numerical order of material change. Velocity v is calculated out of numerical order t_n: $v = \dfrac{d}{t_n}$.

Experiments confirm that material change (velocity of clocks mechanism included) have different velocity in different inertial systems. In SR velocity of material change is not absolute, it is relative. A more than hundred year misunderstanding of SR is that material change run in time as a part of space, and so time is a dimension of a medium in which electromagnetic waves, particles and massive bodies move. Formalism of SR $X_4 = i * c * t_n$ shows clearly space-time is 4D. Definition of time here proposed "time is numerical order of change which runs in 4D space" resolves this century long misinterpretation: electromagnetic waves, particles and massive bodies move exclusively in space, time is numerical order of their motion.

4D space is a medium of immediate information transfer by phenomena with numerical order zero $t_n = 0$.

According to the concept of space-time all physical phenomena happen in space and time. This concept cannot explain physical phenomena where information transfer is immediate. By this phenomena time t is zero. If phenomena would happen in time as a some physical reality, time could never be zero. In this article is presented a new concept of space-time as 4D physical reality where time is only a mathematical quantity (numerical order) of physical phenomena. Some physical phenomena have numerical order zero: $t_n = 0$. Physical phenomena characterized by numerical order zero are immediate information transfers carried directly by the timeless 4D space. Examples of such phenomena are: the non-local correlations between quantum particles in EPR-type experiments and other immediate physical phenomena like tunneling or the quantum communications regarding the continuous

variable systems or the quantum excitations from one atom to another in Fermi's two-atom system (6,7,8,9). Their velocity is always constant; namely zero (just as the constancy of light speed of special relativity). The speed zero by the immediate information transfer turns out to have an ontological status similar to the light speed of special relativity.

Conclusions

In this article is shown that with using concept of space-time as a 4D space where time is exclusively numerical order of material change one can describe physical world more accurately; in the universe nothing can happen in "past-present-future" that is merely a psychological frame into which we experience material change running in space. In physics symbol t is exclusively a mathematical quantity describing numerical order of material change running in space. We live in a timeless universe where time measured by clocks is exclusively numerical order of material change.

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