



# How many Models of Time do we need in Physics?

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## ABSTRACT

Elementary perception (sight) and experimental data confirm we measure with clocks sequential numerical order of events which means that flow of time has only the mathematical existence. The idea of some physical flow of time has no support in elementary perception and experimental data and should be abandoned. On the other hand in today physics, we have several other models of time: coordinate time, proper time, internal time, external time, thermal time, cosmic time. None of these times we are able to observe with our senses. In this article it is shown these models of time have no real physical existence, they are pure theoretical mistakes.

**Key Words:** Flow of time, Cosmic time, Internal time, External time, Thermal time, Coordinate time, Psychological time

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## Introduction

Since physics exists we measure with clocks duration of material changes, i.e. motion. If we say that “time is duration” no one who knows physics can object to this statement. The common interpretation that duration exists in some physical time has no experimental evidence and we will abandon it. We can only claim that duration exists in space. You do a simple experiment: you move a pen on your table from the left to the right side of the table. You can experience only motion in space. Without measurement, the motion itself has no duration on its own. We can conclude on this simple experiment that a given motion in order to have duration needs to be measured. Time as duration exists when is measured. If there is no measurement from the side of the observer there is no duration. Time as duration is the result of the interaction of the observer with the given physical event. The following question arises: “Does time run without measurement”? We can observe in the universe that every physical event has its own sequential order. Let’s take the example of photon motion from the left side of the table to the right side of the table. Photon is moving from point A to point B in space so that it passes from one Planck distance

to the next Planck distance. When a photon is on the Planck distance  $l_{p1}$  it is not anymore on the distance  $l_{p2}$  and so on. Each Planck distance  $l_{p_i}$  which photon is passing corresponds exactly one Planck time  $t_{p_i}$ . In this sense Planck times  $t_{p1}, t_{p2}, \dots, t_{p_N}$  represent sequential numerical order of photon motion from A to B. In this view time is the numerical order of photon motion. We name this time “fundamental time” because it exists without the measurement of the observer. When fundamental time is measured by the observer “emergent time” which is duration enters existence. Emergent time in the case of photon motion from A to B is the sum of Planck times.

$$t = t_{p1} + t_{p2} + \dots + t_{p_N} = \sum_{i=1}^N t_i \quad (1)$$

Planck time  $t_p$  is the unit of fundamental time which has only the mathematical existence (Fiscaletti and Sorli, 2015). Our experience and experimental data confirm: time is real, time exists; time is the sequential numerical order of physical events; time has only the mathematical existence. Flow of fundamental time does not run in some physical time as the 4<sup>th</sup> coordinate of space. Fundamental mathematical time runs exclusively in space in which is always NOW (Sorli *et al.*, 2018). With clocks we

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measure duration of events in space. Relative velocity of events (rate of clocks included) depends on the variable energy density of space and is valid for all observers. GPS system proved this with no doubt (Sorli, 2018a). Shapiro experiment proves that light has a bit lower velocity in stronger gravity (where energy density of space is lower) which means that the same photon clock (or any other clock) will have a slower rate in stronger gravity and faster rate in intergalactic space where gravity is weak and energy density of the space is at the maximum (Sorli, 2018).

The “paradigm shift” in the understanding of time is following:

1. The flow of time has only the mathematical existence.
2. Material changes, i.e. motion run only in space and time is their sequential numerical order.
3. “Relative” is the velocity of material change, i.e. motion; time is not relative, it cannot dilate or shrink. Time cannot go faster or slower, only the velocity of physical events can be faster or slower.
4. Relative velocity of material change (rate of clocks included), i.e. motion is valid for all observers and depends only on the variable energy density of space and not on the position of the observer.

## Discussion

Barbour is denying the existence of physical time which is right. On the other hand, he claims: “I will not claim that time can definitely be banished from physics; the universe may be infinite, and black holes present some problems for the timeless picture. Nevertheless, I think it is entirely possible – indeed likely – that time as such plays no role in the universe” (Barbour, 2009). I do not agree with Barbour’s view, on the contrary: “Fundamental time *as such* is the numerical order of events and is at the very core of the universe despite it has no physical existence”. Time is the fundamental element of the universe and fundamental element of physics. The solution is not in banishing time as Barbour suggested, the solution is to give it the right meaning.

Rovelli and Connes also are misunderstanding the real nature of time which is time has only the mathematical existence: We consider the cluster of problems raised by the relation between the notion of time, gravitational theory, quantum theory and thermodynamics; in particular, we address the problem of relating the “timelessness” of the

hypothetical fundamental general covariant quantum field theory with the “evidence” of the flow of time. By using the algebraic formulation of quantum theory, we propose a unifying perspective on these problems, based on the hypothesis that in a generally covariant quantum theory the physical time-flow is not a universal property of the mechanical theory, but rather it is determined by the thermodynamical state of the system (“thermal time hypothesis”) (Connes and Rovelli, 1994). Physical time-flow cannot be determined by the thermodynamical state of the system because physical time-flow does not exist. Time is the numerical order of the changes of a given thermodynamic system.

Borghi is introducing “internal time” and “external time”: “A careful analysis shows that in physics the concept of time is used in two different ways: as an external attribute of motion or as an implicit variable that measures the internal evolution of a system. The first one is explicitly used in mechanics, the second, implicitly, in thermodynamics. Since in thermodynamics the variable  $t$  in practice does not appear in the definition of the physical quantities, we naively think that the concept of time introduced in mechanics can be used everywhere. Although it may sound a simplification, it is immediately clear that, as the mechanical evolution is related to the change in the position of a body with respect to others, the thermodynamic evolution of a system is linked to processes that involve it internally and might not have relationships with the environment, thus with the external space of relations” (Borghi, 2012). Borghi introduction of internal time and external time seems not necessary as time is the mathematical parameter of motion of space and the mathematical parameter of a thermodynamic evolution of a given system.

Einstein has introduced in Special Relativity “coordinate time” and “proper time” of a given inertial system. The 4<sup>th</sup> coordinate of Minkowski manifold is not “time coordinate”, it is spatial too because  $X_4 = ict$  means the product of velocity  $c$  and duration  $t$  which is spatial distance. Minkowski manifold is not  $3D + T$ , it is  $4D$ . In this 4D manifold time has only the mathematical existence as we have seen in the introduction (Sorli *et al.*, 2018). Einstein “coordinate time” model has no bijective correspondence in the physical world.

The common view in cosmology is that some “cosmic time” exists as the time coordinate since the



big bang. No one ever has seen this cosmic time and we have no experimental data confirming its existence. In this article is proposed that term “cosmic time” is abolished because we have not a single evidence of its existence. The universe is running in space (in which is only and always NOW) where time is merely the sequential numerical order of universal changes.

Smolin is arguing in his book that physical time in which universe runs exists (Smolin, 2013). He does not give any experimental prove about the physical existence of time. Nobody ever gave it any proof, so would be wise we take into account in physics that physical time does not exist.

Isaac Newton said:” Hypotheses should be subservient only in explaining the properties of things but not assumed in determining them, unless so far as they may furnish experiments” (Hutton *et al.*, 1809). We have many hypotheses of time and none of them has experimental verification. By giving them credibility we are not ensuring progress, on the contrary confusion about what is time is increasing. On the basis of elementary perception (sight) and experimental data we can conclude that flow time is real, time exists, but it has only the mathematical existence (Sorli and Kaufman, 2018). It is time we acknowledge in physics that also non-material things exist. Time is one of them.

Considering time flow has only the mathematical existence hypothetical time travels (Sengupta, 2018) are categorically excluded. We can travel only in space in which is always NOW (Sorli *et al.*, 2018). Twin brother on the Moon aging will be faster than aging of his brother on the Earth, but both are getting older only in space. Hypothetical travel through wormholes in some “other time” is out of question. “Time Machine” hypothesized by some researchers is out of question (Aref’eva and Volovic, 2007). Linear time “past-present-future” exists only in the human mind as the psychological time (Sorli *et al.*, 2018) through which we cannot travel with the spaceship. “Symmetry in time” is another model which does not correspond to the physical reality. A given physical phenomenon can only be symmetric in space because physical time is nonexistent (Sorli, Patro, 2018).

### Time arrow, outer and inner research

We have in physics today several models of “time arrow”: “The thermodynamic arrow corresponds to the direction of increasing disorder and hence

of entropy. Thus it is also called the entropic arrow of time. It follows from the second law of thermodynamics. Time proceeds in the direction of the increase of entropy” (Eddington, 1928).

“The Cosmological arrow of time is the direction in which the universe is expanding at present. The quantum mechanical arrow of time is the direction in which wave function collapse or state vector reduction occurs leading to definite state from among many possibilities. The psychological arrow of time is the direction from past to future that we assign to perceptual time because we remember the past and not the future. Whether all these arrows are distinct or they have a common origin is not yet clear though mappings of one to the other have been proposed in the literature (Zeh, 2010)” (Rajat, Tripathy, 2018).

None of models of time arrow presented above one can perceive by senses in physical reality or measure them by instruments. The only existent “arrow of time” is psychological one. The observer which is locked in psychological time will experience change  $X_2$  is entering existence after change  $X_1$ , change  $X_3$  is entering existence after change  $X_2$  in some physical time which he cannot perceive by senses (because is nonexistent). The observer which is aware of inner psychological time will experience flow of material changes in space in which time runs only as the numerical order of these changes; when change  $X_2$  is entering existence, change  $X_1$  does not exist anymore. When change  $X_3$  is entering existence, change  $X_2$  does not exist anymore. The entire universe is dying and being born in the eternal moment of NOW (Sorli, Kaufman, 2018a). This model of time is the necessary tool for the advancement of physics.

Psychological arrow of time has the physical origin in the neuronal activity of the brain. The observer can reach beyond the brain by “watching the mind” which is awakening the conscious observer which is beyond the matter and beyond the mind; the conscious observer can watch (witness) the way his mind functions (Sorli, Kaufman, 2018a). Conscious observer is experiencing flow of material changes only in space (not in time) in which is always and only NOW. Regarding physical existence of time Albert Einstein, was “out-of-the-box” thinking. He said: “People like us, who believe in physics, know that the distinction between past, present, and future is only a stubbornly persistent illusion” (A. Einstein Online,



2018). Albert Einstein was embodiment of mysticism and physics in one person. He said: "I maintain that the cosmic religious feeling is the strongest and noblest motive for scientific research" (A. Einstein Online, 2018). The same is valid for Max Planck: "All matter originates and exists only by virtue of a force... We must assume behind this force the existence of a conscious and intelligent Mind. This Mind is the matrix of all matter" (Brainy Quote, 2018) Today's physics is locked in reductionist rationalism which is suffocating the progress of physics. Mathematic has overruled physics and phenomena are discovered for which we do not have direct experimental evidence (Sorli, 2018b). Einstein said: "I do not believe in mathematics" (A. Einstein Online, 2018). Today "peer review" is considering that a given article has scientific validity if there is enough mathematical modelling. Nobody is posing the question if the phenomenon which is mathematically described, has bijective correspondence with the physical world (Sorli, 2018b). This flawed methodology has taken physics its beauty and exactness. It will be recognized soon that observation and experimental data are the pillars of physics. Mathematic is just the descriptive tool.

Outer research of outer material world and inner research of inner psychological world and spiritual world are complementary. In both the observer is the central point. The same observer is exploring outer world and inner world. Once you are entering the state of conscious observer you aware the way your mind creates models of reality (Sorli, Kaufman, 2018b). Then you have better possibilities to build a model of reality which will have bijective correspondence with the reality itself (Sorli, 2018b). Research on time is the classical example that without inner research and discovery of conscious observer we will never understand time. The conscious observer is beyond matter and beyond mind. Its source is consciousness itself. It is the noblest discovery one can achieve. Albert Einstein said: "The most beautiful thing we can experience is the mysterious. It is the source of all true art and all science" (A. Einstein Online, 2012).

## Conclusions

Careful examination of different models of time shows that all these models are not built on perception and experimental data, they are pure theoretical

speculations. Physics today is in deep crisis because today is modern to invent new models and publish theoretical articles about them. In this way, we will not have any progress. The progress of physics is building models of the world which are based on elementary perception and proved by the experiment. The spirit of Newton should be respected in order to progress research on time and physics in general.

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