

Article

Non-Existence of Physical Time and Extension of Chronology Protection Conjecture on Open Timelike Curves

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Abstract: In experimental physics, we understand time as the duration of material changes that run into space. This fact is the standpoint for our model of time-invariant space in which causality is only a principle and not a physical actuality, and entropy runs only in space and not in time. Time is merely a duration of entropy that is increasing in time-invariant space. Time is entering existence when measured by the observer. In time-invariant space, motion happens only in space and not in time which means that also in open timelike curves motion happens only in space and not in time.

Keywords: time; space; motion; timelike curves; chronology protection conjecture

1. Introduction

Material changes in the universe are the indisputable reality that all physicists agree on their existence. We observe the change in the space only, never in time, and thinking that changes run in time was never observed and should be taken as an unprovable proposition. That's why we suggest a model which stipulates the fact that changes run only in space. In this model time is the duration of changes that the observer is measuring with the clock. We must ask: Is the duration existing before being measured? The answer is the following: we observe in the universe only the flow of changes, not their duration. Duration enters existence after the given flow of changes is compared with the other flow of changes. Clocks are mechanisms that we use for a general comparison of all changes. Clocks run only in space and do not measure some general cosmological time that is non-existent, a pure theoretical unproven proposition. Time as duration enters existence when measured by the observer. This confirms that the universe is utterly timeless, there is no trace of time in physical reality. Entropy increases only in space. There is no such thing in the universe as a "thermodynamic arrow of time". Time has no arrow and is not pointing anywhere. The flow of changes is irreversible, change 2 is after change 1, and change 3 is after change 2. We are interpreting change 1 as the cause of change 2 but this is only our interpretation, an unprovable idea. In the universe, we can only observe the flow of change that runs in space.

Universal space is time-invariant in the sense that time is not its 4th dimension, and that time does not exist in space as a kind of real physical quantity [1]. Equipped with this understanding, the real actual relation between time, causality, and entropy becomes undisputable clear: time-invariant universal space has a so-called "timeless configuration" [2]. The model of time-reversal symmetry (T-symmetry) has no physical correspondence with the physical world. The equation of time symmetry has no physical meaning:

$$T: t \rightarrow -t \quad (1).$$

There is no symmetry in time because there is no negative time $-t$. Elapsed time t is neither positive nor negative. It has an absolute value:

$$t = |t| \quad (2) \quad [3].$$

The increasing entropy in the universe is accepted by mainstream science and it is based on astronomical observations. We propose in this article that entropy does not increase in time because there is no physical time in the universe. In this perspective entropy and time are not physically related. "Thermodynamic arrow of time" is an empty term, time is not pointing anywhere. Also, "cosmological time" is an empty term, because, in the universe, time is not running, only changes are running, and their relative velocity depends on the variable energy density of the superfluid quantum space that is the physical origin of the universal space [4]. In principle, we can use increasing entropy as a clock, and we measure with the increase of entropy the duration of some other change that runs in space, but we must understand that entropy does not increase in time and does not measure some physical time, because physical time does not exist.

In our model, causality is a concept, a model, and time, when measured by the observer, is created by the observer. In this sense makes sense to see time as the discrete entity that measures the numerical order of causality where change X is always before change $X+1$. Time as the numerical order of changes is discrete and the fundamental unit of time is a Planck time. Every elapsed time can be seen as a sum of Planck times:

$$t = t_{P1} + t_{P2} + \dots + t_{PN} = \sum_{i=1}^N t_{Pi} \quad (3) [5].$$

That time is a discrete entity is also suggested by the recent research: With the introduction of causality introduced here, time can only be reconstructed as a discrete entity also yielding other consequences from entropy to the evolution of the universe and many other findings, and thus opening more avenues for investigation. We, therefore, invite the reader to participate in this journey [6].

In recent research, it is suggested that the flow of change and the flow of quanta embodies the flow of time: "It is difficult to break the habit of thinking that time is not a dimension. Still, there is no universal axis along which to organize all events since events occur in relation to an observer. Time is relative. The passage of time that I experience matters to me, the one you sense matters to you. Greenwich Mean Time (GMT) serves to synchronize events globally, but it is just a local convention in the universe. For example, what took place on our neighbouring star, Proxima Centauri, about four years ago, is visible only here today. Time is not just what can be timed, so to speak, operational comparison. A running clock is also a system in a state of imbalance. The ticking is a series of events targeting balance; the flow of quanta embodies the flow of time" [7]. In our model, this is true only in the sense that the so-called "fundamental time" is the numerical order of this flow of quanta that runs in time-invariant universal space. The fundamental unit of the numerical order of quanta flows is a Planck time. The duration of quanta flows, which we call "emergent time", does not exist on its own. Its existence requires measurement from the side of the observer [5].

Our model of time resolves the puzzle of the Einstein-Podolsky-Rosen experiment where the transfer of information between two entangled particles is immediate which is not in accord with the theory of relativity: "In modern language, the Einstein-Podolsky-Rosen paradox, in its most elementary form, is concerned with two entangled particles with opposite spin. We do not know the spins of the individual particles, only that they are both created at time $T1$ with total spin equal to zero; once we measure the spin of one of the particles at time $T2$, we can immediately know the spin of the other particle, even if they are separated by a very large distance. So, it appears as though the influence of the measurement on the first particle instantaneously reaches the second particle, which contradicts the principles of the theory of relativity since such an influence should not be able to travel faster than light" [8]. In the universe, there is no time $T1$ and some other time $T2$, changes run in time-invariant space. Fundamental time is the sequential numerical order of events that run into time-invariant universal space. When event $X+1$ occurs, event X is not in existence anymore. When event $X+2$ occurs, event $X+1$ is not in existence anymore. The only real existent event is the one that we perceive with our senses and measure with instruments. Fundamental time runs without being observed by the

observer. But without the observation and measurement from the side of the observer, the fundamental time has no meaning of its own. The numerical order of events (events are following one after another) makes sense when being observed. When we measure it with the clock, in fact, we get the duration. In our model of relativity, there is no contradiction. The time-invariant universal space is the direct medium of entanglement EPR-type. An entanglement is an event that has no numerical order and so no duration [4].

In our model, the universe is timeless in the sense that it does not run in some physical time, it runs only in the time-invariant space. In our model past and future do not exist eternally as is proposed in a block universe: "Timelessness", as such, is not a new idea. It was proposed in a specific form by Albert Einstein. In a block universe, all of space and time is claimed to exist eternally" [9]. In our model, the universe is timeless in the sense that universal change run in time-invariant space. Albert Einstein has said: "For us believing physicists the distinction between past, present, and future only has the meaning of an illusion, though a persistent one" [10]. Yet even the great Einstein despaired from understanding the flow of time and the meaning of *now*. Einstein's quandary was described by Rudolf Carnap: "Einstein said the problem of the Now worried him seriously. He explained that the experience of the Now means something special for man, something essentially different from the past and the future, but that this important difference does not and cannot occur within physics. That this experience cannot be grasped by science seemed to him a matter of painful but inevitable resignation. So, he concluded that there is something essential about the Now which is just outside the realm of science" [11]. Our proposal for interpretation of Einstein's NOW is that in physics we experience time-invariant space as NOW, where time as duration enters existence when measured by the observer.

Our recent research has shown that space-time model where one can move into future or into past leads to contradiction because the four-vector can be positive or negative and depends on the direction of motion in future or in past:

$$d\tau = \pm\sqrt{dx^\mu dx_\mu} \quad (4).$$

where τ is proper time. The idea of moving into past or into future is questionable because it leads to the logical inconsistency where the sum of positive four-vector and negative four-vector is zero:

$$\sqrt{dx^\mu dx_\mu} + (-\sqrt{dx^\mu dx_\mu}) = 0 \quad (5).$$

This means that the value of the space-time interval in the Minkowski manifold from A to B and back from B to A is zero which seems wrong. In our model the value of the four-vector cannot be positive or negative, it is absolute. A given physical object can move only in space and not in time, you cannot move into the past or into the future. Time travels are categorically excluded [3]. In experimental physics, we daily measure time as the duration. This acknowledgment that duration is the result of the observer's measurement is a necessary step to develop theoretical physics [12]. No measurement means no duration in the universe, only material change and motion exist running in the time-invariant space.

2. Hawking's chronology protection conjecture, time travel, and quantum teleportation

Einstein has brought into science the idea that universal space is four-dimensional, and that its 4th dimension is time. Our rigorous examination has confirmed that universal space might be four or more dimensional, but time is not its physical dimension. Universal space is time-invariant. This time-invariant space is the medium of quantum entanglement EPR-type [1]. Quantum teleportation can happen only in space and not in

time. The idea of quantum teleportation also having a temporal aspect is questionable [13] because it predicts the existence of some physical time for which there is no scientific evidence. In physics, the existence of physical time was and is an unproved proposition. Authors are introducing the term “temporal entanglement” that seems to have no physical reality. Entanglement can only occur in space; we can only think about “spatial entanglement” having in our mind that space is time-invariant.

In physics, we experience the time-invariant property of universal space as NOW. All physical reality that exists is existing in time-invariant superfluid quantum space. All the rest is the illusion that Einstein was talking about. What has happened, we experience as past and what will happen, we experience as future. But past and future both have no physical existence.

In general relativity “closed timeline curves” exist only as a mathematical model that has no actual physical correspondence. Time cannot be curved because it has no physical existence and NASA has measured back in 2014 that universal space has a Euclidean shape [14]. This means that curvature of space in general relativity is the mathematical modelling of gravity that has no actual physical correspondence in the physical world. In general relativity, it is space that is curving because time cannot curve as it has no physical existence. Hawking’s “chronology protection conjecture” is excluding the possibility of the existence of closed timeline curves: “The laws of physics do not allow the appearance of closed timelike curves” [15]. It is shown in this article that also the open timelike curves in general relativity are the mathematical model through which no motion is possible. Not only on the macro level a physical object can move only in space but also on the quantum level a given particle can move only in space: a photon can move in space and time is its duration of motion. The idea that “the photon does not experience time” is extended to the macro level. Also, massive objects do not experience time. Only humans experience time when time is measured by clocks. The universe is utterly timeless, time-invariant.

Closed timelines curves were developed by Kurt Gödel back in 1949 [16]. These closed timelines curves allowed time travel into the past, one could go into the past and kill his grandfather and so his birth becomes impossible. Gödel was aware of this fact, already in 1949. He postulated: “In any universe described by the theory of relativity, time cannot exist” [17]. Although the basic equation of special relativity shows time is not the 4th dimension of space ($X_4 = ict \rightarrow X_4 \neq t$) still today this idea is persisting in scientific thought.

3. Conclusions

Space-time where time is the 4th dimension of space was considered one of the biggest achievements of 20th-century physics. Einstein’s view on space and time seems to have not been well understood until today. Einstein has interwoven space and time into a four-dimensional continuum where space and time are merging. In his view, the 4th dimension of space-time X_4 is not temporal, it is spatial too. This four-dimensional continuum was given an improper name “space-time” which has caused a century-long long misconception. In Einstein’s four-dimensional continuum, time exists only as duration when measured. Time travels are out of the question, one can move only in space and time is the duration of its motion. Motion in time is not possible in closed timelines nor in open timelines. Hawking’s chronology protection conjecture is extended to open timelike curves that have no physical existence, they only exist in a mathematical model.

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