

Neurophysiology of Time

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“Time--the time that we know through clocks and calendars--was invented”. Albert Einstein
<http://www.britannica.com/clockworks/article.html>

Abstract

Research on functional and neural mechanisms of interval timing shows that experience in linear time past-present-future has basis in a neuronal activity of the brain. On the other side we experience motion run in space only and not in time. With clocks we measure duration and numerical order of motion of elementary particles and massive bodies in space. Measuring of motion is directly interconnected with clocks run. Clocks run in space only and not in time. And thus we must assert that the true basis of fundamental reality is space rather than space-time. Space-time is mathematical model merely and physical time is run of clocks in space. Experiencing motion and change in generally in past-present-future perspective is result of neuronal activity of the brain, means of the mind. Time belongs to the mind; universe itself is timeless phenomena with no past and no future as physical realities. Timelessness of the universe we experience as a present moment. Present moment is the only one that exists as a physical reality. Our experience of motion and of material change is always in present moment. Clocks run in the present moment. Past and future belongs to the mind.

Key words: time, timeless, space, duration, numerical order, clocks run, information, mind, observer, neuronal activity

Introduction

Result of research in done in 2005 shows that neuronal activity of the brain is a basis of psychological time “past-present-future” (1). In the universe we observe motion and change that run in space only and not in time. Sense of “being in time” is created in the brain. Space-time cannot be physical reality in which we live. There is no experimental evidence whatsoever to support the view that space-time exists as the basis of fundamental physical reality. We cannot observe space-time directly, nor can we actually observe a world line, or a light cone. We should remember that space-time is an abstraction, a 3+1 dimensional "mathematical space" devised for ease of calculation. In real experiments we observe motion, or the resulting changes, in physical space. Space is the arena in which massive bodies move and particles interact. The motion and change is patently observable, we can literally measure a distance, and we can be utterly confident that space exists. We employ clocks to measure duration and we record a sequencing to the motion and the material changes that occur in space. Here physical time is understood as a clocks run in space. Physical space itself is therefore timeless; physical time is derived from clock motion in timeless space.

Physical Time, Mathematical Time and Psychological Time

In 1908 the English philosopher John McTaggart Ellis said *"It will be convenient to begin our enquiry by asking whether anything existent can possess the characteristic of being in time. I shall endeavour to prove that it cannot"* (2). And yet we still suffer from a conviction that has no supporting evidence whatsoever. As humans we operate using a psychological model of time which involves the past, present, and future. At home in a chair we consider ourselves to be motionless whilst travelling forwards through time. We imagine ourselves to be stationary observers, and we forget that our brains are operating via the motion of electrical signals. We forget that we can only experience our thoughts and produce the elaboration of psychological time because of the internalised motion that drives our consciousness. With practice however, one can gain an awareness of "the flow of thoughts", and thence an awareness of our own internalised motion. We can then liken our brains to clocks, and this new awareness of internal motion supplants the notion of motion through time. We then become conscious of timeless space and its physical existence in this present moment, and see at last that the past and future are block-time abstractions constructed by our brains.

The thing we call physical time is a measure of the motion of clocks. Mathematical time is the symbol t in equations, representing the measure we call duration and the sequencing of motion. Symbol t represents duration and numerical order of events in timeless space. Smallest unit of time is Planck time. In Planck time photon pass Planck distance of timeless space.

Temporal and Atemporal Experience of Motion

Motion occurs in timeless space. We experience it through psychological time, wherein information concerning motion enters the eyes, and is then is elaborated by the brain to become part of our experience. This involves a re-interpretation of the original information, distorting it, and interfering with perception. However once we become aware of psychological time, we can experience motion directly as it occurs. This direct experience gives the scientist an objective view of the timeless nature of the physical world, and in my view is essential for the further development of physics. It can be achieved with something as simple as a pendulum. Observe a pendulum, and for the first few minutes you will experience the pendulum moving in space and time. Close your eyes to envisage an image of the pendulum moving in your mind's eye, and you then become aware of the psychological time in which you experience pendulum motion.

Observer is consistent part of scientific experiment. In temporal experience observer is captured in psychological time. In atemporal experience observer is fully aware of psychological time and experiences motion directly (3, 4).

TEMPORAL INDIRECT EXPERIENCE

motion – perception - elaboration (in psychological time) - temporal experience of the observer

ATEMPORAL DIRECT EXPERIENCE

motion - perception (eyes) - atemporal experience of the observer

Another paper on arXiv examining arrow of time says: *In the concluding section 7.1., we translate the consequence of our interpretation in a less technical language. That "Time" is related to our perception process, and conscience could be responsible for the collapse of the wave function, are not new ideas. Only now they have reached the responsible maturity, being ready to receive a satisfactory scientific formulation. As a "confirmation" of the present author's views exposed in (28), an idea starts to spread (12): "It is not reality that has a time flow, but our very approximate knowledge of reality. Time is the effect of our ignorance" (5).*

Here we confirm that the time we experience in physics today is intimately related to our perception process. Observation of motion remains ensnared in psychological time. Experiencing in linear time is the result of not clearly distinguishing between physical, mathematical and psychological time. Once observer is aware of psychological time he experiences run of clocks and motion directly as they run in timeless space.

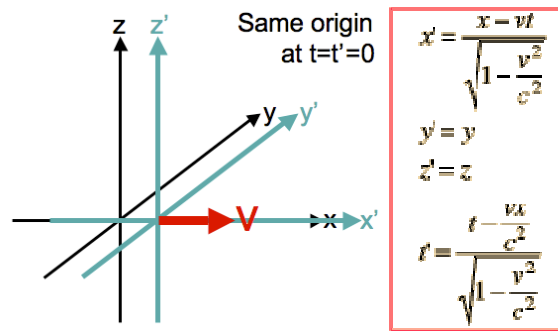
Discussion

A growing number of modern researchers are challenging the view that space-time is the fundamental arena of the universe. They point out that it does not correspond to physical reality, and propose "timeless space" as the arena instead. One recent paper on the subject is *A New Geometric Framework for the Foundations of Quantum Theory and the Role Played by Gravity* (6). Another recent paper says *"We illustrate our proposal using a toy model where we show how the Lorentzian signature and Nordstroem gravity (a diffeomorphisms invariant scalar gravity theory) can emerge from a timeless non-dynamical space"* (7). Julian Barbour says in *The Nature of Time: "I will not claim that time can be definitely banished from physics; the universe might be infinite, and black holes present some problems for the time picture. Nevertheless, I think it is entirely possible, indeed likely, that time as such plays no role in the universe"* (8). Such challenges are nothing new, and go back as far as Aristotle. Even Ernst Mach said: *"It is utterly beyond our power to measure the changes of things by time. Quite the contrary, time is an abstraction, at which we arrive by means of the changes of things"*. Time and clocks are man-made inventions. Motion is primary, time is secondary. Time is an artifice of measurement, a useful tool that permits us to build mental and mathematical models for our daily lives as well as for our physics and cosmology. But time as a fundamental entity has no role in physics.

Relativity and Time

With a concept of time cofounded with motion rather than space, a new interpretation of relativity emerges. In the Special Theory of Relativity, the rate of clocks and material change is reduced within a fast-moving inertial system. In the General Theory of Relativity, the rate of clocks and material change is similarly reduced within a gravity well. This understanding easily resolves the so-called Twins Paradox. The twins do not live in time, they live in space. They are made up of atoms and electrons, and as evidenced by pair production and annihilation, they are quite literally "made of light". Each twin might observe reduced local motion in his brother and so reduced ageing, but the twin in the spaceship returns younger than his brother on Earth because his

travelling motion through the universe was at the cost of local motion within his body. His reduced rate of local motion was labelled as time dilation, but time is merely a by-product of motion. Clocks run in space only and not in time. Elapsed time t is a measure of cumulative local motion, and a Lorentz transformation merely describes how t and t' as measured within inertial systems A and A' are relative to their motion through space:



Minkowski space-time is a mathematical abstraction derived from this motion. The motion is not through space-time, and not through time. It is through space, and space itself is timeless. Twins are getting older on space only and with clocks we measure speed of their aging. Travelling into past is out of question. Past exists only as a memory in the mind. One can travel in space only and not in time. With clocks we measure duration of their travelling.

Direct Quantum Information

Some research indicates that timeless quantum communication is a real phenomenon: *“We show how continuous-variable systems can allow the direct communication of messages with an acceptable degree of privacy. This is possible by combining a suitable phase-space encoding of the plain message with real-time checks of the quantum communication channel. The resulting protocol works properly when a small amount of noise affects the quantum channel. If this noise is non-tolerable, the protocol stops leaving a limited amount of information to a potential eavesdropper”* (9).

Here it is considered that information does not move through space-time, but instead moves through space, an immediate medium for identifiable quanta. This is echoed by the concept of a photon as a particle which “experiences no time”, long-wave radio reminding us that a photon is an extended entity perhaps 1500m long rather than a point particle. The EPR experiment similarly reminds us that physical space is a timeless environment. There is no discernible signal in the form of a photon travelling between A and B. The time of information transfer between A and B is essentially zero, and we might infer that A and B are similar extended entities which experience no time (10).

Causality problems for Fermi’s two-atom system

Physical space as an “immediate information medium” resolves the causality problem of Fermi two-atom system: *“Let A and B be two atoms or, more generally, a ‘source’ and a ‘detector’ separated by some distance R. At $t=0$ A is in an excited state, B in its*

ground state, and no photons are present. A theorem is proved that in contrast to Einstein causality and finite signal velocity, the excitation probability of B is non-zero immediately after $t=0$. Implications are discussed" (11). The excitation probability of B is non-zero because the space in which atoms exists is an "immediate medium of excitation". There is no time needed for information or excitation to transfer from A to B. Since instantaneous action at a distance remains an uncomfortable concept, we might again infer that A and B are extended entities which experience no time.

Timeless Physical Phenomena

From the above in conjunction with the second approach to time, certain physical phenomena might be said to be timeless, wherein no measurable time can be said to have elapsed. For example within *Attosecond Ionization and Tunneling Delay Time Measurements in Helium* by Eckle et al, a conclusion is drawn wherein "an electron can tunnel through the potential barrier of a He atom in practically no time" (12).

In similar vein a recent arxiv paper depicts a system of diagrams to represent the various elements of a quantum circuit, in a form which makes no reference to time (13).

According to loop quantum gravity, space itself consists of quanta (14). The perspective gained here is that quantum space itself is timeless and energy/information (I/E) is directly transferred between spatial quanta whose size is governed by the Planck length. According to this interpretation, the time t of direct transfer between quanta is zero, velocity v is infinite. On the other hand, the time t of indirect quantum energy/information transfer via photons is non-zero, whilst velocity v is light speed.

$(I),(E) \xrightarrow{\text{transfer}} 10^{-35} \rightarrow t = 0, v = \infty$ immediate (timeless) transfer

$(I),(E) \xrightarrow{\text{transfer}} \triangleright 10^{-35} \rightarrow t \triangleright 0, v = c$ temporal transfer

Conclusion

When physical objects move, they move through space, not through space-time, and not through time. Time is derived from this motion through space, and space itself is timeless. Whilst the speed of light is considered to be a maximum rate of motion, at the Planck level energy and information transfers appear to be timeless. Clocks are macroscopic measuring devices which accumulate local internal motion, and we can record a sequencing of that motion and the changes that occur in space. But we can find no evidence to support the existence of space-time as a fundamental entity. Accordingly we must conclude that we live in a timeless universe of space and motion, where the past and future only exist in the human mind. Linear time has its origin in the neuronal activity of the brain, present moment has physical origin, past and future belongs to the mind.

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