

The “Measurement Problem” in Quantum Physics can be partly resolved with Analysis of Relatedness between Space-time, Physical Time and Psychological Time

Amrit Sorli
Scientific Research Centre BISTRA
sorli.bistra@gmail.com

Abstract

Clocks are systems for measuring frequency, velocity, duration and numerical order $t_0, t_1, t_2, \dots, t_n$ of physical events. Time t obtained with clocks is not a fourth dimension X_4 of space, time t is only a component of $X_4 = i * c * t$. This view of clock/time as a measuring system sees physical phenomena running exclusively in space and not in time. This view is supported with several experiments which confirm that time t of physical event can be zero. Time is not part of space; time is run of clocks in space. Past, present and future exist as a psychological time in the mind only not in the universe. We experience motion i.e. change in the space through the frame of psychological time. We “project” linear psychological time “past-present-future” into the space, however it is not there. Observer who distinguishes between space-time, physical time and psychological time is aware that in quantum measurement he only measures physical events in space and not in time. Clock/time is merely a measuring device. With this understanding observer’s observation, measurement and experience of quantum phenomena are closer to their real nature. Stream of numerical order of quantum phenomena $t_0, t_1, t_2, \dots, t_n$ runs in space only and not in time. Stream of quantum phenomena has no duration on its own. Duration is result of measurement.

Key words: time, space, space-time, run of clocks, numerical order, frequency, velocity, duration, psychological time, observer, quantum phenomena, measurement problem

Introduction

Time t is not an independent dimension of space-time. Time t is only a component of X_4 that is not temporal, it is spatial too. In physics the spatial distance d is a product of velocity v and time t : $d = v * t$. Mathematical formalism $X_4 = i * c * t$ confirms that the fourth coordinate X_4 is spatial too. In Special Theory of Relativity time t obtained by clocks is only a component of $X_4 = i * c * t$. Planck time t_p is the basic

unity for measuring frequency, velocity, duration and numerical order of physical events. Planck time is calculated: $t_p = \frac{c}{l_p}$, where l_p is the Planck distance:

$l_p = \sqrt{\frac{\hbar G}{c^3}} \approx 1.616252(81) \times 10^{-35}$ meters, G is the gravitational constant and \hbar is the reduced Planck constant. Planck time as a basic unit for measuring material change is not a part of space. The clock/time run is a reference system to measure physical events, i.e. material change running in space (1).

That time is not part of space is discussed in recent research: The fact that imaginary numbers appear when computing space-time intervals and path integrals does not facilitate that when multiplied by i , than 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 the time intervals. What this illustrates is that although space and time are interwoven in Minkowski space-time, and time is a 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 how microscopic, there would appear to be inherent continuity i.e. interval of time (2). Space and time are interwoven in a sense that time t obtained with clocks is a component of fourth dimension of space X^4 . Time is always time and space is always space in a sense that time is run of clocks in space. Interval of time t we obtain with a clock. There is no time in space behind a clock run. Space is timeless, universe is timeless.

Physical time as a run of clocks resolves ancient problems on time and motion

According to the "time is run of clocks in space" Achilles surpasses Tortoise in space only and not in time. Clock/time is a measure of speeds of Achilles and Tortoise. 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 10 seconds. Achilles has passed 10 meters, his speed is $v = 1ms^{-1}$. Tortoise has passed 1 meter, its speed is $v = 0,1ms^{-1}$. At the starting points the distance d between Achilles and Tortoise was 9 meters. Achilles and Tortoise they both move in space only and not in time. Clock/time is a measuring

device for their motion.

Zeno's arrow is not moving from the past, being still in the present and moving on into the future. Zeno's arrow is moving in space only and not in time. Clock/time is a measuring device for arrow motion.

Time travel into past is not possible. One can travel in space only. Twin living on the moon is getting older faster than his twin-brother on the earth because speed of material and biological change is faster on the moon than on the Earth. Both twins are getting older in space only and not in time. With clocks we measure speed of their biological change that depends on the strength of gravity in a given volume of space.

Physical time as a run of clocks resolves puzzle of immediate physical events

For certain physical phenomena clock/time is zero, since no measurable time elapses for them to happen. For example in the article *Attosecond Ionization and Tunneling Delay Time Measurements in Helium* by Eckle et al., a conclusion is drawn that "an electron can tunnel through the potential barrier of a He atom in practically no time" (3).

Also in EPR experiment the elapsed time for quantum entanglement is zero. EPR does not happen in space and time, EPR happens in space only. Here space in which particles exist is being considered as a direct information medium between entangled quanta (4).

The space as an "immediate information medium" resolves the causality problem of the 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's causality and finite signal velocity, the excitation probability of B is non-zero immediately after $t=0$. Implications are discussed" (5). The excitation probability of B is non-zero because the space in which atoms exist is an "immediate medium of excitation".

At the Planck scale information and end energy (IE) transfer in space are immediate. Elapsed time for them to happen is zero. At the photon scale information and end energy transfer in space are happening with the light speed. Elapsed time t for them to happen is more than zero. At the scale bigger than photon information and end energy transfer in space have a speed lower than light speed. Elapsed time

t for them to happen is more than zero.

(IE)transfer → *PlanckSc* → $t = 0$ → $v = 0$ *space is immediate (IE) transfer medium*

(IE)transfer → *PhotonSc* → $t > 0$ → $v = c$ *photon moves into space*

(IE)transfer → *Scale* > *photon* → $t > 0$ → $v < c$ *particle moves into space*

Why we experience material change i.e. motion in space in time?

Recent neurological research shows that psychological time “past-present-future” is a result of neuronal dynamics of the brain. Through the psychological time we experience motion in space that itself is timeless.

“Time is a fundamental dimension of life. It is crucial for decisions about quantity, speed of movement and rate of return, as well as for motor control in walking, speech, playing or appreciating music, and participating in sports. 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 (6).

Linear time “past-present-future” is psychological time. Physical time is run of clocks in a space. In space “before” and “after” exist only as a numerical order of physical events $t_0, t_1, t_2, \dots, t_n$ that we measure with clocks. Material change i.e. motion that we experience through psychological time happens in space that is timeless; past, present and future do not exist in space. There is no physical time existing in space behind run of clocks. Time as a run of clocks in space implies that the duration of a material change has no existence on its own. Duration of material change i.e. motion from the Planck scale to the galaxy is result of measurement with clocks.

Conclusions

In space “before” and “after” exist only as a numerical order of physical events $t_0, t_1, t_2, \dots, t_n$ that we measure with clocks. Material change i.e. motion we experience through psychological time “past-present-future”. Run of clocks synchronizes run of

psychological time with run of material change quantum phenomena including.

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