

Exact Solution for Time and Entanglement in UDE Cosmology

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Abstract: The idea that time has its origin in entanglement is based on the preposition that “internal observer”, “external observer”, “coordinate time”, and “proper time” are theoretical models of the world which have a counterpart in the physical universe. Bijective epistemology based on the bijective function of set theory confirms that these models have no counterpart in physical universe; they are pure theoretical inventions on which we cannot build a consistent scientific theory. The idea that time could have its origin in entanglement does not have enough theoretical and experimental basis to be taken seriously as an adequate model of the physical world.

Keywords: Time, Entanglement, Space-Time, Special Relativity, GPS System, Presentism, Cosmology

1. Introduction

In Special Relativity (SR) we have a famous example of a train passing by the station. We have two observers, observer 1 is on the station, observer 2 is on the train. When the train is passing by the station both observers adjust their clocks. A common interpretation is that clock 2 will run slower for observer 1 and clock 1 will run faster for observer 2. In this case observer 1 is “external observer” for the clock 2, and observer 2 is “external observer” for the clock 1. Both observers move in “coordinate time”, but each in their own inertial system is running in his own “proper time”, and both proper times are not mutually valid for both observers. Clock 2 runs slower only for the observer 1 and clock 1 runs faster only for the observer 2.

This common interpretation in SR is not confirmed by the GPS system, which confirms that clocks run slower on the satellites (because of the SR effect), compared to the clocks on Earth for all observers independently, may they be on the Earth's surface, on a flying airplane, in a car, on a boat, or on the satellite.

In the GPS system the satellite clocks run slower because of SR effect for 7 microseconds a day, and because of GR effect they run faster for 45 microseconds a day. The combination of these two relativistic effects means that the clocks on-board each satellite should tick faster than identical clocks on the ground by about 38 microseconds per day (45-

7=38)! This looks small, but the high precision required from the GPS system means that nanosecond accuracy is necessary, and 38 microseconds is 38,000 nanoseconds [1].

This experimental fact of GPS which we use in our daily life puts under question the existence of theoretical models “internal observer”, “external observer”, “coordinate time”, “proper time”.

2. Bijective Epistemology, Internal Observer, External Observer, Coordinate Time and Proper Time

An observer in physical universe perceives five fundamental elements: space, energy, matter, changes and time. In order to build an adequate fundamental model of the universe, the observer uses a bijective function of the set theory, where each observed element in the universe set X corresponds exactly to one element in the model of the universe set Y :

$$X : \{O_x, C_x, T_x, M_x, E_x, S_x\}$$

$$Y : \{O_y, C_y, T_y, M_y, E_y, S_y\}$$

O_x - observer (which observes other 5 elements), C_x - change, T_x - time, M_x - matter, E_x - energy, S_x - space

O_y - model of the observer, C_y - model of change, T_y - model of time, M_y - model of matter, E_y - model of energy, S_y - model of space [2].

According to the bijective epistemology, the observer and time as elements of “set model” Y have “bijective correspondence” in the “set universe” X , which means that elements “observer” and “time” of theoretical model correspond exactly to the observer and time in a real universe. Bijective epistemology in accordance with experimental data of the GPS system does not predict existence of an “internal observer”, existence of an “external observer”, existence of a “coordinate time” and “proper time”. These terms are epistemologically “empty”, it seems they do not have counterpart in physical universe, and on them a theoretical model, which would correspond to physical reality, cannot be built.

Moreva and others published a paper with a proposal that time has origin in quantum entanglement. This proposal is built on the preposition that “internal observer”, “external observer”, “coordinate time” and “proper time” have existence in real universe:

“The ‘problem of time’ [2–6] in essence stems from the fact that a canonical quantization of general relativity yields the Wheeler-De Witt equation [7, 8] predicting a static state of the universe, contrary to obvious everyday evidence. A solution was proposed by Page and Wootters [9, 10]: thanks to quantum entanglement, a static system may describe an evolving ‘universe’ from the point of view of the internal observers. Energy-entanglement between a ‘clock’ system and the rest of the universe can yield a stationary state for an (hypothetical) external observer that is able to test the entanglement vs. abstract coordinate time. The same state will be, instead, evolving for internal observers that test the correlations between the clock and the rest [9–14]. Thus, time would be an emergent property of subsystems of the universe deriving from their entangled nature: an extremely elegant but controversial idea [2, 15]. Here we want to demystify it by showing experimentally that it can be naturally embedded into (small) subsystems of the universe, where Page and Wootters’ mechanism (and Gambini et al. subsequent refinements [12, 16]) can be easily studied. We show how a static, entangled state of two photons can be seen as evolving by an observer that uses one of the two photons as a clock to gauge the time-evolution of the other photon. However, an external observer can show that the global entangled state does not evolve” [3].

In this paper will be shown that the idea of time emerging from quantum entanglement does not have enough theoretical background to be seriously taken in consideration as a promising theory which can enrich physics.

3. Time, Space-Time and Entanglement

In Special Relativity the forth coordinate X_4 named “temporal coordinate” is written by formalism (1) below.

$$X_4 = ict \quad (1)$$

Formalism (1) confirms that fourth coordinate X_4 of Minkowski manifold is not time t :

$$X_4 \neq t \quad (2)$$

In formalism (1) time t is merely numerical order of photon motion in space. X_4 is a product of speed of light c , time t and imaginary number i , means X_4 is a spatial distance. Minkowski manifold is not 3D + T, it is 4D. Interpretation of time as being a 4th dimension of a space-time model and consequently a 4th dimension of universal space is a misunderstanding of physics of 20th century.

Results of recent research confirms that clocks run only in space and not in time, time is merely a numerical order of material changes, i.e. motion which runs in space. Fundamental time is a numerical order of material changes which run in space. Measurement of fundamental time by the observer gives existence to duration, which is emergent time. There is no duration without a measurement of the observer [4].

Experimental data confirms that entanglement is an immediate phenomenon which has no numerical order, and therefore no time. Time is a characteristic for phenomena which have certain numerical order as for example motion of photon in space. Each Planck distance passed by photon corresponds exactly one Planck time. The sum of Planck times is the duration of the photon from the point A to the point B in the space as is shown in formalism (3):

$$t = t_{P1} + t_{P2} \dots + t_{PN} = \sum_{i=1}^N t_{Pi} \quad (3) [4]$$

Moreover, by taking into account that existence of duration of physical events requires measurement of the observer, one can speculate that there are two understandings of time:

- Time measured with clocks is a numerical order of change which has only a mathematical existence;
- Duration of a given material change requires measurement of the observer.

These two understandings bridge Rovelli’s, Barbour’s, Elze’s, Chiou’s, Palmer’s, Girelli’s, Liberati’s and Sindoni’s, Caticha’s and Prati’s views. They point out that in physics we have two kinds of times:

1 *Fundamental time* which is the numerical order of change and exists independently of the observer.

2 *Emergent time* which is a duration of material change and originates from observer’s measurement [4].

In cosmological model UDE mathematical universe as a non local phenomenon is an immediate medium between entangled quanta [5].

observer - non local and timeless	mathematical universe - non local and timeless
quantum vacuum - local and temporal	photon - local and temporal
elementary particles - local and temporal	massive bodies - local and temporal

Figure 1. Structure of the universe [5].

Cosmological model UDE have two types of phenomena: immediate phenomena for example gravity and entanglement. Temporal phenomena for example motion of particles and massive bodies. The main difference between immediate phenomena and temporal phenomena is that immediate phenomena are non local and temporal phenomena are local [5]. The only common thing of time as numerical order of changes and entanglement is that they both have existence in mathematical universe which governs physical universe and is non local phenomena. The idea that time could have its origin in entanglement as suggested by Moreva and others seems not exact. More appropriate is to say that time and entanglement have common basis in non local mathematical universe.

Interpretation of entanglement presented in this article does not require existence of local “hidden variables” [6]. Recent research confirms that entanglement is immediate and that light could not be a carrier of information between entangled particles [7]. These results are in tune with model of entanglement where carrier of immediate information transfer between entangled particles is non local mathematical universe.

4. Einstein’s Now, Presentism and Special Relativity

Research done by the English philosopher John Ellis McTaggart shows that nothing can happen in time. At the beginning of the twentieth century McTaggart discussed that time is not a physical reality in which things exist: “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” [8].

Also the research by Kurt Gödel confirms that time is not a physical reality in which universe exists. By 1949, Gödel had produced a remarkable proof: “In any universe described by the Theory of Relativity, time cannot exist” [9].

Einstein himself did not consider that space-time has an independent physical existence: “Space-time does not claim existence on its own but is only a structural quality of the [gravitational] field” [10]. Einstein once remarked that:... [prior geometry] is build on the a priori, Euclidean four

dimensional space, the belief in which amounts to something like a superstition”. His opinion was that: “...time and space are only models by which we think and not conditions in which we live” [10]. For Einstein time did not have a physical existence: “... there is something essential about the NOW which is just outside the realm of science. People like us, who believe in physics, know that the distinction between the past, present and future is only a stubbornly persistent illusion” [11].

Bijjective epistemology confirms space-time has no physical existence, and time is only a mathematical parameter of motion in space, which originates from the interaction with the quantum vacuum fluctuations [2]. This view is bringing Einstein’s NOW in the realm of physics, namely in quantum vacuum (from which universal space originates) is always NOW. Past, present and future belong to the psychological time, in which we experience the flow of material changes running in NOW [11]. NOW is everlasting, it is eternity itself. World known spiritual master Eckhart Tolle is perfectly right, saying that only “present moment” exists. Universal changes run in this present moment which is eternity itself.

This model of everlasting NOW has the power to reconcile presentism with relativity theory. Reconciliation of presentism and relativity is proposed by William Craig and criticised by Yuri Balashov and Michel Janssen: »Presentism is, roughly, the view that only the present exists. The advocate of this doctrine is therefore committed to there being a fact to the matter of what events on Pluto are present (hence real) when John snaps his fingers here on Earth. Special Relativity (SR) denies that there are any such facts. Craig contends that facts about absolute simultaneity and the absolute present have a place in SR after all, provided this theory is given a suitable, “neo-Lorentzian” re-interpretation, and argues that this re-interpretation is physically acceptable, as well as metaphysically preferable to the standard formulation. Unlike some other A-theorists who tend to ignore, evade, or table the relativistic objection, Craig confronts it head-on. We believe his arguments all fail, but it is not entirely trivial to see why they fail” [12].

A model of quantum vacuum which is NOW allows the existence of absolute present and absolute simultaneity. In chapter 3 it is shown that quantum vacuum is an immediate medium of quantum entanglement. As we have seen in chapter 3, in SR the 4th coordinate is not temporal, it is spatial too. Considering time a 4th dimension of space is a misconception according to which two phenomena are physically distant in space and time. In quantum vacuum which is NOW, two phenomena are physically distant only in space. Time is a numerical order of material change, i.e. a motion which runs in quantum vacuum. In physical world »past«, »present« and »future« have only a mathematical existence. Craig is right, absolute simultaneity and the absolute present have a place in SR and also in entire physics.

At the beginning of 20th century it was discovered that light has a constant speed regardless you move towards the source of light or away from it. This was not possible to describe in a frame of Newtonian physics. To describe mathematically

constancy of light Einstein has used Minkowski manifold where we have “time dilation”, “length” contraction, “coordinate time”, “proper time”, “internal observer” and “external observer”. Minkowski manifold was successful in description of light constancy speed but has brought also contradictions. Let's have two photon clocks in a given fast moving reference system as presented on figure below:

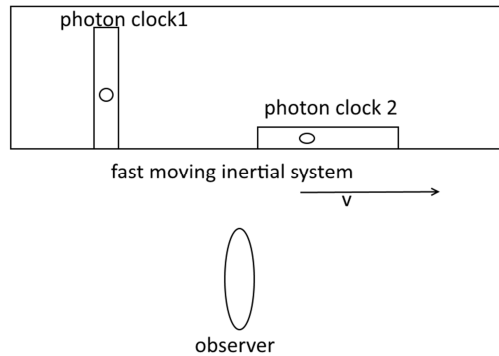


Figure 2. Photon clocks in a fast moving inertial system and external rest observer

Photon clocks have identical length. First clock is positioned vertically second clock is positioned horizontally along the inertial system of motion. For an external observer at rest horizontally positioned clock will shrink (“because of length contraction”) and will have a faster rate than a vertically positioned photon clock. This is in contradiction with SR where in a given inertial system all clocks should have the same rate. We solve this contradiction introducing in Special Relativity a 3D Euclidean space where we use Galilean transformation for spatial coordinates X, Y and Z and Selleri transformation for time t, where time t means numerical order of material changes, in particular photon motion in space. In our model of SR there is no “time dilation” and no “length contraction”. What is “relative” is not time in which it changes. “Relative” are velocity of changes and rate of clocks which run in quantum vacuum which is always NOW [13].

Common idea of SR interpretation, namely that position of an observer can influence rate of clocks is not right. In every text book of Special Relativity you can see a picture how an external observer at rest will see a vertically positioned photon clock in a passing inertial system as you see on figure below:

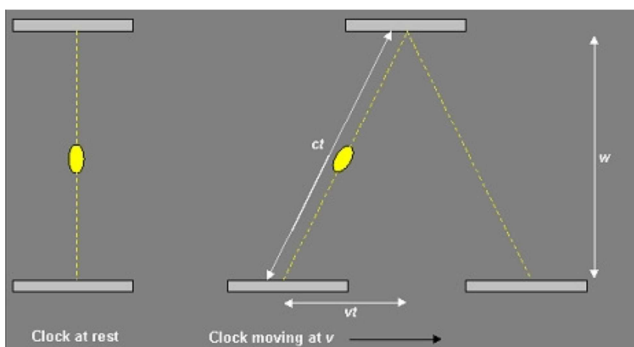


Figure 3. Photon clock seen for an external observer.

The common interpretation is that for the observer at rest moving clock will have a slower rate because photon has a longer path between mirrors than by the rest clock. This is not true. Observer sees moving clock as it is shown on the figure 3, but because of this “optical illusion” clock rate will not change. The length of both clocks is the same and so rate of clocks should be the same. Prolonged length of photon motion in a moving clock is optical illusion of the observer which cannot change rate of the clock. This is not in accord with the common sense of physics. In cosmological model UDE relative velocity of material changes and clocks rate in generally depend only from the density of quantum vacuum. Because of its kinetic energy moving inertial system is additionally diminishing density of quantum vacuum what causes that clocks have slower rate. In GPS we call this phenomenon as “diminishing of clocks rate because of SR effect” as we have seen in chapter 1. For still observer moving light clock will have a slower rate as the clock because in fast moving inertial system is additionally diminishing energy density of quantum vacuum which causes that velocity of light is minimally diminishing. This minimal diminishing of light speed caused by lower energy density of quantum vacuum will be presented in chapter 5.

5. Einstein's Now, Gravitational Time Dilation and Shapiro Experiment

In physics term “gravitational time dilation” means that in stronger gravity 4th coordinate of space-time is dilated and because of this clocks run slower in the area where gravity is stronger. GPS confirms rate of clocks is slower in stronger gravity [1]. Shapiro has measured that speed of light is minimally smaller in stronger gravity than in interstellar space [14]. Shapiro experiment was explained as following: in stronger gravity 4th coordinate of space-time is dilating and so light has a bit longer path and needs more time. That's why they associate results of Shapiro experiment with term “gravitational time dilation”.

In cosmological model UDE model light moves only in quantum vacuum (not in time) where time is only a numerical order of light motion. Quantum vacuum is a kind of “super fluid”. What really happened in Shapiro experiment is that factually light diminishes its speed because density of quantum vacuum is decreasing. We know in physics that speed of sound increases in materials which have higher density. Our explanation is that in Shapiro experiment light speed decreases minimally, because of decreasing of quantum vacuum density. This is in accord with first postulate of Special Relativity according to which light has a constant speed in all inertial systems: also in Shapiro experiment light has a constant speed in all inertial systems, because light is a wave of quantum vacuum in which all inertial systems including light source are moving, just light speed has diminished because density of quantum vacuum has diminished.

Every particle, massive body and moving inertial system

diminishes the local energy density of quantum vacuum in accordance with the amount of its energy. The diminished energy density of quantum vacuum (in which is always NOW) diminishes relative velocity of material changes in generally, rate of clocks included [15]. In diminished energy density of quantum vacuum also velocity of light diminishes minimally.

A model of quantum vacuum which is always NOW explains clearly the “twin brother paradox” and “time travel paradox”. The twin brother on a superfast spaceship is aging slower than his brother on the Earth because the relativistic mass of his spaceship is additionally diminishing the energy density of quantum vacuum and so velocity of material and biological changes is slower than on the Earth, where the energy density of quantum vacuum is higher and velocity of material and biological changes is higher too. Twins age in quantum vacuum only and not in time which is merely numerical order of their aging. Time travel in past or future are categorically excluded. One can travel in quantum vacuum only and time is a numerical order of his motion. When he measures his motion with clocks he will get duration.

6. Einstein's Now and Triangle of Creativity

In physics it is important that we distinguish between a model of a given phenomena which we search on and phenomena itself. Einstein's idea was that each element in the model of the universe should corresponding exactly one physical element in the universe. When the observer is trained properly, he has clear inner vision and he distinguishes between physical phenomenon and its mathematical description. Observer, a model of phenomenon and corresponding phenomenon in physical world are building so called “Triangle of creativity”.

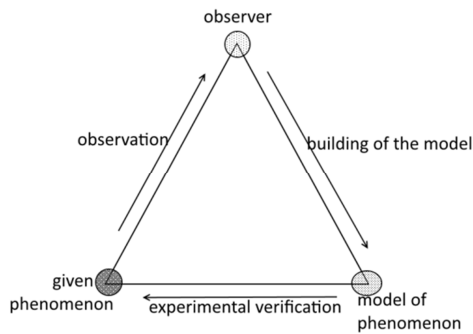


Figure 4. Triangle of creativity.

Ordinary exploration in physics is processed in the model of linear time “past-present-future” which is the psychological structure through which ordinary observer perceives and experiences a model of phenomenon and co-respective physical phenomenon in exploration. Extraordinary process of exploration is when observer discovers his inner psychological time and he sees the whole situation in NOW which allows him to see observed phenomenon and its model in a new fresh vision which

reaches beyond duality “subject-object”. Often result is the insight about shortcomings of existing model of phenomena under consideration. The insight provides rearrangement of the model which than presents phenomenon in a clear light which offers deeper understanding.

Classical example is searching for gravitational waves for 30 years without success. The model of gravitational waves is theoretical failure build on a-priory preposition that gravity is carried by some particle named “graviton” which moves in space and time with the light speed. Once we understand that universe is NOW, it is clear that gravity is immediate; it has no numerical order which is time. Gravity has origin in variable energy density of quantum vacuum in which particles and massive bodies move. Numerical order of their motion is time. After 30 years of searching, finally physics has acknowledged gravitational waves research has failed; there is no trace of hypothetical gravitational waves. They could save time and money by recognizing at the very beginning that gravity cannot be transported by some particle, because gravity is immediate. In Newton formalism for gravity there is no symbol for time t . Gravity as well as entanglement does not have a numerical order [5].

Other example is the idea that some hypothetical field (named “Higgs field”) could be origin of mass without considering that already Einstein discovered indivisibility of inertial mass and gravitational mass. We cannot search for origin of mass separately from origin of gravity. Our research confirms inertial mass and gravitational mass both have origin in variable energy density of quantum vacuum [5].

7. The End of the Myth of Time Reversal Symmetry

In today physics time reversal symmetry means following: “Before we go any further, it's important to get a clear idea of what time reversal symmetry really means. At the simplest level, we may think of the laws of physics as equations involving a time variable t , and say that they are symmetric under time reversal if given any solution, and making the substitution $t \rightarrow -t$, we obtain another solution” [16].

Time reversal symmetry implies that time t can be positive or negative and that physical changes can run backward in time. Our research confirms that time is merely a numerical order of changes which run in quantum vacuum. Changes do not run in time, their run in quantum vacuum only; this means the end of a concept of time reversal symmetry. From this point of view also Feynman's interpretation of positron as an electron which moves backward in time appears non adequate [11]. No particle can move backward in time because time is merely a numerical order of its motion in quantum vacuum. There is no such a phenomena in the universe as time reversal symmetry. Time symmetry is a wrong concept which has led to the idea of »time arrow« which is epistemologically an »empty« concept in the sense that there is no »arrow of time« in physical universe which exists in NOW.

“Energy symmetry” indeed exists. In physics equations describe symmetric energy transfers in physical universe.

The amount of the energy on the left side of equation is always the same as on the right side of the equation. Our recent research shows there is symmetry between energy, mass and energy density of quantum vacuum:

$$E = m \cdot c^2 = \Delta E_{qv} = (\rho_{PE} - \rho_{qvE}) \cdot V \quad (4)$$

This fundamental symmetry of the universe is the origin of inertial mass and gravitational mass [5].

8. Conclusions

Physicists of 20th century did not take in account Mc Taggart, Gödel and Einstein discovery that time does not have a physical existence. Common belief was that the model of space-time where time is a 4th physical dimension of space has a counterpart in physical universe. Bijective epistemology analysis shows that theoretical models of “space-time” “internal observer”, “external observer”, “coordinate time” and “proper time” have no counterpart in physical world. Material changes run in quantum vacuum only and not in time. Time is a mathematical parameter of material changes and is existing only in mathematical universe which is an immediate information medium between entangled particles.

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