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Two-Dimensional Time, Energy as A Dimension, and Speculations on The Nature of Time

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ABSTRACT

It is known that time with two or more dimensions leads to causal paradoxes and closed time like curves and the possibility of time travel. Itzhak Bars in his theory keeps two-time physics, but mathematically dismisses causal paradox and negative probability, that arise naturally when you have time with two dimensions. I present experimental evidence of negative probability, which supports the possibility that time may really have two or more dimensions, and shows that Itzhak Bars is wrong. Then I consider if energy has a dimension as time has dimensions, uniting time with energy, as part of a dimension. There follows after this speculations on the nature of time, followed by a paper that suggests there are two flows of time, one into the past, and one into the future. This supports my own and Takaaki Musha's hypothesis that there are two flows of time, and supports Takaaki Musha's model of the universe having two-time flows.

Keywords: negative probability; dimension; causal paradox; temporal phenomena.

INTRODUCTION

Its known that time with two or more dimensions leads to causal paradoxes and the possibility of time travel. That's why most physicists are afraid of considering time with extra dimensions. Professor Itzhak Bars, keeps two-time physics, while mathematically getting rid of causal paradoxes and ghosts (negative probability), that appear if one has time with two dimensions. I present evidence where negative probability has been shown to exist in experiments, which shows that Itzhak Bars is wrong. And implies that time may really have two or more dimensions and that nature may allow for the existence of time travel and causal paradoxes.

One then considers if energy has 5 dimensions, and if time has an energy, that time would be regarded as a geometrical quantity, intimately connected to the very geometrical structure physical world itself. Because energy as a 5th dimension is considered to also be connected to the very geometrical structure of the physical world itself.

From this, I move on to speculations on the nature of time, where I consider what and where the past is, in regard to the reference frame of someone in the present. I regard the past, present, and future as energy states, and that the past, present, and future are whole realities of the universe at that time, and speculate that mass also with energy is also a temporal phenomenon, having magnitude, being a scalar. In general, it's a mistake from habit to regard time in spatial terms and must be regarded in temporal terms. One discusses the idea that there are two flows of time, one forward and one backward in time and consider a paper in support of this. Which also supports Takaaki Musha's model of the universe having forward and backward time.

CONSIDERATIONS ON TIME

Time has always been regarded as 1-dimensional, but little is known about the possibility of considering time with 2-dimensions. The reason physicists do not talk of this is their fear that it allows the possibility of closed time-like curves and time travel. With an extra dimension to time, instead of a linear timeline, one could have a loop, where one travels back in time to where one started off. Mutable time dimensions appear to allow the braking or re-ordering of cause-and-effect in the flow of 1-dimension of time and allows time travel.
In a talk by Itzhak Bars [1] at a lecture on a video, 'Two-time physics', where he discusses extra time dimensions. How many space-time dimensions may exist, 1, extra space dimension and 1, extra time dimension is needed for a more complete view of nature (a higher dimension of space and time). Nobody discusses more time-like dimensions, why? Because physicists are scared of them. Because you get 1- ghosts, which is a negative probability, and 2-causal violations (time machines) where someone can kill their grandfather before they were born. Both 1 and 2 have kept physicists away from contemplating more time-like dimensions. With extra time dimensions make the above possible.

But at that talk, Itzhak Bars dismisses 1-negative probability and 2-causal violations but keeps the framework of time having 2 dimensions.

He goes on that advocate time with 2-dimensions, where you have a new symmetry that makes (position and time) (momentum and energy) indistinguishable from energy. He argues further that 2-time physics has higher space-time with extra time and extra space, are large dimensions, not curled up like Kaluza-Klein dimensions, on this point, he may be correct. But that 1-time physics in ordinary space-time of our world/dimension, 1 time + 3 space + possible curled up dimensions (string theory) and our world being a shadow of these higher extra time and space dimensions. With a new fundamental principle, a broader equivalence principle, $x =$ (position and time), $p =$ (momentum and energy) are indistinguishable at any instant.

He says further: Out of this new gauge symmetry of the laws of mechanics applied to all motion.

1) New symmetry allows only highly symmetric motion, with little room to maneuver.
2) With only 1-time dimension, the highly symmetric motion is impossible, it collapses into nothing.
3) With extra 1+1-time dimensions necessary 4+2, extra space, and extra time dimension, highly symmetric motion is possible.

He goes on to say: That the Hydrogen Atom is one of these shadows of a higher dimensional system. One can search for the hidden symmetry of the Hydrogen Atom, which is a window to see the extra space and time dimensions. The Hydrogen Atom has 4 states and orbits of electrons. Why do they all come at the same energy. The answer to that is the higher dimensions, changing the orientation does not change the energy. The mystery is solved by having one extra dimension where changing the orientation does not change the energy.

Why different states of angler momentum come at different energies, because of the extra 4th dimension. The orbit of the Earth round the Sun is an ellipse and why does it not change year after year, has to do with the same symmetry in the 4th dimension.

There is a paper by Itzhak Bars [2] 'Survey of two-time physics'. He says on page 2: Historically in previous failed attempts for more timelike dimensions, some formidable obstacles to overcome included causality and unitarity, the latter due to ghosts (negative probability) created by extra timelike dimensions, could not be hidden away by treating them naively like extra spacelike dimensions and pretending that they are compactified in little circles.

He says further: The answer to the fundamental problems could only be a new gauge symmetry that removes the ghosts (negative probability) and establishes both unitarity and causality. Two-time physics introduced a new symplectic gauge symmetry which indeed removed all ghosts, established unitarity and causality, and played a role analogous to duality.

Itzhak Bars can Mathematically get rid of ghosts by Mathematically hiding them under the carpet, but it will not go away as well with causal time paradox when you have 2 times or more dimensions. But it does not mean they are right. I will show later, that there is experimental evidence of ghosts (negative probability) and it implies time really might have 2 or more dimensions. This also implies that 2 or more dimensions still imply time travel paradoxes and not Mathematically got rid off. All these arguments are pure Mathematics, which does not mean they are right, an experiment has the last word, and there is experimental evidence of negative probability.

Itzhak Bars is trying to keep a theory of 2-dimensions to time, and trying to remove paradoxs of causality, that you have when you have 2-dimensions or more to time. He says on page 4: Thus, the gauge symmetry demands that neither fewer nor more timelike dimensions are permitted in the description of a single particle.

However, the evidence of ghosts (negative probability) would suggest that the above is wrong and that there could be more time-like dimensions. Now I am going to present experimental evidence of ghosts or negative probability, also called backflow.

The first evidence is in a single paper [3] by G. H. Yuan and N. Zheludev, 'Experimental proof of energy backflow and gigantic local wavevectors in the super-oscillatory optical field'. They say: It is commonly believed that only the non-propagating electromagnetic field in the vicinity of nanostructures can be structured on the sub-wavelength level and thus could be decomposed into plane waves with wave vectors exceeding that of incident light creating the high spatial frequency near-field. Here we show that super-oscillatory fields in free space could feature energy backflow and gigantic local wavevectors that are several times higher than that of incident light. With the aid of an appropriately designed plasmonic metasurface, we experimentally measured the phase of the super-oscillatory field and visualized fast-variation phase singular points. Unlike conventional phase measurement techniques where an interferometry setup is usually required, our metasurface serves as a built-in interferometer which is capable of retrieving the phase by simply adjusting the incident polarization and recording the corresponding intensity components.

The next evidence is from a paper [4] by Yaniv Eliezer, Thomas Zacharias, and Alon Bahabad. 'Observation of optical backflow'. They say in their abstract: Quantum backflow is a counterintuitive phenomenon in which a forward-propagating quantum particle propagates locally backward. The actual counter-propagation property associated with this delicate interference phenomenon has not been observed to date in any field of physics, to the best of our knowledge. Here, we report the observation of an analog optical effect, namely, transverse optical backflow where a beam of light

propagating to a specific transverse direction is measured locally to propagate in the opposite direction. This observation is relevant to any physical system supporting coherent waves.

They say in their introduction: Quantum backflow (also known as retro-propagation) is a surprising phenomenon, first pointed out in 1969 by Allcock in the context of the time-of-arrival problem in quantum theory. Allcock found that a local quantum probability current may become negative even for positive momenta quantum states, and thus cannot be a valid measure for time of arrival. The phenomenon was studied in detail in 1994 by Bracken and Melloy who found a limit on the total amount of backflow. This led them to introduce a new dimensionless quantum number whose value has been reproduced more accurately in subsequent years. Recently there has been a renewed interest in blackflow with various studies reintroducing and exploring various aspects of the phenomenon.

They say further: Importantly, the first experimental observation of the local momentum associated with backflow near optical superoscillatory foci was reported [3]. This was the first paper above [3] that I presented.

They say of their experiment, page 74: In a sense, the filtering by the slit applied on the backflow beam realizes a nonlinear ''projection'' operation of a local property (local transverse momentum, which is not an eigenvalue of the momentum operator), to a global property (eigenvalue of the momentum operator), thus allowing to observe the backflow as an actual deflection of the beam.

In their conclusion on page 75, they say: We experimentally constructed, measured, and observed beam deflections associated with backflowing beams. We first designed a backflow beam based on the mathematical form of suboscillatory functions that were discovered recently. This allowed controlling the degree of backflow in the beam. Slit-filtering the generated beams allowed, counterintuitively, their deflection towards a direction opposite to that associated with the momentum states comprising the original beam. This effect is the result of a delicate interference phenomenon that, until now, hindered the observation of movement or deflection associated with backflow in any wave system (from quantum particles to optical waves to acoustic waves, etc). Our results are also relevant to single photons, where each photon is in a backflow state comprising a superposition of different transverse momentum states. The backflow we demonstrated in this work is transverse optical backflow. It would be more challenging to demonstrate longitudinal optical backflow along the axis of propagation of a light beam, which is more in line with the original concept of reto-propagation.

This experiment of backflow has proved negative probability exists and contradicts Itzhak Bars paper [2] Mathematically getting rid of ghosts (negative probability) or backflow. The results of detecting backflow may imply that time has 2 or more dimensions and also implies time travel paradoxes may be allowed in nature.

In the next paper providing evidence of backflow or negative probability, [5] by Sh. Mardonov, M. Palmero, M. Modugno, E. Ya. Sherman and J. G. Muga, 'Interference of spin-orbit Bose-Einstein condensates'. They say in their abstract: Interference of atomic Bose-Einstein condensates, observed in free expansion experiments is a basic characteristic of their quantum nature. The ability to produce synthetic spin-orbit in Bose-Einstein condensates has recently opened a new research field. Here we theoretically describe the interference of two noninteracting spin-orbit coupled Bose-Einstein condensates in an external magnetic field. We demonstrate that the spin-orbit and the Zeeman couplings strongly influence the interference pattern determined by the angle between the spins of the condensates, as can be seen in time-of-flight experiments. We show that a quantum backflow, being a subtle feature of the interference, is nevertheless, robust against the spin-orbit coupling and applied synthetic magnetic field.

In part of their conclusions they state: In addition, the system exhibits a spin-dependent quantum backflow behavior, which is relatively robust against synthetic spin-orbit coupling and magnetic field.

So here we have evidence showing in their experiment negative probability, which they call backflow. In another experiment, they also detected negative probability [6], 'Optical experiment to test negative probability in the context of quantum-measurement selection'. They say in their abstract: Negative probability values have been widely employed as an indicator of the nonclassicality of quantum systems. Known as a quasiprobability distribution, they are regarded as a useful tool that provides significant insight into the underlying fundamentals of quantum theory when compared to classical statistics. However, in this approach, an operational interpretation of these negative values with respect to the definition of probability - the relative frequency of the occurred event - is missing.

An alternative approach is therefore considered where the quasiprobability operationally reveals the negativity of measured quantities. We here present an experimental realization of the operational quasiprobability, which consists of sequential measurements in time. To this end, we implement two sets of polarization measurements of single photons. We find that the measured negativity can be interpreted in the context of selecting measurements, and it reflects the nonclassical nature of photons. Our results suggest a new operational way to unravel the nonclassicality of photons in the context of measurement selection. They say further: We now experimentally illustrate the negative probability in an operational way by measuring the degrees of freedom of the polarization of single photons.

By considering the negative quasiprobability together with the quantum nature of photons, nonclassically was demonstrated in the laboratory.

They further say: The heralded single photons exhibit an anti-bunching. However, discussions on the second-order correlation function of these photons have been previously reported. As a demonstration with a deterministic single-photon source, we performed similar measurements with photons emitted from a single molecule (terrylene). In this case, the photon statistics clearly show the anti-bunching nature without any detection schemes such as triggering.

Finally, we also performed the same experiment with the weak-field light source. Similar to the results obtained for the single photon sources, we also observed negative values. In this experiment, we post-selected the raw data to evaluate the negativity in a way that only single APD clicks were sampled, and the rest of the events, e.g., more than two clicks simultaneously were neglected. In general, the weak-field light is understood not to be the single-photon source in the sense that this light does not show anti-bunching effects. However, the negativity can be detected with a post-selection process. Recently, such a phenomenon was reported that a coherent state of the optical field can show nonclassicality. We highlight that operational quasiprobability reveals the negativity by an interplay between a given state and measurement.

So here again we have more evidence in this experiment, and many others, of negative probability disproving Itzhak Bars theory, with the implications that time has 2 or more dimensions and the possibility that nature might allow causal paradoxes and time travel.

Now after considering time as having 2 or more dimensions I want to present the notion that energy is a dimension and then time is energy. There is a paper [7] by Fabio Cardone, Mauro Francaviglia, and Roberto Miganani, 'Energy as the fifth dimension'. In their abstract, they state: A recent analysis of the experimental data on some physical phenomena ruled by the four fundamental interactions (electromagnetic, weak, strong, and gravitational) seems to show the possibility of describing such interactions in terms of a deformation of the usual Minkowski spacetime, with a metric whose coefficients do depend on the energy of the process considered. In this paper, we show that such results can be accounted for in terms of a Kaluza-Klein-like scheme, based on a five-dimensional Riemannian space in which energy plays the role of the fifth dimension. The corresponding five-dimensional Einstein equations in vacuum are solved in some cases of physical relevance and it is shown that all the phenomenological metrics describing the four fundamental forces are recovered as special cases of the classes of solutions found. Possible developments of the formalism are also briefly outlined.

They say in their introduction: Recently, two of us (F. C. and R. M.) have discussed some physical phenomena, ruled by different fundamental interactions, whose experimental data seem indeed to provide some evidence for local departures from the usual Minkowski metric. They are: the lifetime of the (weakly decaying) K_S° meason, the Bose-Einstein correlation in (strong) pion production; the superluminal propagation of electromagnetic waves in waveguides. All such phenomena seemingly show a (local) breakdown of Lorentz invariance and, therefore, an inadequacy of the Minkowski metric in describing them, at different energy scales and for the three interactions involved (electromagnetic, weak, and strong). On the contrary, they apparently admit to a consistent interpretation in terms of a deformed Minkowski spacetime, with metric coefficients depending on the energy of the process considered. Moreover, it was shown that also the experimental results on the slowing down of clocks in a gravitational field can be described in terms of a deformed energy-dependent metric.

They say further: The analysis carried out leads therefore to a (four-dimensional) generalization of the (local) space-time structure based on an energy-dependent deformation of the usual Minkowski geometry. Moreover, the corresponding deformed metrics obtained from the experimental data provide an effective dynamical description of the interactions ruling the phenomena considered (at least at the energy scale and in the energy, range considered).

Further, they say: Two main further conclusions can be drawn from such an analysis. The first one is that the energy of the process considered (which is to be understood as the energy measured by the detectors via their electromagnetic interaction in the usual Minkowski space) does play the role of a dynamical variable. Moreover, it represents a parameter characteristic of the phenomenon considered (and therefore, for a given process, it cannot be changed at will). In other words, when describing a given process, the deformed geometry of spacetime (in the interaction region where the process is occurring) is ''frozen'' at the situation described by those values of the metric coefficients corresponding to the energy value of the process considered. Otherwise speaking, from a geometrical point of view, all go on as if we were actually working on ''slices'' (sections) of a five-dimensional space, in which the fifth dimension is just represented by the energy.

They end by saying: It is the aim of the present paper to show that this is indeed the case; namely the four-dimensional, deformed, energy-dependent spacetime is only a manifestation (a ''shadow'', to use the famous word of Minkowski) of a larger, five-dimensional space, in which energy plays the role of the fifth dimension. In fact, we will show that the deformed, energy-dependent metrics, derived on a phenomenological basis from the experimental data, can be obtained as solutions of Einstein's equations in a five-dimensional space, with energy as the fifth dimension.

So here energy is considered as a fifth dimension, with our previous regarding time as having 2 or more dimensions and 3 of time leads to 5 dimensions. I later present the speculations that time has energy and is a part of the structure of the world.

They say further: It is easily seen, from the examination of the phenomenological metrics considered in the previous section, that, in the formalism of the deformed Minkowski space, energy does play a dual role. Indeed, on one side, E is to be considered as a dynamical variable, because it specifies the dynamical behavior of the process under consideration and, via the metric coefficients, it provides us with a dynamical map- in the energy range of interest - of the interaction ruling the given process. On the other hand, a fixed value of the energy determines the spacetime structure of the interaction region for the given process at that given energy. In this respect, therefore, E is to be regarded as a geometrical quantity, intimately connected to the very geometrical structure of the physical world itself. The simplest way of taking into account such a double role of E is to assume that energy does in fact represent an extra dimension - besides the space and time ones - namely, to embed the deformed Minkowski spacetime in a larger, five-dimensional space.

Therefore, considering time as having 2 or more dimensions and time as having energy, as being the 5th-dimension, one can say that time is to be regarded as a geometrical quantity, intimately connected to the very geometrical structure of the physical world itself. They further say on page 9, that in the standard Kaluza-Klein scheme, the fifth dimension must necessarily be space-like, because the number of timelike dimensions cannot exceed one if one wants to avoid causal anomalies. I argued earlier, because of the discovery of negative probability in this paper, that may imply time as having 2 or more dimensions, that the fifth dimension must be a timelike dimension, and must exceed one, allowing for causal anomalies.

Regarding time as energy, I wrote a paper [8], 'Notes: Time as an energy wave', that I considered time had energy, that one might be able to manipulate it, and then manipulate time. The idea of time having energy originated from a scientist, Takaaki Musha, in Japan, who I have corresponded with. I wrote another paper [9], 'On the nature of time and energy', where independently of Takaaki Musha, a Russian scientist by the name of Nikolai A. Kozyrev in 1958, in experiments he conducted on causality found evidence of energy to time, that has no momentum and appears everywhere at once, no matter what the distance.

I say in my paper: In my treatment of Kozyrev's work, I go over each of his conclusions in this paper. Kozyrev also comes to the conclusion that time energy is not propagated but appears immediately everywhere at once, in the causal pattern of cause and effect, and discovering its relation to the law of inverse proportionality of the first power of the distance. I find in another paper, the Wheeler and Feynman Absorber theory that retarded fields passing points in the process of cause and effect falls off by the law of inverse proportionality of the first power of the distance, and I speculate if there is a relation here.

SPECULATIONS ON THE NATURE OF TIME

The future past and present have to be energy states, must be seamlessly connected to each other, for all time, temporally connected, and all exist as whole realities. At the time the past occurs in an observer's frame in the past, has its own present now for that observer. In this sense, these are realities that could be visited, if the past and future are fixed in the continuum. But events in the past, present and future only occur once, no matter how many times a time traveller visits it.

I know it sounds trivial and obvious, but it must be stated to be clear and not confused, that when we think of the past, or of any moment in time, we must think of the past, present, and future as whole realities of the universe.

If mass and energy are temporal phenomena, they can be represented as a magnitude or scalar in our 3-dimensional space. How does one understand mass and energy extended in time, in terms of the past, present, and future, as whole realities? One has to think of these states of mass and energy temporally as a part of time if the past is not to be a mere shadow of itself. If the whole universe is infinite, the past present, and future are whole realities that have no end and can be represented as a single point in time?

The past and future have energy states and each energy state obeys the laws of thermodynamics. But how do these energy states exist when one is in a different time, the future say? The past still exists, exists in its own present to a observer's frame of reference in that past, and has a thermodynamic state of a present now, that happens only once, in the sense that it exists. But what is it from the view of someone in a different time, where it does exist. One can say it exists temporally in a different position in time, in the continuum.

We can use Noether's theorm and say that energy travelling through time into the past is conserved. One might use:

$$S = \int_{t_2}^{t_1} L dt$$

Where S is the action, and L is the Lagrandian.

Or:

$$S = \int_{t_2}^{t_1} L dt > 0$$

And the principle of least action temporally, energy travelling into the past may take the shortest path temporally. However, the above equation does not have any terms for energy.

One has to use an equation not in terms of spacial dimensions, but in terms of temporal dimensions, expressed as a magnitude or scalar, and I have such an equation of my own, in terms of energy:

$$ds^2 = c^2dt^2 = S = \int_{m_{(t1)}}^{m_{(t_2)}} Ldt\phi\big[\big(E^2\pm = (p^2c^2 + m^2c^4)\big)\big]t_{1past} \Rightarrow \phi\big[\big(E^2\pm = (p^2c^2 + m^2c^4)\big)\big]t_{2present}$$

ds is space-time, L the Lagrandian, the terms $m(t_1)$, $m(t_2)$ is mass of an object through time in the integral - for mass of an object into the past one simply reverses these trems in the integral. I think I now found an equation of the mass of an object in the present, compared to the same mass of the object in the past. $E^2\pm = (p^2c^2 + m^2c^4)$ is the total energy of the mass. This expression was derived by Einstein., p is momentum. Einstein dropped p^2c^2 which he derived $E = mc^2$.

The above equation says that the speed of time c^2dt^2 is equal to the action S of the mass through time $m(t_1)$, $m(t_2)$ from the past to the present, with the Lagrandian L, here we have the total energy $E^2\pm = (p^2c^2 + m^2c^4)$ that includes the mass m. The $\pm$ means the total energy of m can be either forward or backward in time. I wanted also to represent the total energy of the mass in the past, compared to what it is in the present. ϕ is a scalar.

One could add an extra term for the total energy for the future as well. And one can represent the whole total energy for the whole universe in the past, present and future by introducing the term U at the end of each expression outside each square bracket. What is the state of energy through time when it becomes the past? I think my equation shows that. In what state temporally does the past exist. I argued earlier that the past can't be a mere shadow of itself if it is fixed, and can be visited, must be a whole reality in space-time and visiting the past will always be experienced from the reference frame of the time traveller as his present now, of the present now in the past.

In the experiments of Bajlo [10][11], who was the first person to detect advanced waves, that travel into the past, the reason advanced waves converge from infinity to a point on the transmitter, who's effect arises before its cause, is because from an observers frame of reference that is not moving into the past with the advanced wave, because that observer and us are moving in the retarded thermodynamic forward flow of energy in the present, toward the future, that we see the effect arise before its cause of advanced waves. Yet according to Bajlo these advanced waves are really outgoing waves into the past, and from the observers frame not moving into the past, these advanced waves are really converging from the past to the present, had to already have been sent into the past in the first place. So really there has to be 2 flows of time. One into the past, (advanced), and one into the future, (retarded).

The effect arising before the cause can be treated with Noether's theorem, or the principle of least action:

$$S = \int_{t_2}^{t_1} Ldt > 0$$

Or one can use Tolmans paradox to express this. For sending a signal faster than light

$$\Delta t = t' - t^{\circ} = \frac{B - A}{a}$$

The arrival at B is given by the velocity a and event A is the cause of B. This inertial frame moving with relative velocity v, the time of arrival at B is given according to the Lorentz transformation:

$$\Delta t' = t' - t^{\circ} = \frac{t^{\circ} - vB/c^2}{\sqrt{1 - v^2/c^2}} - \frac{t^{\circ} - vA/c^2}{\sqrt{1 - v^2/c^2}} = \Delta t' = \frac{1 - av^2/c^2}{\sqrt{1 - v^2/c^2}}\Delta t$$

If $a > c$ then certain values of v, can make $\Delta t'$ negative, in other words the effect arises before the cause in this frame. This expression shows exactly the behaviour of advanced waves, where the effect arises before the cause.

In the forward flow of time, of time energy, thermodynamics in our frame of reference in the present now, entropy may increase, be used up (or conserved). In what sense does this state still exist in the past? The best way to view it, may be to argue that it exists temporally and only once happening, no matter how many times that past is visited. But I feel this is not the whole story.

This issue may be resolved by the fact that from an observers frame of reference in the present now, will view the past as elsewhere, when that past was the present now to that observer, it was in the present not the past, and to our observer in the future, which in his present is viewed as the past. It's in the sense of the sense of the present now of the frame of the observer that distinguished the present from the past, that creates the view that the past is elsewhere, when not in our present now anymore, but exists when it is our present, and now exists in the past and is fixed, that it can be visited.

I think Einstein's block model of the universe is a way of considering the nature of time. Although some consider the block model of the universe means all our future actions are already determined with the loss of free will. I believe that all our future actions are still made by our own free will.

Time/space must analogously be a speed in time relative to space. If time has an energy it may be motion/speed, transformation in time relative to space. That implies that both space and time must be 3-dimensional that space must progress like time, and that there must be locations in time just as there are locations in space.

Is mass a temporal phenomenon? Like energy, only having a magnitude, being a scalar. The notion I explained earlier in this paper of time having energy, looks like the normal energy of our world, that time is fundamentally part of the mass/energy of our world, that ordinary energy of the universe and matter is the time energy, existing temporally. If mass is a temporal phenomenon, the more mass you have, the more time is slowed, the more it's a form of acceleration, which is a gravitational field. Then gravity is a temporal phenomenon, along with mass and inertia being indistinguishable from gravity, and being a form of acceleration like all gravitational fields.

If m and E are temporal phenomena, so is gravitational potential ϕ:

$$\phi = -\frac{GM}{r} = g$$

Where here M, the mass is equivalent to energy E. It is known that regarding March's principle that $\frac{GM}{Rc^2} = 1$ or $\frac{1}{G} = \frac{M}{Rc^2}$ Since R is a function of time, it would seem to follow that G should also be a function of time. If G is a function of time one can apply it to the equation:

$$m = \frac{\Gamma c^3}{G}$$

Making G the subject:

$$G = \frac{\Gamma c^3}{m}$$

If G is a function of time one can replace G with t in the expression:

$$t = \frac{\Gamma c^3}{m}$$

Or:

$$t = \frac{\Gamma c^3}{m} = G$$

The present now must be temporal, having only a magnitude, being a scalar with no direction in space, only a temporal direction in time, past, present and future. Some have said the past, present and future are all simultaneous to each other. Mass may be a temporal phenomenon and time energy all the ordinary normal matter/energy of our everyday world.

There is a paper [12] by Thomas Guff, Chintalpati Imashankar Shastry, and Andrea Rocco, 'Emergence of Opposing arrows of time in open quantum systems'. Where they show that there are two-time flows, one into the future and one into the past, which supports my idea mentioned earlier, that there are two time flows, one backward in time, the other forward in time. That also supports a paper [13] by Takaaki Musha, 'Time wave function of the universe'. Supporting Takaaki Musha's idea of a model of a closed-loop timeline where advanced waves and retarded waves of the universe exist. But I believe its not in a mirror part of the universe, but both advanced and retarded in our universe at the same time. It also supports my arguments earlier of the nature of advanced waves, wherein the frame of an observer not moving backward in time with the advanced wave, observing advanced waves travelling from the past, converging from infinity (in the retarded direction) upon the transmitter, but are really outgoing waves travelling into the past. This is possible because there are two flows of time, forward and backward in time [11]. They say in their paper [12], their abstract: Deriving an arrow of time from time-reversal symmetric microscopic dynamics is a fundamental open problem in many areas of physics, ranging from cosmology to particle physics to thermodynamics and statistical mechanics. Here we focus on the derivation of the arrow of time in open quantum systems and study how time-reversal symmetry is broken. This derivation involves the Markov approximation applied to a system interacting with an infinite heat bath. We find that the Markov approximation does not imply a violation of time-reversal symmetry. Our results show instead that the time-reversal symmetry is maintained in the derived equations of motion. This imposes a time-symmetric formulation of quantum Brownian motion. Lindblad and Pauli master equations, which hence describe thermalisation that may occur in two opposing time directions. As a consequence, we argue that these dynamics are better described by a time-symmetric definition of Markovianity. Our results may reflect on the formulations of the arrow of time in thermodynamics, cosmology, and quantum mechanics.

They say in their conclusion: All derivations of the quantum arrow of time must be built upon microscopic dynamics with time-reversal symmetry. Because of this symmetry, the two directions of time are indistinguishable when considering the microscopic evolution of any many-body system. Whether this is the case also for the reduced descriptions of these systems is the core issue addressed in this paper.

We find that when examined closely the time-reversal symmetry persists into the derived quantum Langevin equation and Brownian motion master equation. This is also the case in the Lindblad and Pauli master equations, which are derived from the generic time-symmetric Hamiltonians.

Our findings are consistent with the second law of thermodynamics and emphasise the distinction between the concepts of irreversibility and time-reversal symmetry. Once the arrow of time and a particular low entropy initial condition at $t = 0$ have been chosen, then the von Neumann entropy will increase forward in time from the temporal origin. However, a different choice of the arrow of time would have implied the same dynamics. The Markov approximation applied to the time-reversed evolution leads likewise to the same dissipation and entropy increase. Consequently, any thermal equilibrium state for a forward-running trajectory is

also an equilibrium thermal state for any time-reversed trajectory, and entropy increases in both directions: the system thermalises into both time directions. It is interesting to note that similar conclusions in the classical realm had been previously drawn in [50] in a statistical mechanics context. Our derivation here is based instead on a fully Hamiltonian picture.

As a result, the quantum arrow of time, descending from the increasing entanglement between a system and its environment, is split into two arrows when the Markov approximation is performed, according to our derivations. Increasing entanglement, as well as the decoherence process of the system of interest, follow the time-symmetric quantum master equations here derived, and hence happen symmetrically along opposing time directions. This might have measurable implications in terms of quantum interference between forward and backward processes.

They say further: Furthermore, we speculate that these results may reflect on the cosmological arrow of time. In fact, the natural assumption that the universe was dissipative from time zero onwards would suggest that a model of it would rely on the Markov approximation performed at the moment of the Big Bang. If so, this would imply that two opposing arrows of time would have emerged from the Big Bang, which would account in turn for the maintenance of time-reversal symmetry despite the ensuing dissipative nature of the universe. We would happen to live in one of them, where dissipation and entropy increase are common experiences, but unaware of the existence of the other alternative possibility. We notice the striking similarity of this conjecture with the cosmological model proposed where the origin of time is described as the so-called Janus point. However, along with the similar conclusion that time emerges from $t = 0$ in a symmetric fashion, allowing for dynamical evolution in opposing time directions.

The last point above, where they speculate their results on the cosmological arrow of time, supports my view and Takaaki Musha's view that there are two flows of time, one into the past, and the other into the future. But also supports Takaaki Musha's cosmological model of the universe, in his paper [13] 'Time wave function of the universe'. He writes in his paper: The process by which this inequality between matter and antimatter particles developed is called baryogenesis. In physical cosmology, baryogenesis is the physical process that is hypothesized to have taken place during the early universe to produce baryonic asymmetry, i.e. the imbalance of matter and antimatter in the observed universe. However according to Feynman, the antimatter travels backward in time, and the antimatter universe proceeds to the opposite direction of the matter universe along the time line.

As shown, there are an advanced wave (backward time flow) and a retarded wave (forward time flow) of the universe. If the timeline is closed, the positive matter universe and the negative matter universe will collide with each other in the timeline within a finite length of time.

What is remarkable about what Takaaki Musha is saying here is very similar to the conclusions in the paper 'Emergence of opposing arrows of time in open quantum systems'[12] that I stated above in this paper, on their views on cosmology, where they say: If so, this would imply that two opposing arrows of time would have emerged from the Big Bang, which would account in turn for the maintenance of time-reversal symmetry despite the ensuing dissipative nature of the universe. We would happen to live in one of them, where dissipation and entropy increase are common experiences, but unaware of the existence of the other alternative possibility.

Such a view could even explain the possibility of parallel worlds in quantum theory. But where I differ from Takaaki Musha and all the above papers, is that I believe that the backward and forward flow of time occur only in our universe, and I differ from Takaaki Musha, in that I believe that the universe is open not closed, and it's not matter or antimatter universe, but negative time flow into the past, and positive time flow into the future.

Going back to the paper [12] 'Emergence of opposing arrows of time in open quantum systems', they show in their paper, that entropy increases in both temporal directions, but there is nonetheless no arrow-of-time, as time-reversal symmetry is maintained. Increasing entropy only indicates motion away from temporal origin, not whether system is moving forward or backward in time.

One can state their findings:

1) No idea if the system is moving forward or backward in time, but with both temporal directions included.
2) The Markov approximation, made at the origin, has preserved time-reversal symmetry about the origin, but not about any other point.
3) It is in fact time translation symmetry that is destroyed by the Markov approximation, is creating a temporal boundary distinguishing past from future.
4) The question remains as to the significance of the time $t = 0$.

Regarding 4, in reality t is a constant temporal motion from an observer frame of reference when $t = 0$ is constant, and regarding, someone in the past time from their reference frame, (compared to someone in the present) there have their $t = 0$ which is in their present now. But this creates a contradiction. And this all has a bearing on what I was saying earlier in speculations on time, of what is the state (energy state) in the past, as compared to the state (energy state) in the present?

This all revolves around $t = 0$, and $t = 0$ would be for the whole reality of the universe at that time, and the same in the past and future. Is $t = 0$ a mathematical illusion by our limited thought not

comprehending the whole of time, where we are psychologically dependent on the nature of our consciousness on having $t = 0$? That we are not aware of the whole reality of the past and future, stretching off in both directions. Or does it reflect a fundamental truth of the nature of time?

In Einstein's block model of the universe, is there any $t = 0$, or is $t = 0$ an illusion as all times have a present $t = 0$, to the frame of reference of an observer. So what is so special about $t = 0$. This makes the present seem illusionary? But is this present really fundamental to our reality, perhaps it is?

Michael Lockwood, in his book [14] 'The labyrinth of time', said on page 53-54: Relativity, as Einstein saw it, supports a tenseless conception of time. From this perspective, a person who is not living now, but did or will live at other times, exists in just as substantial a sense as someone who does not live here, but only at some other place. If Einstein is right, the terms 'past', 'present', and 'future' do not express objective differences between times, any more than 'to the west', 'here', and 'to the east' express objective differences between places. Living in the early sixteenth century, from the standpoint of the early twenty-first century, should accordingly be thought of as analogous to living in Bangalore, from the standpoint of Oxford. Regarded in this light, death is not the deletion of a person's existence. It is an event, merely, that marks the outer limit of that person's extension in one (timelike) spatio-temporal direction, just as the person's skin marks out the limit in other (spacelike) directions. The space-time view is, therefore, inconsistent with our regarding one of those limits, but not the others, as a cause for sadness.

This implication-or alleged implication-of relativity is a rather appealing one. L. P. Hartly (1953: 1) famously declared, in his novel 'The go Between'. 'The past is another country: they do things differently there'. The concept of space-time, as understood by Einstein, makes this more than just a metaphor. Einstein is urging us to regard those living in times past, like those living in foreign parts, as equally out there in space-time, enjoying the same flesh-and-blood existence as ourselves. It is simply that they and we inhabit different regions of the continuum.

He goes on: As I say, this view doubtless has its attractions-though it cuts both ways. If our loved ones are to be thought of as being out there in space-time, as real as ourselves, then so too are Hitler, Jack the Ripper, and Atilla the Hun! So also are the 'old, unhappy, far-off things. And battles long ago', of which Wordsworth speaks. What really gives us pause, however, is the reflection of the same way of thinking that, when applied to the future, implies a denial of free will. For the conception of time that Einstein is promoting clearly implies that future objects and events therefore our own future actions-are likewise out there in space-time, as real as present or past actions.

But one can also argue that despite all of this, that one does have free will?

CONCLUSIONS

Time might have two or more dimensions, due to the evidence from experiments showing negative probability, which implies that nature allows for time travel and causal violations. Time may have an energy and that energy might exist as a 5th dimension. But that the time energy can be regarded as a geometrical quantity, connected to the very geometrical structure of the physical world itself. Where mass (and energy) may be a temporal phenomenon.

Opposing arrows of time may exist, both forward and backward in time, and support mine and Takaaki Musha view that there are two flows of time. And Takaaki Musha's model of two arrows of time in his model of the universe, but where I differ in that I regard the universe as open and not closed. And that its only in our universe that there is two arrows of time, and not in some other universe. Time $t = 0$ may have significance, in that it may be due to our psychological limitation of only being aware of the present moment now, of our consciousness not to be able to be aware of the past or future, or that $t = 0$ may be a fundamental part of nature.

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