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Quantum Gravity Consciousness Could Cause Brain Controlled Atemporal Evolution of Space-Time

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Abstract

On the question of time, there is a growing consensus in physics that a good theory of space-time should reconcile the presentism of quantum mechanics with the eternalism of general relativity, through a model that preserves both the creativity of time and the presence of the future. In previous papers (Guillemant *et al.,* 2018; Guillemant and Medale, 2019), we have proposed such a model through a flexible space-time requiring 6 extra dimensions, as an alternative to multiverse theories, based on the possibility of making it evolve locally in an atemporal way even if it is already realized in the future. In this paper we go further to show how a quantum gravitational consciousness should be involved in such an evolution process, involving the possibility for the brain to update the branches of space-time through the mechanisms of perception balanced by quantum gravity. This model also requires a double causality, allowing local changes in a timeline without changing its future, which should therefore exert its influence. We show that such an influence from the future could explain phenomena like intuition or serendipity, which would result from the necessity to switch timelines in the present in order to adapt to changes in the future. We finally describe a protocol to experiment this hypothesis, thus demonstrating that the flexibility of space-time is a testable theory.

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1. Introduction

In a recent paper (Santo and Gisin, 2019) claiming that classical physics is not deterministic, just like quantum physics, the authors propose an interpretation of physics without determinism that is using intuitionistic mathematics (Gisin, 2020) to describe real numbers with finite information. They also envision “top-down causation” to decide what happens in the

resulting undetermined future. As it is compatible with quantum physics, this interpretation is particularly interesting because it could help to solve the most fundamental problem facing physicists today, which is to find how to reconcile quantum mechanics and the physics of relativity.

To date, these two great theories of physics have been the two most extensively tested through experiment, with quite stunning results. However, they are mutually incompatible. It is widely recognized (Falk, 2016) that this mystery is linked to our misunderstanding of time, about which it is often said that “time doesn’t exist”, meaning that it could be just a fourth dimension that is not building our future. Some renowned physicists (Connes and Rovelli, 1994) even propose that time could be a thermal illusion created by the brain. Moreover, the brain itself has recently been considered by (Zwirn, 2020) and its “convivial solipsism” to play a major role in the way our classical world could emerge from a true quantum reality, but in a purely deterministic process.

In this paper we will go further and propose an original lighting according to which our brain could actually update space-time, but in a non deterministic way that would account for the unexplained phenomenon of “intuition” by involving quantum gravity or extra dimensional information (Guillemant *et al*., 2018). We will also argue that the same mechanism could explain a parent mysterious phenomenon called “serendipity”, both phenomena being for us caused by changes in the configuration of timelines in the future. This future changing possibility is based on space-time flexibility, a new concept that we have introduced in a recent paper (Guillemant and Medale, 2019) and will develop more precisely in the present one. Space-time flexibility can be briefly understood as the result of repeating timelines “commutations”, a commutation being what figure 1 illustrates. It has sense only if a second time that we have called the cybernetical time (Guillemant, 2019) is at work to describe the steps of an atemporal evolution of our space-time, through a multiverse of alternative ones, by involving a double causality (Guillemant, 2018).

In terms of our current understanding of time, the favorite or at least simplest model of space-time is the "block universe" theory (Smart, 1955) that implies the future already exists, issued from the physics of relativity. Quantum mechanics, on the other hand, is more inclined to agree with the idea of "presentism", in which the future does not yet exist. Today, however, recent progress in both experimental and theoretical fields is starting to prompt even quantum physicists to consider that time does not exist, as quantum events have proven themselves to be indifferent to space and time (Megidish *et al.,* 2009). The present balance in physics is then tending to weigh strongly on the side of a future that is already realized, the big question then being: "can it be modified?". Apparently not, if we limit ourselves to the present block universe; and it is embarrassing, to say the least, for our status within the universe.

However, we have shown in recent papers (Guillemant, 2019; Guillemant and Medale, 2019) that a block universe could be flexible (Figure 1), meaning that it would be possible for an already realized future to change its configuration along time. It would also have strange consequences, such as the possibility for the future to influence the present or even the past. This is usually forbidden by classical physics but it should be understood here in the non-classical context of the “partially quantum future” we suggest in (Guillemant and Medale, 2019), meaning that even at a macroscopic scale the ontology of the future could be at least locally a multi-paths one. In other words, in this vision the famous many-worlds theory or “Everett multiverse” (Everett, 1957) would not be constituted of a myriad of experienced and well separated

universes, but as a myriad of alternative possibilities of one experience, that could then be as a whole an integral part of our universe. It means that physics would be indeterminist at a macroscopic scale, for the reasons we have published in different contributions (Guillemant *et al.*, 2013; Guillemant, 2018, Guillemant *et al.*, 2018; Guillemant, 2019; Guillemant and Medale, 2019) which are close to those of the already mentioned Santo & Gisin paper (Santo and Gisin, 2019).

This proposal is raising very large and philosophical questions about the nature of time that we have partially addressed in (Guillemant, 2019). We will show more precisely in this paper that it can highlight the difference between brain and consciousness, which could be based on the latter's ability to grasp multiple paths, resulting in an intuitive but perhaps illusory sensation of free will. We will not discuss here the metaphysical question of free will: whatever it is involved or not in the flexibility of space-time does not matter here. We will only examine the possibility for a flexible space-time to cause "intuition" or "serendipity" phenomena, through hypothetic quantum properties of consciousness (Penrose and Hameroff, 2011). Both phenomena are defined in this paper as a discovery (internal or external to the brain respectively) that changes the individual's life but that cannot be explained by rational mean or causality. Note that the necessity for physics to deal with the relation between brain and consciousness has been already deeply addressed for example by (Penrose and Hameroff, 2011) and (Bitbol, 2011).

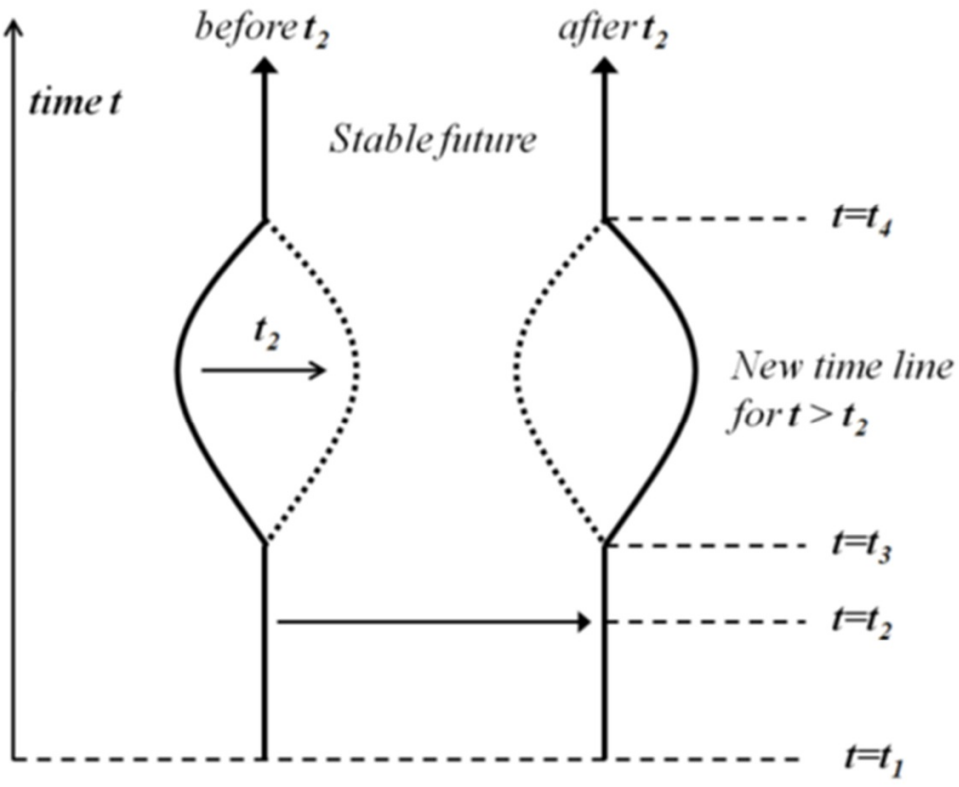

Figure 1. In the flexible block universe model suggested in (Guillemant and Medale, 2019), space-time could safely change its configuration by evolving via local commutations of different timelines. Note that the commutation time t_2 may be different from the bifurcation time t_3.

2. The Multiverse Of frozen Space-times

In the four-dimensional block universe, each person's life can be described according to a trajectory or timeline (temporal line), that remains forever fixed, because it existed prior to our birth and continues to exist, unchanged, after our death. All the journeys we make in our lifetime, everything we feel, we think and we observe around us are described entirely in advance and in the smallest detail, like a video on a CD-Rom. Physics does not understand the true function of the "tape-head" that reads the video - this "presence" we call time, but which seems to have more to do with consciousness. Our life is described a bit like a film being projected: the result of a journey through space-time that gives us the feeling of perpetual creation controlled by illusory free will.

Nevertheless, we suspect that this four-dimensional space-time is only a provisional model, because it is not compatible with quantum theory. Quantum theory introduces fundamental indeterminism at the stage of nature's "choices" at elementary particle level (quantum state collapse), and today it is widely accepted that such indeterminism cannot be reduced to any hidden variables physicists may have yet to discover. Before (Santo and Gisin, 2019) claimed that classical physics was incomplete, (Stefanov *et al.*, 2002) demonstrated that quantum fate cannot involve any local (subliminal) cause and (Suarez, 2008) argued that it has to be considered as information from outside space-time, that has to be brought into space-time if we wish to preserve the principal law of physics – the conservation of energy.

However, the mainstream interpretation of quantum fate still does not take into account such a coordination from outside that would somewhat imply free will (Suarez, 2013), but appeals the Everett many worlds theory, meaning that it would exist a myriad of parallel block universes, as for example Damour stated in (Damour, 2015).

Though the Everett multiverse of block universes is the current prevailing model of space–time in physics, it is still the object of a large debate (Falk, 2016) because a lot of physicists do not agree with a future that already exists with the same status as the past. If it is so, time could not exist physically as our intuitive frontier between a well determined past and an undetermined future, but as an emergent thermodynamic phenomenon (Connes and Rovelli, 1994). But many physicists as for example (Smolin, 2014) or (Ellis, 2009; Ellis, 2009) reject the block universe because it does not give a real physical and creative sense to the present and leaves no possibility, at best for free will, at worst for an undetermined future that seems yet promised by quantum fate.

We have proposed in (Guillemant and Medale, 2019) another model of space-time so as to maintain an undetermined future and a possible free will, which has the big interest to be compatible with the block universe model. In Figure 1, we have condensed in the simplest possible way the basic concept of the new flexible model of space–time that we suggest. This model is reviving the function of time in a rather different way of Smolin and partially restoring the indefiniteness of the future in the same sense of Ellis. The big interest of this proposition is that though it is dynamic, it remains compatible with the mainstream static block universe model by making it at all times a well defined space–time in the past and the future. The objective sense of present time may then be to allow to define locally a succession of particular instants t2 (see Figure 1) when each timeline commutation occurs, thus permitting the block universe to evolve out of time. Such commutations should be controlled by timeless parameters, involving a new cybernetical physics of timelines which is still unknown. We will show further that this new physics of timelines should imply some influence from the future that we

mention as stable in Figure 1. Note that the possibility of retrocausality has long ago been suggested (Costa de Beauregard, 1953) before coming back strong with the work of (Price 1996, Price 2012). It is now claimed as compatible with quantum mechanics (Aharonov *et al*., 2016) and even with relativity (Dragan and Eckert, 2020).

But before that, we have to consider more seriously the possibility that we would really live into a multiverse with a myriad of separated block universes, as it is also a consequence of string theory, which has recently gained credibility through the new developments of the holographic principle of Maldacena (Maldacena, 1998). Indeed, string theory offers a highly elegant solution for solving the multiverse interpretation through another way, by bringing us within a determinist framework and calling on six extra spatial dimensions, where “outside space-time information” might lie. Maintaining this determinist framework, however, leads us to envisage the true physical existence of myriad parallel universes with one important precision: we would necessarily have to be imprisoned inside a single one of these ten-dimensional universes, and it would be just as fixed as our four-dimensional space-time. However, this interpretation supposes, quite arbitrarily, that string theory’s settings, which give rise to an immeasurable number of possible variations (10^{500}), are forever fixed inside one same universe. Whereas in fact, this hypothesis is merely the result of the desire to keep a determinist framework for physics as it is now.

Actually, there are good reasons to interpret differently the extra dimensions of string theory. Both the fundamental principle of general relativity and the quantum gravity premises show that space–time has to be considered as something flexible, as it is bending and warping. Indeed, if we look at the timeless configuration of the block universe, there is something incoherent in the idea that even the infinitesimal creases and curves of space-time would not vary out of time and then always leave the space–time exactly in the same gravitational frozen state from the big-bang to nowadays. One of the reasons why it is still considered like this is that our understanding of time is still vague and largely debated, as already noticed. But the main reason is that – if we disregard our own theory (Guillemant and Medale, 2019) - nobody knows how extra dimensional data could cause, by varying in time, a variation of the timeless gravitational field without destabilizing space–time as a whole. In brief, it is implicitly considered that space–time would collapse if such variation was permitted in the equations.

Going on disregarding our alternative of a flexible space-time who can dismantle this accepted idea, this leads to admitting the existence of what we call “prison-universes”, and prematurely evades the quantum indeterminism that momentarily opened the door to an undetermined future, or even free will. It is like a hurried move to slam the door shut faced with an inacceptable indeterminism, by arbitrarily fixing the settings of the Calabi-Yau functions (Shing-Tung and Nadis, 2010) that describe quantum vibrations in six extra spatial dimensions, as yet undetectable because of their tiny size (~ 10^{-35} meters).

As a result, forgetting the possibility for the values of extra dimensions to evolve in time. our universe would continue to resemble a frozen ocean upon which, if our life were played out a second time, we could not but make the same journey. Our universe would have to have been frozen for the whole of eternity, or otherwise have suddenly appeared as is, from the Big Bang right to the end of time. This would make us no more than tourists in space-time, mysteriously gaining consciousness along distinct timelines and probably condemned to disappear once the “tape-head” reached our death -

unless it allowed us to play out the same life again and again, without there being the slightest change?

This disconcerting perspective is not the only thing that seems a bit hard to swallow. Any attempt to maintain a space-time fixed within the classical framework of determinist temporal evolution invariably leads us to conceptual extremes that are highly unlikely:

- either we would have to accept that we have myriad, fully conscious doppelgangers of ourselves in parallel universes, who might have exactly the same life as us, apart from infinitesimal differences that make it necessary to create a new universe each time, - or we would have to accept the creationist nature of a unique space-time that appeared instantaneously or is fixed for all eternity, where our life could be endlessly relived without there ever being the slightest, even tiniest change to it.

A very interesting way to solve this problem is to consider the Zwirn model of “convivial solipsism” (Zwirn, 2020) where our brain is playing the major role of updating space-time in the sense that any observer is only aware of one branch of a true quantum or multi paths reality. In this model, the updating process authorized by the brain is considered purely deterministic, but there is no specific argument to support this assertion. If we consider, on the contrary, that the brain perception process could be perfectly indeterministic, based on the arguments given in the introduction with (Santo and Gisin, 2019) and (Guillemant and Medale, 2019), we just need to describe how the time lines could be updated in a non-deterministic way for this model to be compatible with ours.

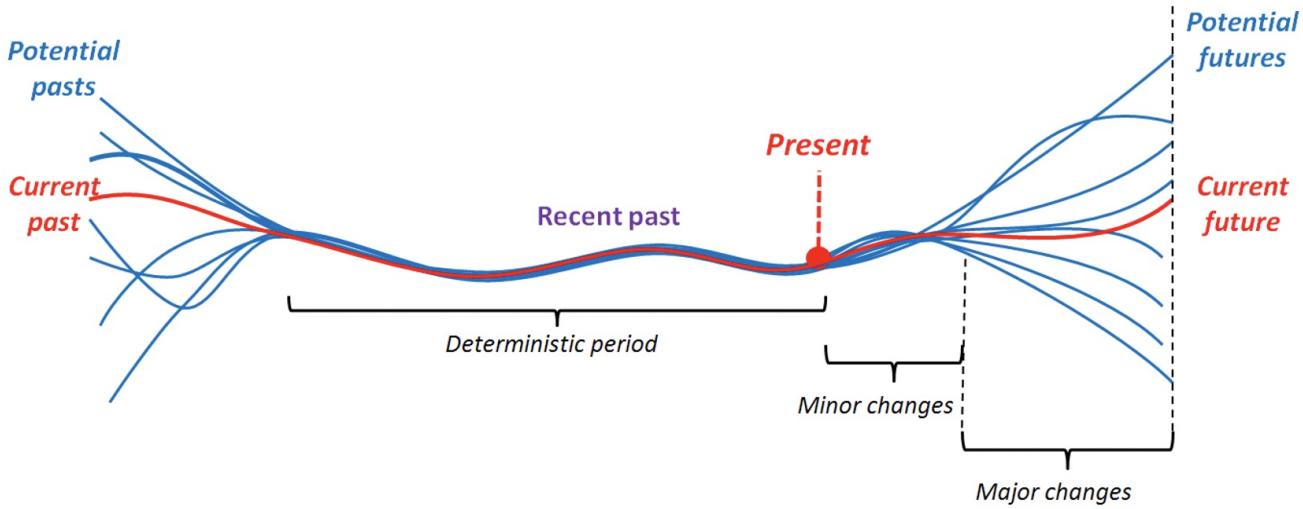

Figure 2. What means unfreezing space-time is that timelines could change as time passes, which implies that determinism is only partial, reigning much more in the past than in the future, where little changes could occur even directly from the present.

We have proposed in (Guillemant *et al*., 2018) an alternative interpretation of extra dimensions using path and destination 3D governing points, which then avoids the extremes of infinite parallel universes and restoring an undetermined future, while staying compatible with the block universe model. In this interpretation, physics might only be giving a partial description of reality and a fuller description is still lacking, which could specify precise paths and destinations.

This fuller description would have to deal not only with quantum fate that presides to “choices” of Everett many worlds’ branches, but also with bifurcations that appear at the macroscopic scale of sufficiently complex dynamical systems, by creating different paths and destinations. What is particularly interesting in this previous work (Guillemant *et al*., 2018) is that we have shown that the necessity of adding six extra dimensions to space-time (not to space alone) is emerging in the very classical context of describing the timeline of a billiard, from the simple hypothesis – now largely considered in physics (Sorkin, 2005, Gudder, 2012, Kempf, 2018) - that our space-time is a discrete one, meaning that the density of physical information into the universe is bounded.

According to this new approach, extra dimensions should be better interpreted as space-time dimensions rather than additional space dimensions, meaning that they are required to describe in which universe we live by quantifying all choices - through extra dimensions values or non causal fate - at any bifurcation, whatever it’s of a classical or quantum nature. The space would only have three dimensions and extra dimensions other than time would only be necessary to restore determinism. However this determinism would be relative, as it would only be effective if the values of extra dimensions don’t vary. As we reject this arbitrary postulate, we have to admit the possibility of an “atemporal determinism” which would consist of describing the laws that govern the variations of the values of extra dimensions.

This being said, we must assume that this new determinism can only emerge from the quest for evolutionary mechanisms outside of our illusory time.

A simplistic way of achieving such an evolution of space-time "out of time", within the framework of string theory, would be to consider that the settings for the vibratory functions (Shing-Tung and Nadis, 2010) that regulate extra dimensions might vary according to an as yet unknown mechanism, using information sources outside of 4D space-time that could be responsible for its atemporal evolution.

Carlo Rovelli, one of the authors of string theory’s main contender, loop quantum gravity, seeks another way of conceiving space-time evolution. In one of his books (Rovelli, 2012), he also suggests that we should rethink the world, as something that evolves not in time, but rather in an atemporal manner.

However, we can only envisage such a timeless evolution of space-time, whatever its dimensions, if we accept to "unfreeze" it, as illustrated in Figure 2.

3. The Atemporal Evolution of Space-time

In order to unfreeze space-time (Figure 2), we have to consider a possible evolution out of time, which we have shown equivalent to introduce cybernetical time (Guillemant 2019), that is a second time defined as the succession of couples of commutation times $\{CT_1(n), CT_2(n)\}$ that makes the space-time evolve everywhere at any present time T(n) between times $CT_1(n)$ and $CT_2(n)$. An example of such couples is illustrated in Figure 3. Note that the $CT_i(n)$ are never equal to T(n) and not ordered in time, meaning that we can often have $CT_i(n+1) < CT_i(n)$. We can then consider the cybernetical time as the time along which we change our universe, i.e. we move from one universe to another within a browsable

multiverse of potentialities, which must be distinguished from the realities of “other being”.

Since this solution has to respect the laws of physics, it can only be valid if the changes have their origin into infinitesimal quantum fluctuations. Indeed, in (Guillemant *et al*., 2013, Guillemant *et al*., 2018, Guillemant and Medale, 2019) we have demonstrated that those fluctuations can have considerable effects on timelines, since they tend to diverge greatly at a macroscopic level as the number of interactions is growing.

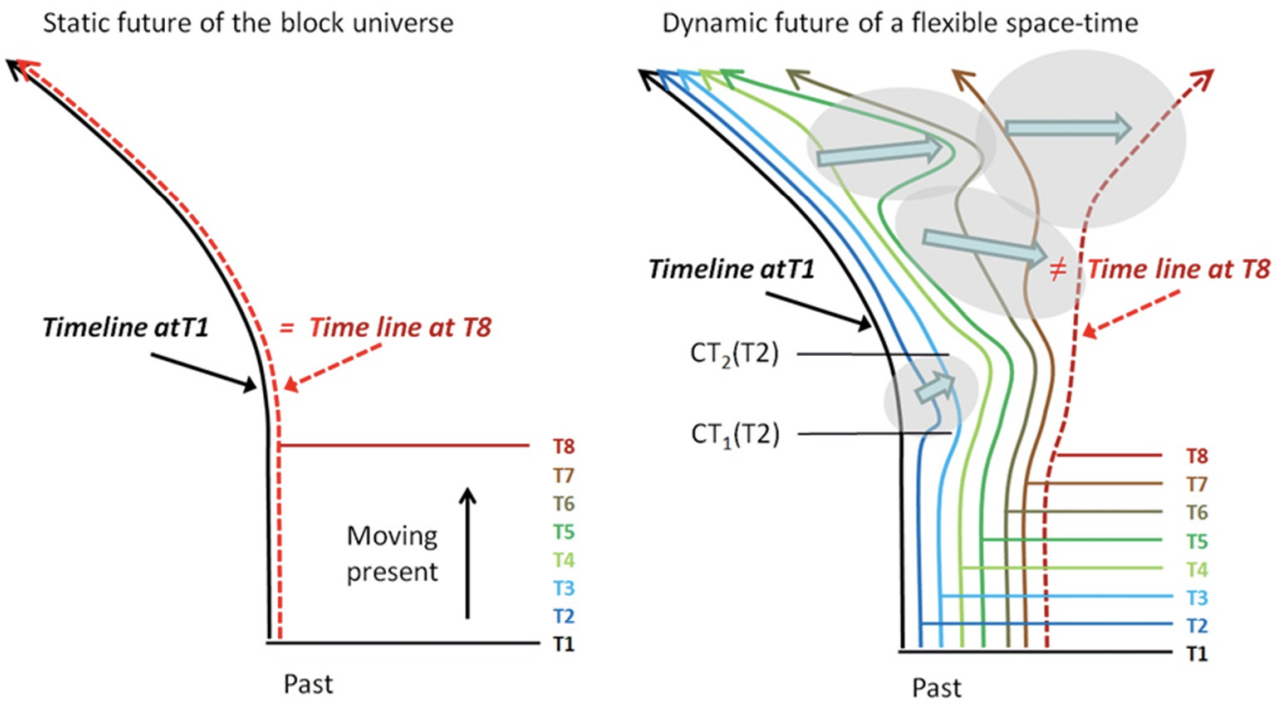

Figure 3. The multiverse of potentialities can be understood as a “territory of timelines” in which it is possible to navigate from our current timeline (at T1 in black) to other ones (from T2 to T8) via successive commutations (arrows), in the same way that paths and destinations can change when we use a GPS to navigate into a road network.

In a more synthetic paper (Guillemant, 2019), we have suggested the GPS metaphor (Figure 3) to understand the way our universe could change, as it is the best way to understand space-time commutations. Recall that our space-time flexibility hypothesis is based on the generalized result that it is possible to make a commutation of events locally in space, along a limited time, without collapsing the space-time structure as a whole. This requires the essential condition that any change should have a certain duration after which the future is no more affected at all. The evolution of space-time would then result from innumerable commutations that step by step would end up completely changing its event structure. This evolution process requires additional information from outside space-time, which result in a modification of the values of extradimensions as defined in (Guillemant *et al*., 2018) or (Shing-Tung and Nadis, 2010) depending on the model, in order to specify which version in all possible universes we live in.

Note that if this additional information was lacking, we should consider the possibility that the path of one object is not locally unique to be a macroscopic property, meaning that several events or branches of the multiverse would coexist

simultaneously into our universe. This is only conceivable if we consider future events, which have never been observed before. So we may have to conceive additional information of extra dimensions in the same sense as the quantum fate that is involved into the collapse of states in quantum mechanics. In the absence of collapse, the states as well as the paths are undetermined. However, when extra dimensional or random fate data (which finally amounts to the same) arrives in space-time, it becomes determined.

Now, whatever the way we consider additional information- issued from outside space-time, due to a temporary incomplete physics, or irrelevant in case of a quantum future - it should emerge from what quantum gravity theories could tell us, and in particular loop quantum gravity (LQG) emerging from the famous Wheeler Dewitt equation (DeWitt, 1967).

Contrary to string theory, LQG actually lets quantum randomness come into play, giving it the possibility of managing additional information, which could substitute for randomness. One attractive aspect of loop quantum gravity is that it does not require any extra spatial dimensions, but it does not solve indeterminism. However, it vibrates the inner structure of space-time at Planck level, but these vibrations have not yet been described other than in a purely probabilistic way. The theory is based on very tiny loops that bear an obvious similarity with the strings: all you have to do is to consider the loops as strings that, instead of vibrating without moving the space, actually vibrates the internal structure of space without having to introduce the idea of extra spatial dimensions. However, it should be still necessary to respect the inherent vibratory functions of strings, something that would no longer imply the existence of actual "rolled-up" spatial dimensions, but true degrees of vibratory freedom, or even "vibratory space dimensions". However, what is especially interesting here is that their vibratory modes should not be regulated by mechanics based on ordinary time, as this time has disappeared in (DeWitt, 1967).

So how can we describe these vibrations? Mechanics necessarily describes an evolution, while no mechanical evolution can be based on calculation without resorting to a time-variable closely linked to this notion of evolution. This is why we have distinguished two types of time, the usual Newtonian time and the cybernetical time (Guillemant, 2019), the latter being illustrated by arrows in Figures 2 and 3.

Such an idea approaches one of the proposals put forward by Stephen Hawking, whereby in order to describe the history of the universe just after the Big Bang, he introduces an imaginary time perpendicular to Newtonian time during which this history could vary, something that amounts to changing the initial conditions of the universe (Hawking, 2001). However, there would still only be one real creative time, the cybernetical one in which we could change timelines, as our usual time does not describe any real change in space-time. The possibility thus left of vibrating a new timeline in the cybernetical time is what makes it possible to describe the vibrations of space-time without falling into the trap previously highlighted by the space-time "prison".

As we now understand that the values of extra dimensions or the vibrations of space-time could occur out of time in order to change our timelines – which is somewhat equivalent to slip from one universe to another –, we can metaphorically depict these vibrations as waves on an ocean representing space-time. This appears in the illustration of Figure 4, with the cybernetical time figured by an arrow to the left. We can get a rough idea of their effect on an individual's timeline by making him move through life inside an invisible flexible tunnel (Figure 4). Floating on the “quantum sea”, this tunnel could

take on different shapes according to the motion of the waves; thus, even if the life of an individual can be traced from birth, it could in fact change during the course of his existence.

We can then make the connection between this way of considering the space-time evolution and that described by the GPS metaphor (Fig 3). While the latter is well suited to describe elementary evolution based on commutations, the metaphor of the tunnel is on the contrary the best adapted to describe the consequence of innumerable commutations. And the gravity waves on the ocean should then be considered as responsible for the elementary commutations or paths switching: that's exactly what quantum fate makes possible. In such a description, quantum fate thus appears as the result of macroscopic changes in the position of the tunnel, thus involving a top-down causation that is similar to that invoked in the Santo & Gisin paper (Santo and Gisin, 2019).

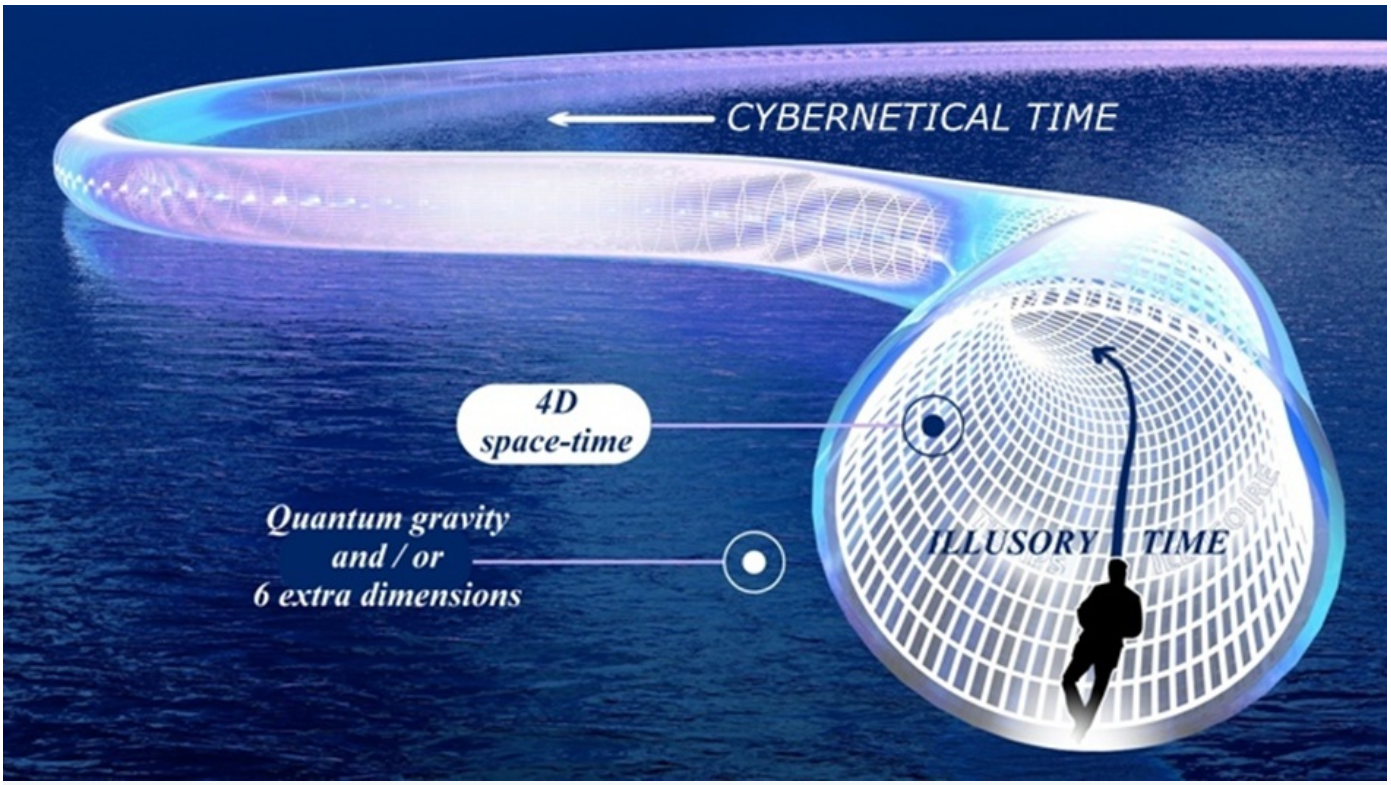

Figure 4. Ocean waves of quantum gravity could displace our timelines (life tunnels), resulting in space-time flexibility. This ocean is made of "out of 4D space-time information" that could also be described by variable values of extra dimensions.

In this way, we can see that Newtonian time, the equivalent of moving through a tunnel, is reduced to a kind of purely spatial dimension, while the cybernetical time disturbing the waves on the ocean is really responsible of evolution. The Newtonian time thus becomes no more than the illusory sensation of consciousness that a change of environment is produced during a journey, even to the point of making us forget that the environment itself also changes out of time, regardless of the speed of our journey.

The fundamental difference between our usual concept of time and the second one we are proposing here is that while time passes, bringing us nearer a precise date in our future, not only does this future already exists, but above all, it

continues constantly to evolve, to the point that the new future that we will eventually reach might be completely different from that which existed a year earlier. Imagine the passing of time like a train journey: nobody would dream of thinking that when we got off the train, the same events must have happenned in the station as what happened there when we got in.

Such a concept is hindered by our difficulty in imagining that our future could be as realist as our present. This stems from our tendency, even in the present, to confuse reality with what we actually perceive of it. A simple effort of logic forces us to admit that the only thing we really know about reality is that it is a field of information common to everybody's consciousness and somehow "connected" to it via our brains. Today, physics distorts our representations of time, space and matter so much, that it would in fact be more reasonable to consider them as creations of the brain, or even of consciousness itself, rather than realities that exist, as we actually perceive them. There is in particular no reason to distinguish the space itself from consciousness. Taking this as our starting point, we can give the future a much more flexible status than that which consists in believing that a "hard" future exists with the kind of information we can perceive in the present, as matter in space.

Which brings us to the following and fundamental question: do the events of our personal future change due to new intentions, projects or still unconditioned objectives, implying a real free will? Or would this free will be totally illusory, in case the changing of events in our timeline would only depend on atemporal (or outside time) fluctuations in the quantum gravitational field, according to physical laws we do not yet know? Considering the latter as a more scientific hypothesis, we are led to understand the changes in our intentions, and more generally all ideas or emotions that could affect our timeline, as the result of space-time flexibility due to quantum gravity, somewhat like a boat pilot who could in spite of himself be oriented by the waves.

Another way to highlight this dependence between space-time and our brain is to note that it goes without saying that since our intentions are correlated to our future, our cerebral activity is correlated to these waves, namely the fluctuations of the quantum gravitational field on which our future (or the trajectory of the boat) depends.

Though this is not compatible with the largely consensual and materialist conception of brain itself, this atemporal link between space-time and brain activity is in harmony with (Zwirn, 2020) and also with the Connes & Rovelli proposition about time (Connes and Rovelli, 1994), which they claim would be an illusion created by brain itself, forced to work with its information in a sequential or linear manner. Now, if we are to introduce the possibility for the brain to be influenced by atemporal space-time fluctuations, we must also to attribute their information to an atemporal extension of the brain, which necessarily corresponds to extra dimensions of space-time.

This is giving us an argument to make a fundamental differentiation between brain and consciousness. The two would not be strictly causally linked, which has never been proven, but only correlated. It would in particular imply that brain and consciousness would have different natures or ontologies, the first being linked to physical information and the latter to quantum information, or “out of 4D space-time information”. The mechanism involved in the relationship between brain and consciousness would then concern extra dimensional data: as long as consciousness is solely involved, this data would be in a quantum state but when the brain needs this data, this would cause a collapse of the quantum state where

extra dimensions would then be well defined, as well as the timeline of the brain or the person himself.

And so, following a path that consists in burying time in order to give birth to a new time, where the past and the future evolve simultaneously, our ideas converge with those of the illustrious physicist and mathematician Roger Penrose, whose work in collaboration with Stuart Hameroff develops the hypothesis of the quantum brain (Penrose and Hameroff, 2011). According to this hypothesis, consciousness is by nature made up of quantum gravitational information and it allows collapse of the quantum state to occur in the brain, a collapse non-locally orchestrated.

What do we know about the brain and its complexity that would be in accordance with this hypothesis?

4. From Brain Complexity To Quantum Hypothesis

The human brain is a complex organization of neural tissue, with approximately 86 billion neurons organized in networks, each neuron forming thousands of links with other neurons, giving a typical brain well over 100 trillion synapses. Most studies in neuroscience are focusing on the brain matter: cells made of molecules, themselves made of particles. Electroencephalography (EEG) allows to record on the surface of the skull the resultant of the synchronized or correlated activity of a great number of neurons mainly on the cerebral cortex under the skull (Niedermeyer and Da Silva, 2004). These rhythms have been classified in term of frequency band: delta rhythm <4Hz, theta between 4 and 7Hz, alpha 7-13 Hz, beta 14-30Hz, gamma 30-100Hz and the various EEG waves have been correlated to different activities or states of consciousness (Hugdahl, 2001). For instance, delta waves are observed in the frontal cortex during adult slow wave sleep (deep sleep); theta during drowsiness; alpha in posterior regions of the head during relaxation; beta during active thinking and focusing; gamma in sensory and short term memory processing. During waking states mostly low-voltage, desynchronized brain waves are observed. Thus, brain is functioning differently in the different states of consciousness.

We have shown in the past (Guillemant and Rey, 2005) that the mathematical dimensionality of brain activity can be evaluated in a successful and productive way (Rey *et al*., 2007) through the concept of “dimension of activation DA”. However, at that time, we had not found any model of brain activity that could explain our measurements. Such a model, explaining the high dimensionality of brain structures, has been proposed in a recent study (Reimann *et al*., 2017), showing that the human brain can create structures in up to 11 Dimensions. This is in harmony with our results (Guillemant and Rey, 2005) in which the dimension of brain activation was measured to vary from 4 (for a deep sleep) to 10 (during a cognitive task requiring full awareness). We also measured the effect of anesthesia, which, conversely, lowered the DA from 10 to 4. It could not be just a coincidence, because it is remarkable to notice that, from the absence of consciousness to full consciousness, the brain activity gains 6 “additional” dimensions.

The information in the brain can be coded by the firing pattern of action potentials (transient membrane potential depolarization that propagates along the axons of the neurons), and by rhythms emerging from groups of neuronal firing together in assemblies (Reimann *et al*., 2018). In most brain areas, two or more of these rhythms can superimpose and several rhythms have been associated to the coding of information (Buzsaki and Watson, 2012). For instance, in the hippocampus, a brain area particularly involved in learning, memory, spatial and temporal coding, theta/gamma discrete

phase code has been shown to encode sequential places in the form of sequential gamma subcycles of the theta cycle (Lisman, 2005). This code, involving correlation with diverse degrees of freedom, is also occurring in several other areas of the brain and multiple oscillations may serve a general function: the encoding of multiple units of information (items) in a way that preserves their serial order (Buszaki, 2006; Lisman, 2005).

The question of how this physiology gives rise to the phenomenon of consciousness remains elusive. How our conciousness gives sense to the reality? How does it transform the reality into representation? (Naccache, 2018). Some neuroscientists think that from the huge complexity of the brain matter could emerge the extraordinary competences of our brains bringing us a representation of the external word (Damasio, 2012). The occurrence of changes in the environment or inside the body can be detected through the various captors of our senses and is influencing the transmission of information into our brain but only a part of the information is kept. Neuroscientists such as Stanislas Deheane have shown that the brain is engaged in calculations of an extreme complexity before we can reach the conscious level of information and most of the information we treat (about 98%) remains at the unconscious level. In other words, in the brain, there is a dynamic flow of information moment after moment, some of which, only, are remembered. Functional imaging techniques show that a correlate of the conscious level (occurring at least 300 ms after the stimulus) corresponds to a huge sharing of information between the different brain areas which are responsible for selected treatments of the information (Deheane, 2014). Why and how certain information become conscious while other are not depend on many factors all of which are not fully understood.

In 1973 Benjamin Libet, in a series of fascinating experiments (repeated many times by other groups), proved that unconscious cerebral events (observable in the form of electrical potentials, called preparation potentials) actually precede, in variable time (by 0.3 to several seconds) the conscious feeling of having made a voluntary decision in preparation for a motor action, such as pressing a button (Libet, 2002). John Dylan Haynes more recently showed using imaging that it is possible to predict the choice of people to press the right or left button even before the decision is taken consciously, up to 7 sec before thinking to have decided by examining the MRI voxels (Soon *et al*., 2008).

This questions the notion of free will. A first interpretation of these experiments is that our feeling of liberty is created by our brain and that our consciousness is following the decisions of our unconscious brain (in our psychological time), just informing and/or keeping the event in memory. Another interpretation, in line with our theory, is that the future is already realized and that the Consciousness is present in a time interval that belongs to the future (cybernetical time), that would determine in advance, when it seems the opposite, the initial brain decision and/or the access to awareness (Figure 5).

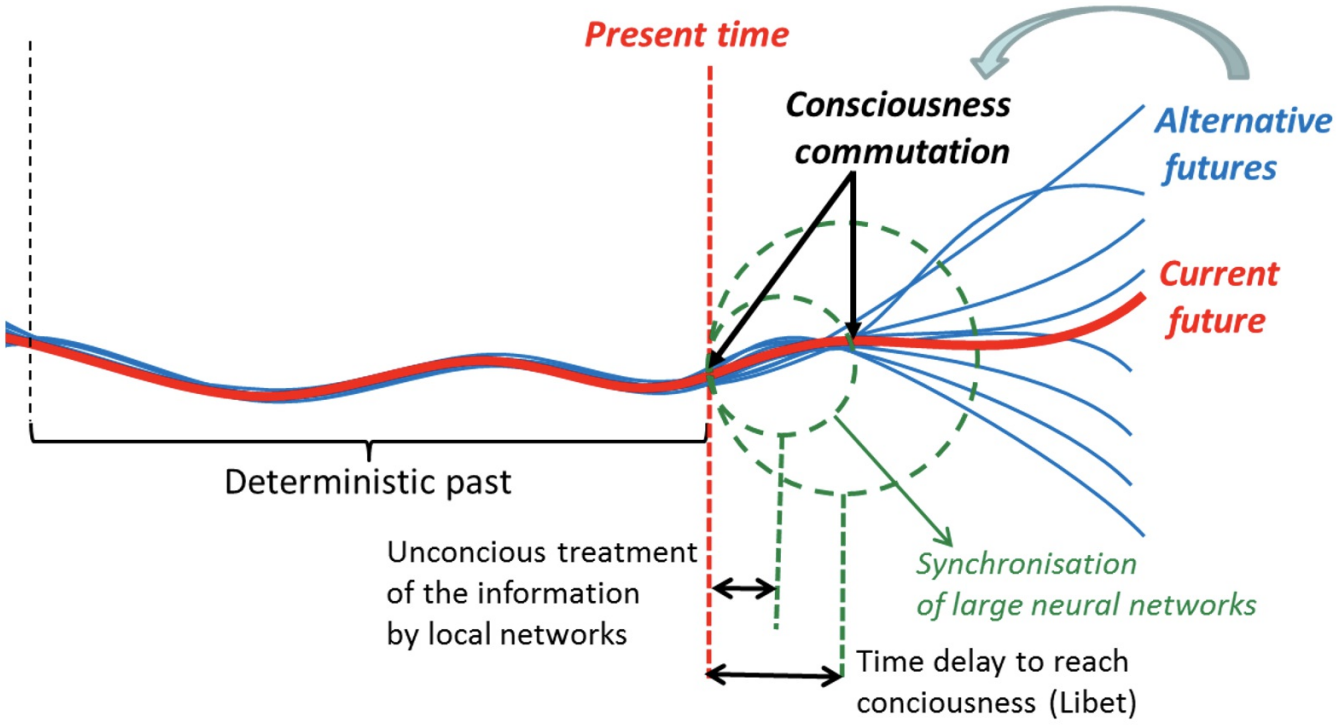

Figure 5. Libet's experiments showed that it takes a fraction of seconds to seconds between the brain initiation of a simple choice (pressing a button) and the moment when the person becomes aware of this choice, correlated to a spreading of the activity in large integrative neural networks. It might also never become conscious. The Future could act to orientate choices at the initiation of the brain activity of local neural networks and/or could favor or not the processes involved in the awareness.

Most ancient spiritual traditions claim that using techniques such as meditation, relaxation, or mind-body techniques (Yoga, Tai-chi or Qigong, …) can help raising the "vibration level" of our brain and our body, which could put us in a state more susceptible to attract changes according to how you direct thoughts and emotions. Interestingly, those practices all induce a highest synchrony, coherence and harmony level between the various rhythms of the brain and the body, creating more order that could be explained by a gain of information or negentropy thanks to an influence from the future (Costa de Beauregard, 1995).

Let us take the example of meditation, which consists in inwardly and consciously directing attention in a particular way. Meditation and mindfulness induce a heightened state of awareness and focused attention and it can significantly impact and change brain's structure and function, being a self-directed neuroplasticity - as our brain is extremely plastic, its functioning and our perceptions on the word is constantly modified by training - (Lutz *et al.*, 2008, Goleman and Davidson, 2017). Besides thickening the hippocampus, enlarging the prefrontal cortex (an area responsible for rational decision-making) and shrinking the amygdala, a key brain structure known as the emotional or fear center of the brain, meditation practices can enhance particular EEG brainwave activities such as high-amplitude gamma brainwave activity (correlated with states of heightened awareness and bliss) (Dentico *et al.*, 2018). Meditation can also reduce the activity of the brain default mode network activity (an interconnected group of brain structures that are most commonly active when a person is not focused on the outside world and the brain is at wakeful rest, such as during daydreaming and mind wandering),

thus “optimizing” how the brain uses resources. Changes in EEG power and coherence can also be recorded, for example, during mystical experiences (Beauregard and Paquette, 2008).

In addition, during meditation, relaxation techniques, prayer and body-mind practices (Yoga, Qi-on, Tai-chi, …), the body usually adopts a special rhythm called cardiac coherence (Tuladhar *et al*., 2018), that can be also achieved by simply controlling one’s breathing (5 sec inspiration, 5 sec expiration) (Goshvarpour and Goshvarpour, 2013; O'Hare, 2014). Breathing influences the way the autonomic nervous system regulates heart rate: inhalation temporarily inhibits the influence of the parasympathetic system and increases heart rate, while exhalation stimulates the parasympathetic system and decreases heart rate. During cardiac coherence, there is an ideal sympathetic/parasympathetic balance leading to a coherence between cardiac and breathing rhythms, with a maximum heart rate variability, which allows increasing the adaptability of the autonomic nervous system, providing subtle control over many organ function in the face of stimuli or stress (O'Hare, 2014). In the same line, cranial rhythmic impulse is a fundamental concept used by osteopaths in their practice. The amplitude of this phenomenon, which is supposed to be related to harmonization of heart-brain-circulatory rhythms and to allow a fluid circulation of the energy in the organism, increases under meditation, relaxation and cardiac coherence breathing, leading to a state of wellbeing, plenitude and receptivity. Interestingly, this rhythmic impulse can be simultaneously monitored and recorded with the primary respiratory mechanism (PRM) as manifested by the Mayer waves, which are oscillations of arterial pressure occurring spontaneously in conscious subjects at a frequency close to that of respiration (0.1 Hz in humans) (Julien, 2019). Mayer waves are tightly coupled with synchronous oscillations of efferent sympathetic nervous activity, which would induce rhythmic changes in fluidity of the extracellular matrix both in the brain and in the periphery, favoring metabolism and assuring nutrients and waste products an efficient transit through the extracellular space (Lee, 2008; Nelson *et al*., 2001).

We suggest that inducing such high synchrony, coherence and harmony level between the various rhythms of the brain and the body could result from a future that primarily exerts its negentropic influence against all other entropic alternative futures, as suggested by the Maximum Entropy Production Principle (Martyushev and Seleznev, 2006). This implies for a future time line to be able to commutate from one alternative to another, a possibility that we have argued to result from space-time flexibility (Guillemant and Medale, 2019), which would be made possible by the multi-paths and even partially quantum nature of the future at a macroscopic scale. This can also be understood with the Zwirn model of convivial solipsism (Zwirn, 2020) which argues that the brain of the observer determines the time line, as well as at the quantum and macroscopic levels through the mechanism of decoherence.

The quantum brain hypothesis has long been criticized for the main reason that decoherence time (a concept we will not enter here) is too short to allow the brain to act like a quantum computer and consciousness to be linked to quantum coherence in microtubules (Hameroff and Penrose, 2014) or ion channels of neurons (Reimann *et al*., 2018, Salari *et al*., 2017). However, more and more studies (Georgiev, 2004; Schwartz *et al*., 2005; Salari *et al*., 2017; Adams and Petruccione, 2019) show that it has become today a reasonable hypothesis.

One very interesting element of the Penrose-Hameroff approach is that they respond to objections to their theory on the decoherence time (Hameroff and Penrose, 2014) by invoking a mechanism of time paths using "commuters" which

intervene atemporally before the orchestrated state collapse, i.e. before the paths which will eventually determine the firing of neurons actually entering space-time. This means we have to get rid of any sort of ordinary-time reasoning to understand the phenomenon of consciousness.

The complex mechanisms of functioning of the brain allow multiple hypothetical possibilities of action for a putative atemporal path that would affect quantum coherence. Transmission in the brain is an electrochemical mechanism that can be influenced by electromagnetic changes (such as by electric stimulations or magnetic fields) and chemical changes (changes in ion concentrations or presence of molecules that mimic neurotransmitters or interact with the receptors or the reuptake, diffusion). Neuronal transmission involves ion channels (responsible for the action potential) which opening and closing properties obey to a quantum process, with a certain probability and can be influenced by physical factors (such as voltage or temperature). Neurotransmitter release involving vesicle exocytosis, mainly depending on calcium concentration, is also a quantic process. Post-synaptic receptors including G coupled protein receptors (GPCRs) change their conformation after binding the neurotransmitter, inducing the opening of ion channels and/or intracellular signaling and have been shown to behave in a quantic way (Georgiev, 2004). Finally, intracellular molecule assemblies constituting the cytoskeleton such as microtubules as well as molecules of the extracellular matrix (like integrin) can influence the functioning of the neurons and these molecules are susceptible of quantum coherence processes.

Commuting any of these elements could change the functioning of the brain and the body, and thus influence our behaviors. The greater coherence of the rhythms in the brain and the body could contribute to a better amplification or filter of the coming information.

5. Quantum Gravitational Consciousness And Brain To Space-time Connection

The key to our understanding seems therefore to depend on addition of the new cybernetical time, which allows us to describe the evolution of our timelines in a space-time "unfrozen" at the quantum level by a quantum gravitational consciousness. In support of this idea, let us quote again Stephen Hawking. Describing an imaginary time capable of changing the history or the initial conditions of the universe, he affirms that such a time, perpendicular to Newtonian time, could well be more real than our usual time (Hawking, 2001).

On the basis of such ideas about a new time associated with a quantum gravitational consciousness, we could now cross the boundaries of physics to explore new and practically virgin territory, which would be a matter of a "metaphysics of quantum gravity", or more scientifically of a “cybernetical physics of timelines” (Guillemant, 2019).

However, in the course of this exploration we want to keep a resolutely determinist and logical point of view, leaving the reader free to choose whether to retain or deny free will. In fact, it is of little importance to know whether our conscious state determines our timeline or whether, conversely, our timeline determines our conscious state. What is important, however, is that the timeline can indeed change under the control of a mechanism operating in the "eternal present" of eternalism that embraces the past and future of the whole of space-time and will not necessarily rule out free will.

Let us suppose, then, that consciousness, whether illusory or not, acts upon our timeline according to determinism that originates outside space-time. The result is that it cannot be the product of the brain alone, because this new determinism engenders fluctuations in space-time that, when considered outside of time, are no longer frozen but fluid. This fluidity, responsible for the slippage of our timelines, could then orient its evolution towards a negentropic creative future, as opposed to what is supposed to be achieved by a purely temporal mechanism, if temporal determinism was true.

If this sort of future is prepared in the present, then how could we use our state of consciousness to provoke the perfect quantum vibrations to drive us there? What this question reveals is our irresistible tendency to reason without being able to rid of the illusion that the future must necessarily be the result of the present or the past. The pre-existence of the future, on the contrary, obliges us to conceive that any influence on the future must be exerted directly on it, therefore outside time, and not by some change in the present followed by its causal consequences. In fact, any attempt to change the present may end up having no causal consequence at all, as there is a risk that a well-defined future may block out its effects, forcing any deviation from the timeline to meet it back and leave it unchanged.

In order to impose determinism born in the present, the future that comes immediately after it must be malleable and unstable – that is to say short on information or, which amounts to the same thing, indeterminist. Change in the present cannot actually causally alter a timeline unless it encounters a sufficiently distant future, where the density of information is too high to permit any longer deviation.

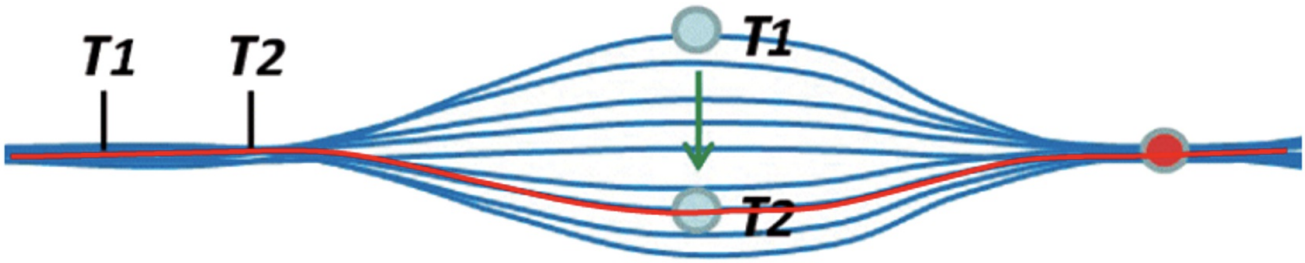

Figure 6. A timeline leading to a firm appointment (red circle) may swing between T1 (departure) and T2 from one means of transport to another among many low-density (i.e. low probability) timelines.

For example, someone makes plans to attend a training course in a few days' time. The course content is entirely planned in advance, but the event is being held a long way from the person's home, somewhere difficult to get to, with unreliable transport like hitch-hiking. So they set out very early to make sure of getting to the course, ready to walk part of the way if necessary. Here we can see the contrast between the determinism of the course, which is high probability, and the indeterminism surrounding the question of transport, characterized by multiple low-probability solutions or, which is similar, by a low density of information on timeline of the person: when the line becomes unstable, it can oscillate between a wide range of switching possibilities (Figure 6).

We could deduce from this that mechanics is unable to create the course using determinism born of the present; unless

we assume that the student's brain provides it with the information that defines the purpose of his transport. In this case, his presence on the course would be determined in the future before his mode of transport. This would imply that when the realization of an intention is certain, then this intention is memorized in not only the brain, but also in the future, which could even impose a determinism that would prevent the brain from forgetting the intention.

Otherwise, it would have to be assumed that the future corresponding to the course should delay its own creation until any indeterminism on transport disappears, but we are then left with the idea of integral presentism, which we have rejected, as well as more and more eminent physicists specialized on the question of time (Ellis and Drossel, 2019, Rovelli, 2019).

If we assume that reality does not wait for the passing of time to determine itself, then this inevitably implies that any reliable intention memorized in the brain is like a necessary corollary "memorized" in the future, and the link between this and the brain necessarily implies atemporal "switching" mechanics for updating space-time, which would operate by means of quantum gravity and as a result by means of physical information acknowledged into space-time. We do not necessarily have to conclude from this that what we are seeing here is free will being exercised, because the new mechanics involving physical information issued from extra dimensions and entering the brain may very well remain deterministic.

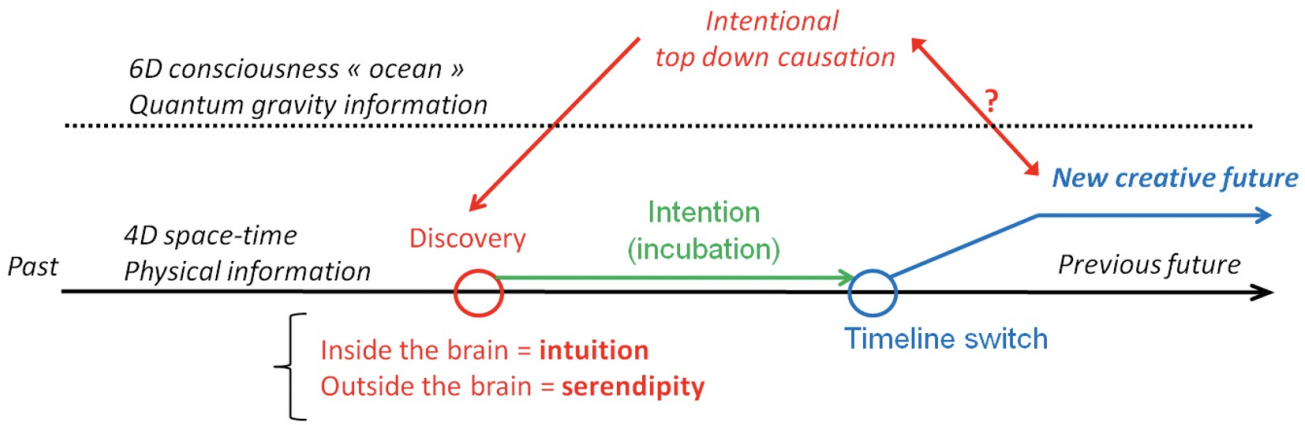

Figure 7. Acknowledgment in the form of a discovery (intuition or serendipity) of an intentional top-down causation related to the potentiality of a new creative future. The possible link between intentional top-down causation and creative future remain speculative (free will, unknown physical law…).

Figure 7 illustrates as simply as possible this acknowledgment of physical information into space-time in the particular case of a new creative timeline after a discovery. Note that the notion of physical information we use to describe the evolution of space-time corresponds to the reality displayed in its four dimensions. It is important to specify that this physical information is quite distinct from quantum information, which is staying physically undetermined (probabilistic) and as such belonging to the "quantum ocean" of Figure 3, containing a myriad of non-manifested potentials.

Physics teaches us that the entire vacuum necessarily contains energy, i.e. quantum information, due to the Heisenberg uncertainty principle, which prevents space-time structure from being perfectly defined locally (so as not to cancel out the

uncertainties relating to everything that influences this structure). Space-time, therefore, fluctuates everywhere at quantum level, causing the appearance of virtual particles that constitute the energy of vacuum. However, each event thus introduced into the vacuum is somehow compensated by an “anti-event” which counterbalances the energy imbalance. This is why the vacuum seems empty.

Because the ratio of quantum vacuum energy to the energy of our reality is so dizzyingly high, it makes more sense to consider it in terms of quantum information rather than energy, for the reasons we have already indicated: although our reality is independent of us, it is still a construction of our brain, or even of consciousness itself. Some authors, like (Carminati *et al*., 2011) and (Martin *et al*., 2009), following in the footsteps of C.G. Jung, prefer to speak of a construction of the “psyche” by extending it to our subconscious, claiming that it is directly connected to our four-dimensional space-time by the quantum vacuum influence on it.

Based on this hypothesis, the Penrose theory of a quantum gravitational consciousness implies that the information in the vacuum is indeed connected to our brain via quantum vibratory structures (like microtubules) corresponding to the psyche, both conscious and subconscious. The information contained in the vacuum is not therefore fundamentally probabilistic, in the way we conceive it in quantum gravity. It would appear to contain all non-manifest potentials of a multiverse and then to be organized entirely by causality, the cement of science.

More specifically, information could be organized in the vacuum in the form of causal relations forming temporal sequences – or archetypes – interlinked inside a vast network, like some huge hyperdense rail networks where it is enough to set up the switches that define the directions of the rails. A timeline in the vacuum for this network could then be stimulated locally, after activating the switch of a corresponding archetype that could thus divert a timeline in the future, long before it enters the present in terms of experienced reality. Now, for such switch activation to be possible and even considered as a “choice” at the macro scale of the switch, we must consider the possibility of an influence of this macro scale to microphysics: this is precisely the concept of top down causation recently revived by (Santo and Gisin, 2019) and (Ellis and Drossel, 2019).

In this new top-down and atemporal mechanics we are proposing, we therefore do not start from a point in space-time and do not determine which points will follow along this line, because such calculations are subject to indeterminism. What we are talking about is using switches to manage the possible branches on the line within the field of possibilities, by stimulating the “vacuum energy” or, more accurately, the “vacuum multiverse information”. In this way, the mechanics of space-time ceases to be sequential, or what we might call “computer novice”, but rather becomes something more worthy of an intelligent computer engineer, who simply manages the switches on timelines which are updated instantly and atemporally in the vacuum by a double causality (top-down and bottom-up), while the auxiliary software performs the updates themselves.

One question arises: how does the vacuum stimulus actually causes a switch change in a bottom-up effect? Conversely, should we not view this stimulus as a top-down consequence of an imposed future? This is questioning free will and we do not intend to solve this question in this paper, as we do not need it. We just need to consider in a psychological

perspective the correlations between switch changes and the emergence of new intentions, stimulated by chance, creativity, intuition or serendipity.

Let us remember that if we find it so difficult to conceive that new intentions can emerge from the quantum vacuum in order to produce a new future, it is because of the fundamentally illusory nature of physical reality as we irresistibly conceive it, while from a strictly objective point of view, this reality is only a set of information passing through our senses and our brains, which does not exclude that there is a reality independent of us. We can keep doing physics, but we have to be absolutely logical about it, considering our intentions as physical realities, with the additional ingredient that they do not seem to depend only on our brains but also on an information system outside of space-time, that is successfully switching changes, whether it does it in a master or slave manner.

Such an information system would thus have the possibility of changing our future, but only if it succeeds in causing quantum waves in the present of our consciousness which results in the emergence of corresponding intentions. The discovery of Figure 8, whether intuition (inside the brain) or serendipity (inside the environment), therefore seems to come from the apparent will of a subconscious information system belonging to the quantum vacuum (self) and “using” my consciousness (myself) to achieve change in the future.

In the case of the brain, since this will is recognized as a germ of an intention, which is not considered to come entirely from the brain, we define its information as an “intuition”. More precisely, “intuition” is defined here as the germ of an “authentic intention”, i. e. which is not manufactured by the brain. Remember that what we call here “will” do not necessarily imply free will, as we do not need this assumption. We simply differentiate an “authentic will” from a “simple will” in the sense that the latter do not involve any extra dimensional data related to a switch change in the future.

Maintaining a scientific approach while using the terms “will” or “self” in a non physical sense leads us to invoke the existence of determinism external to space-time, which is apparently responsible for some of our intentions. This means that such determinism should involve the following two input-output functions:

1. Information external to space-time, exerting “intentional top-down causation”, enters mechanically into space-time as soon as consciousness reduces the determinism of the brain enough to allow the germ of an intention to enter: this germ is called intuition and it could also manifest outside the brain by serendipity, then requiring “attention” to the environment.
2. Information internal to space-time, result of awareness of the intuition and thus transforming it into an intention and decisions, sends a “message acknowledgement” signal or a firing of neurones which collapses a state of coherence, thus activating an update of the timeline in the vacuum.

What must be emphasized in the mechanism involved is that, as it is atemporal, it should also act simultaneously on every switch in the future which could be activated by the same intention, as long as consciousness embraces it by experiencing this intuition as coming from “self” and not instinctively (from the brain). Everything happens as if consciousness then informed the information system that something has been learned, so that it could modify all the switches related to it in the future.

The particularity of the present of consciousness, with the specific sensation of awareness that distinguish it from any other instant, might thus consist of being the instant at which the external information system can play its fundamental role, that is to cause an update of the future via a successful connection with the brain.

6. Atemporal Mechanics Through Retrocausality And Consciousness

The concept of retrocausality has recently gained a lot of credibility, thanks to the work of (Dragan and Ekert, 2020) that demonstrated that the main aspects of quantum mechanics (multiple paths and indeterminism) can be deduced from a special theory of relativity where the superluminal part of its mathematical structure is no more arbitrarily rejected, which implies that in certain situations, causes can arise after their effects.

This is more easily conceivable into a flexible space-time where timelines can change. In any deviation of timelines, the future acts as a magnet resisting any prolonged divergence of the line. A phenomenon of retrocausality is inevitably at work here, which in the context where the future is already realized but still uncertain because changing, has exactly the same sense that the “top-down causation” that we mentioned in introduction. But top-down causation is a relevant concept only if the future is not already realized and in this case, the influence from a top scale to a bottom scale remains mysterious. Now, if the future has the same status as the past, it is better to refer to retrocausality, which perfectly solves this mystery. In such a timeless context, these unconventional causalities play exactly the same role as that of deciding what happens, whatever it is illusory free will or not.

The shape of the timeline diverted from its trajectory in the present depends in fact simultaneously on its past and its future, which both act as stabilizers. We therefore see that retrocausality combined with causality are essential stabilizing factors in the dynamics of space-time, in that they allow it to evolve gradually and in a coherent manner, preventing tiny changes from having huge consequences that would become mechanically unmanageable. Mechanics in cybernetical time thus appears as a real “relaxation dynamic of space-time” based on double causality, something already inscribed into physics equations, which operate back and forth in time. This would imply an exchange of information occurring between internal and external space-time, making it possible to update timelines by switching the points, until they densify and are finally “crystallized” by the consciousness under the form of a “recording” of physical information.

There therefore does not seem to be a transfer of information between the present and the future in space-time, but simply the presence of information systems outside of space-time exerting an “intentional top-down causality” on the future of each timeline. We can conceive the positive result of this intentional pressure in a manner similar to a change in the parameters of the psyche of each system. It is therefore inevitable that such an influence on the future sometimes returns an “echo” to the present in a retrocausal, if not inexplicable, way.

In the book *The road of Time* (Guillemant, 2018), we have described double causality’s potential for solving or simply shedding light on numerous phenomena of this kind, particularly synchronicities (a Jung concept very close to serendipity) that we explain as follows: “Our intentions cause effects in the future that in turn become the future causes of effects in the present”. This is based on the assumption of free will, which is not necessary in the present paper but which is

seriously considered in association with a double causality by eminent physicists like Ellis (Ellis, 2009).

The potential for double causality is certainly broader, as it could contain all sorts of effects on the present of changes affecting the future: we already mentioned intuitions, but we could add premonitions (Bem, 2011) and other kinds of named “extra-sensorial” perceptions that could finally be explained in a much less mysterious way.

Another potential of space-time flexibility, combined with a double causality, holds interest for physicists studying relativity, for whom the puzzle to be solved is the question of the chronological protection essential to space-time to avoid the temporal paradoxes (Everett, 2004) enabled by the theoretical possibility of time travel (Nahin, 2001). The retrocausality naturally provides the ideal system, prohibiting any return or change into the past which would be incompatible with the future of the point of return.

Such changes in the past must of course also be seen as the result of changes in the future, and vice versa. Note that if the future was waiting for us to live our lives in order to strengthen the changes prepared in the vacuum, this would once again allude to a certain presentism, as well as to the obligation for a sort of “reality processor” to be at work, to choose in the present moment what we would live in the next. Now physics has never said anything about any such “space-time processor”, something that presentism considers mathematically obvious. And yet, this is an idea that has just been seen as naïve for example by information technology engineers, for whom calculating a result has nothing to do with visualizing it (bringing it to live). It is therefore legitimate to question this simplistic hypothesis and propose that such an evolution does not exploit a sequential algorithm but rather a network of virtual neurons, as we proposed in (Guillemant, 2019), which operates simultaneously on the whole of space-time via living systems.

The function of such a network would therefore be to update the switches programmed in the quantum vacuum to take into account the evolutionary changes that would occur, in the present, in every information system or psyche linked to space-time. Within such a framework, timeless mechanics would operate like a huge “brain” and our timelines would undergo permanent changes in the future even if we ourselves had nothing to do with it. We would be involuntarily “retrocausally” determined by our future. Causality and its twin would quite simply be responsible for the cohesion of the creation achieved by this huge “brain”, of which we would be mere neurons or even sensory extensions.

Finally, note that given the indeterminism, responsible for the capacity of space-time to evolve, it is fundamental that this evolution can be oriented by information systems, allowing to place a limit on the field of possible finalities, which would be completely impossible if reality evolved in the present. If this were indeed the case, not only would we be missing of the algorithm that makes the choices - preferably something other than God rolling dice - but we would also have to find a solution to the problem of the vacuum which, in spite of its enormous energy density, is undoubtedly insufficient to contain the infinite field of possibilities of the multiverse.

What is interesting about such a model of space-time evolution is the fact that it lifts the veil on one of the great mysteries of quantum mechanics: measurement, where the information delivered appears as non-causal - that is to say independent of the past. The collapse of the quantum state seems to correspond to the reading in the present of the last configuration acquired by the observer’s timeline before the information about the measurement reaches him. Thus, the observation

would merely serve to “crystallize” the line, assuming that the past has not undergone any other subsequent change. Within this operation, a pure randomness disappears because the information observed is already an integral part of the immediate future. This immediate future could even already be entirely crystallized if we are dealing with complete determinism in the short term.

Last but not least, the phenomenon of quantum entanglement can be understood as closely linked to the switching of timelines, for the obvious reason that the local change in one’s individual life course also changes all the others life courses that are correlated with it. We have already explained in (Guillemant, 2019) how this switching process of entangled life paths could be managed by a neural network according to the three-layers perceptron toy model.

At this stage, it may seem ultra-speculative to dare to venture to define, even at a very simplistic level, the principles on which atemporal mechanics, capable of describing the evolution of space-time, could be founded. Nevertheless, the previous analysis provides us with precious clues which points us towards the following elements:

1. A principle of equivalence between the psyche (conscious + subconscious) and the quantum gravitational vibratory field, which reigns inside the brain and the rest of the body.
2. A principle for emitting point-switching physical information after a non-causal discovery (intuition or a serendipity event), resulting in the stimulus of a new intentional potential in the quantum vacuum.
3. A principle for receiving, inside space-time, intuition or serendipity information resulting from the finality of the system that regulates all the switches on an individual’s timeline.

This would make the psyche an entirely mechanical system, probably composed of six atemporal vibratory functions (as several unifying theories introduce six extra dimensions), whose structure or settings might improve thanks to the acquisition of knowledge. Thus, the main function of atemporal mechanics, relayed by the immense “brain” that is constituted of all its living beings, could be to gradually decrease the entropy of space-time.

7. Falsifiability: A Test For Influence From Future

Is this theory of space-time flexibility falsifiable? That is the first question to be raised, because if the answer was “no” it would not be scientific but purely metaphysical. We will show here that the good answer is “yes”, thanks to a falsifiability based on the possibility for timelines to change in the future as a consequence of its flexibility. If the future was not changing, there would not be a priori any way to test its influence on the present, as such an influence may as well be explained by causality. However, we have to mention the famous experiments of Bem (Bem, 2011) that highlighted a “feeling of the future” rather than an “influence”, though the author invoke “anomalous retroactive influences on cognition and affect” as an explanation of his result.

We think that the Bem protocols are more fitted for an interpretation in terms of feeling the presence of a future that does not necessarily change. To account for the anomalous perception, we could also invoke a time thickness of consciousness, extended to the unconscious whose thickness would be larger. As for really “changing the future” we

didn't find any existing protocol to test this hypothesis. Paradoxically, it is theoretically easier to test the latter, as it is possible to really change the future: just base an individual's decisions on the value issued from a quantum random number generator (QRNG), so as to create at least two different futures of which only one is supposed to happen. If the other is just an illusion, then the test will give a negative result.

On the basis of the "choice" thus allowed by a QRNG, one could specify that if its random value is included in a certain interval, then the individual must take a certain action or another (or no action) if the value is different. As quantum mechanics guarantees that such a value is of acausal nature, the choice between the two possible scenarios may imply a possible influence of the future, due to the change of one scenario to the other.

For example, you could ask people taking the test to think about an intention they have and for which they have to take a decision: talk to someone or not, travel to one place or another, try to stop a dependence (cigarette, alcohol) or decide to wait, etc. In each case, the individual is willing to solve a problem or come to a better situation, which we can also consider as intentional top-down causation.

We can then build a test that is funded on the assumption that a change potentially occurs in the future of each individual, for already existing reasons regarless of the influence of the test protocol. There is then a means detecting such a change using this protocol, which is to ensure that the random selection provides random information that is more or less likely to facilitate the change. The desired effect is that the information thus provided could encourage the individual to act in favor of this change, if for example he (or she) still hesitates to take certain actions in the direction of his (her) change.

In such a case, i.e. when the individual certifies that he chooses an action based on the information received, we can keep track of the number of these actions attested for a large number of actions and individuals in order to make the following statistics, based on the comparison of the scores obtained with two types of equiprobable random selections:

1. A random selection HA that could be influenced by future, like for example a QGNA or any other indeterminist source of random numbers.
2. A random selection HB that cannot or hardly be influenced by future.

It is then fundamental that the differences between HA and HB sources may be not responsible of a bias in the results. To create HB, we consider a sequence of m random draws between the k^{th} draw and the $(k+m)^{th}$ one, with identifiers Id(n) of q individuals and a unique QGNA source H(i) where i is the index of the random draw ($0 < i < q$), this property of equivalence can be obtained as follows:

1. HA = (H(i) + Id(n)) mod(N) where i = m values of different draws {k+1, k+2,…, k+m}
2. HB = (H(j) + Id(n)) mod(N) where j = m identical values of the same draw {k, k,…, k}

To fix the ideas, the parameters we used in a preliminary experiment we briefly talk about later were N = 1000, m = 25 and q = 500.

The only difference between HA and HB is then that in case of (2), the random value HB uses the same random value H(j) all the time, while in case of (A) the random H(j) is renewed for each new HA lottery. But since all id(n) are different

from each other, there is no way for anyone to guess that their information was driven by an HB instead of an HA drawing. However, if we consider HA and HB individually, they have exactly the same statistical distribution because they come from the same source and they imply the same calculation.

The way to distinguish HA and HB then appears only at a collective level and is not detectable by any individual, although it has a great influence on the HB value while it has no influence on HA: all the HB values except the first one of the sequence are determined by the first drawing of the sequence.

If, for example, the first drawing has generated information influenced by the future of an individual, which means that it was used by this individual to choose a special action, then all the following drawings depend on this choice and they can no longer, or hardly, depend on the next influences of an individual's future on HB information. So, if there is really an influence from the future, we can expect that the score of the attested actions based on random HB information will be statistically significant lower that the score obtained with HA.

The nature of given information could be of very heterogeneous in nature. For example, in one of the preliminary experiment that we have already done and for which we obtained positive results, but without any scientific value yet, we used a combination of a thousand of symbolically charged images with a thousand of legends composed of proverbs and quotes, involving two HA or HB lots by individual. Each of them had then to respond if the couple (image + legend) chosen at random that they received would be taken into account by them with the intention of making a choice to which they have previously committed. Although the results of this experiment were very significant, we did not published them because it was a preliminary test which was not performed for this purpose and then under sufficiently controlled conditions.

Now, there is a residual question, which is to interpret a significant result as an effect of serendipity or intuition. We have seen that the difference between them is that intuition occurs in the brain and serendipity in the environment, but it is not so clear. It is not really possible to prove that intuition does not involve the environment, if we consider for example the famous case of Poincaré who tells that a key idea came to him by stepping on the edge of a ready-to-run bus in which he was boarding. Conversely, the brain is inevitably involved during an observation responsible for serendipity. It is even possible for both phenomena to occur simultaneously and this is particularly the case when a coincidence occurring in the environment gives a new light idea, as if part of this intuition was brought by the environment. Intuition and serendipity should therefore be better considered as two extreme manifestations of the same phenomenon.

Conclusion

In order to reconcile the mechanics of a relativist block-universe that freezes our lives for eternity and the quantum mechanics that multiplies them endlessly, the flexibility of space-time offers an acceptable solution to our human condition, which consists in evolving space-time in a timeless way, where the future, the present and perhaps even the past evolve simultaneously, coordinated by a huge virtual "brain" which processes all its quantum information through referent systems represented by living beings. We chose to focus here only on human beings although we are aware that

the phenomenon we describe here could be more global, involving perhaps all living beings.

Although this proposal may appear to be breathtakingly fantastic, it unifies physics while it restores its determinism, one of the foundations of science. It provides an interpretation of the quantum vacuum by conferring the essential function of information exchange between the inside and outside of 4D space-time, via switching points that extract our reality from the vacuum to consciousness, a phenomenon that thus enters the field of physics because it can be defined as quantum gravitational information.

It also provides an interpretation for strange aspects of quantum mechanics: indeterminism would correspond to a lack of physical information in an incompletely configured space-time; non-locality would be solved by a temporally non local cause which reigns in the future; the entanglement would result from unavoidable constraints to switch the timelines; and state collapse as well as decoherence choices would result from a brain filtered consciousness of a unique branch of reality, which would then update physical information into space-time by "crystallizing" timelines.

This new "cybernetical physics of timelines" finds its justification in the counterintuitive nature of reality such as physics represents to us: curved, elastic and vibrating space-time, non-locality and spatialized time, essentially vibratory matter which is no longer even distinct from the space itself. From there, it becomes almost imperative to maintain the idea – overall quite logical – that in the end, supported by (Kastrup, 2019), our apparent reality is of a mental nature, which means nothing more than the construction of a collective consciousness filtered by the brain. A more objective description of reality would then be to say it is a vast field of information very different from what we actually perceive and despite the appearance directly linked to each brain. So we have to consider the possibility that information and consciousness could be two key words for the physics of the future.

In this new paradigm, strange phenomena like intuition or serendipity find a natural explanation due to space-time flexibility or influence from future. Above all, these phenomena offer a precious means of testing the validity of this space-time model, which makes it a testable theory, thanks to the methodology and algorithm that we have presented.

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