Theory of Double Causality

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No doubt the most fundamental problem facing physicists today is 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.

As far as time, in particular, is concerned, the physics of relativity offers us the "block universe" concept that implies the future already exists; 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 prove themselves indifferent to space and time. The present balance in physics would tend then to weigh strongly on the side of a future that is already realised, the big question then being: "can we modify it?". Apparently not, if we limit ourselves to the present block universe; and this is awkward, to say the least, for our status within the universe.

In the first ever issue of this magazine, "Temps", Etienne Klein wonders[1]: "Does the future already exist in the future?", suggesting that the future may indeed already be there, but lacking certain information, leaving room for our free will. Moreover, he thinks it is urgent, and I quote, "to conceive a clever synthesis between presentism and the block universe, blending them to give substance to the idea that the future constitutes an authentic reality, but one not completely configured or wholly determined, leaving room to play with, space for will, desire and invention.".

In this article, we will be leading on from his proposal and presenting the foundations of a "theory of double causality", designed not only to achieve the synthesis he calls for, but also to venture beyond the frontiers of physics and sketch out the metaphysics of conscience, the vacuum and quantum gravity; should our approach prove valid, its consequences for our vision of the world could bring about a powerful paradigm shift against materialism.

Frozen space-time

In the four-dimensional space-time of relativist physics – what we call the "block universe" represented in three dimensions (Fig. 1, left) – each person's life can be described according to a trajectory, or 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 and all the movements we continually 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 in fact to do with conscience. Our life is described a bit like a film being projected: the result of a journey through space-time that gives us the impression of perpetual creation controlled by illusory free will.

We can create a visual representation of the texture of such a space-time continuum by reducing it from four to two dimensions, so it resembles a square of taut elastic webbing with all sorts of creases and curves across its surface, corresponding to the material that gives it its shape, depicted Fig . 2, right. Nevertheless, these curves remain eternally frozen by the spatialisation of time, inside the real texture where this time becomes one of the four axes of the webbing.

Fig. 1 The global structure (left) and deformable texture (right) of space-time

Nevertheless, we know 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. Antoine Suarez[2] states that information from outside space-time has to be brought into it if we wish to preserve the principal law of physics – the conservation of energy.

However, string theory offered a highly elegant solution for solving the problem another way, by bringing us within a determinist framework and calling on extra spatial dimensions, where such information might lie. Maintaining this determinist framework, however, leads us to envisage the 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. This, though, is an interpretation that supposes, quite arbitrarily, that string theory's settings, which give rise to an immeasurable number of possible variations (10 to the power of 500), are forever fixed inside one same universe. Whereas in fact, this hypothesis is merely the result of wishing out of hand to maintain a determinist framework for physics as it is now.

Admitting the existence of such prison-universes (Fig. 2) therefore implies that present-day physics is more or less perfected, and prematurely evades the quantum indeterminism that momentarily opened the door to our free will. There is a hurried move to slam the door shut again, by fixing the settings of its functions (Calabi-Yau) that describe quantum vibrations in six extra spatial dimensions, as yet undetectable because of their tiny size (~ 10^{-35} metres).

As a result, despite introducing these extra dimensions, our universe continues 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 temporal lines 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 (Fig. 2), 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.

Fig. 2: Bubble-universe prisons would have to contain myriad doppelgangers of ourselves.

Do we really have to adopt one of these extremes and sacrifice our doubts on the altar of a determinism that maintains that mechanics is already complete? Luckily, such sacrifice is unnecessary: all we have to do is envisage that today's laws of physics might only be giving us a partial description of reality, and that a fuller description could return a precious gift to physicists: a new and as yet unknown determinism that would allow them to discover a conception of space-time that was finally reasonable.

This being so, we have to admit that the new determinism can emerge only 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 that regulate extra dimensions might vary according to an as yet unknown mechanism, using information sources outside of space-time (4D) 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 works[3], 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 an atemporal evolution of space-time, whatever its dimensions, if we agree to "unfreeze" it.

Time is dead, long live time!

In order to unfreeze time and free it from Newtonian time, the only solution is to conceive of it as being able to evolve everywhere at once, meaning in the future at the same time as now. In fact, we can see that if we restrict this out-of-time evolution to the present alone - that is, if we manufacture a new present - then we end up with the same solution, since any change in the present has repercussions on the whole of the future and even the past.

Since this solution has to respect the laws of physics, it can only be valid if the changes are ones whose origins lie in infinitesimal quantum fluctuations. Such a solution becomes realistic – attractive, even – when we see that although such changes are too small to be measured by our instruments, they are quite capable of having considerable macroscopic effects on everything happening in space-time.

I have used numerical simulations to show how tiny, Planck-length scale modifications to the initial position of balls on a billiard table can engender entirely distinct evolutions of the game within a very short lapse of time that tends towards zero as we increase the number of balls. I have also shown that even if we lived in a continuous space with objects localised to infinite precision, the idea that we could conserve the determinism of their trajectories would stumble on a sizeable problem - physical information. Without going into the details, my conclusion was that the indeterminism habitually attributed to quantum mechanics is already intrinsically contained in classical, three-dimensional mechanics, which definitely requires additional information from outside space-time.

Fig. 3: The two principal visions of the infinitesimal texture of space-time (at about 10^{-35} metres).

Such additional information already has its own place in physics in the quantum randomness of state collapse, which defies modern physics by demonstrating its indeterminism. But this indeterminism could well be resolved by a "check" from outside space-time that could be described within a more global mechanism, whose existence we may already guess at from what loop quantum gravity theory tells us. Contrary to string theory, this actually lets quantum randomness come into play, giving it the ability to manage additional information that might substitute itself for randomness. One attractive aspect of this theory is that it does not require any extra spatial dimensions. It does, however, make the inner structure of space-time vibrate 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 to strings: all you have to do is consider the loops as strings that, instead of vibrating without making space move, actually cause the inner structure of space to vibrate without needing to introduce the idea of extra spatial dimensions (Fig.3). However, it is 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 degrees of vibratory freedom, or even "vibratory space dimensions". However, contrary to string theory, their vibratory modes are not apparently regulated by mechanics based on ordinary time.

So how can we describe these vibrations? Mechanics necessarily describes an evolution, whereas no mechanical evolution could be based on calculation without recourse to a time-variable closely linked to this notion of evolution. This leads us to distinguish two types of time, or more exactly, false time and real time: false, ordinary Newtonian time pertaining to consciousness, and real, mechanical time.

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 which amounts to changing the initial conditions of the universe. However, there would still only be one time, the one in which we could change temporal lines, as our ordinary time does not describe any real change in space-time. In the real time of a change to our temporal line, it would thus be possible to describe the vibrations of space-time without falling into the trap previously underlined by the space-time "prison".

Fig. 4: Quantum sea waves could displace our temporal lines (life tunnels).

We can depict the vibrations of space-time, reduced to two dimensions in this new time, as waves on an ocean representing space-time. You can get a rough idea of their effect on an individual's temporal line by making him move through life inside a flexible tunnel (fig. 4). Floating on the quantum sea, this tunnel could take on different shapes according to the motion of the waves;

thus, even though the individual's life might be traced out from his birth, it could in fact change during the course of his existence.

In this way, we can see that Newtonian time, the equivalent of moving through a tunnel, is reduced to a very different spatial dimension from the real time disturbing the waves on the ocean. The old time of conscience thus becomes no more than the illusory sensation of a change of environment produced by a journey, even to the extent of making us forget that the environment is itself changing too, independently of our journey's speed.

The first advantage of such disconnection between objective, mechanical time and eminently subjective conscious time is that we can envisage a slowing-down, or on the contrary, an acceleration of ordinary conscious time, without having to slow down or accelerate mechanical time. A night of deep sleep experienced as a brief flash, or, on the contrary, an instant of great lucidity that gives us the sensation of slowing down, become comprehensible as the acceleration or deceleration of our illusory time, without affecting mechanical time.

The fundamental difference between the old concept of time and the one we are proposing here is that while old time passes, bringing us nearer a precise date in our future, not only does this future already exist in new time, but above all, it continues constantly to evolve, to the point where the new future that we eventually reach might be completely different from the old future a year earlier. Imagine the passing of time like a train journey: no one would dream of thinking that when we got off the train, the same events had to take place in the station as those that had been happening there when we set out.

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 conscience and somehow "connected" to it via our brains. Today, physics so distorts our representations of time, space and matter that it would actually be more reasonable to consider them creations of the brain, or even of conscience itself, rather than realities that exist as we actually perceive them. Taking this as our starting point, we can give the future a much more flexible status than the one that consists in believing that a "hard" future exists with the sort of information we can perceive in the present.

With the future thus reduced to abstract information lacking any real matter, space or time, the question of its evolution comes back to haunt us: how could our future change at a macroscopic level, when this change is simply the result of infinitesimal fluctuations in space-time structure? It is worth repeating the answer to this question a hundred times over: infinitesimal variations can have considerable effects on temporal lines, since these tend to diverge greatly at a macroscopic level due to quantum fluctuations.

Which brings us to the following observation: the events we could change in our future as a result of new intentions, projects or as yet unconditioned objectives, must depend on atemporal fluctuations in the quantum gravitational field, for these alone are capable of affecting our temporal line.

But does this involve the field around us, or the one that reigns in our brain? It goes without saying that since our intentions are correlated to our future, our cerebral activity is correlated to the fluctuations of the quanto-gravitational field on which our future depends.

Fig. 5: Stuart Hameroff and Roger Penrose may receive the first Nobel prize for research into a quantum approach to conscience.

And so, following a path that consists of burying time in order to allow a new time to be born, where past and future evolve simultaneously, our ideas converge with those of an illustrious and daring physicist and mathematician called Roger Penrose, whose work in collaboration with Stuart Hameroff develops the hypothesis[6] that conscience is by nature quanto-gravitational and that it allows quantum state collapse to happen in the brain, a collapse that is orchestrated in a non-local way...

The quanto-gravitational conscience

One very interesting element in the Penrose-Hameroff approach (Fig. 5) is that they respond to objections to their theory about the decoherence time[7] (a concept we won't go into here) by invoking a mechanism of temporal paths using microtubes as "commuters" that intervene atemporally before the orchestrated state collapse, that is to say before the paths that will eventually determine the firing of neurones actually enter space-time. This means we have to get rid of any sort of ordinary-time reasoning to understand the phenomenon of conscience.

The key to our understanding seems therefore to depend on replacing time by a new time that allows us to describe the evolution of our temporal lines in a space-time "unfrozen" at quantum level by a quanto-gravitational conscience. In support of this idea of a new time, let us again quote Stephen Hawking. Describing an imaginary time capable of changing history or the initial conditions of the universe, he affirms that such a time, perpendicular to Newtonian time (Fig. 9), might well be more real than our ordinary time[5].

On the basis of such ideas about a new time – an eternal present – and of a quanto-gravitational conscience, we will now break through the frontiers of physics to explore new and practically virgin territory, that could be qualified as the "metaphysics of quantum gravity", or to put it more simply, the "physics of information".

In the course of our exploration, we will keep a resolutely determinist 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 temporal line or whether, conversely, our temporal line determines our conscious state. What is important, however, is that the temporal line can indeed change under the control of a mechanism operating in the "eternal present" 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 conscience, whether illusory or not, acts upon our temporal line 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, which is responsible for the slippage of our temporal lines, could then direct its evolution towards a negentropic (order-creating) future, as opposed to what can be achieved by a purely temporal mechanism.

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 lead us there? What this question reveals is our irresistible tendency to reason without being able to rid ourselves of the illusion that the future must necessarily be the result of the present or the past. The future's pre-existence, on the contrary, forces us to conceive that any influence on the future has to be exerted upon it directly, therefore outside time, and not by way of some change in the present followed by its consequences alone. In fact, such a change in the present can end up being of no consequence at all, because the risk exists that a well-defined future may block out its effects, by forcing any deviation of the temporal line to meet back up with it and leave it unchanged.

In order to impose determinism born of the present, therefore, the future that comes immediately after it must still be malleable and unstable - in other words, short on information or, what amounts to the same thing, indeterminist. Change in the present cannot actually alter a temporal line unless it encounters a sufficiently distant future, where the density of information is too high to permit any longer deviation.

Fig. 6: A temporal line with low-density information may swing (between t1 and t2)
Transport: low probabilities = less physical information = instability
Training course: high probability = more physical information

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. So they set out very early to make sure of getting to the course, ready to go part of the way on foot if need be. Here we can see the contrast between the determinism of the course, which is high probability, and the indeterminism surrounding the question of transport, characterised by multiple low-probability solutions or, what amounts to the same thing, by a low density of information on the person's temporal line: as the line becomes unstable, it can swing (instant t1, fig. 6) between a wide field of possibilities.

We could deduce from this that mechanics is unable to create the course using determinism born of the present, except if we suppose that the student's brain provides it with the information that defines the finality 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 realisation of an intention is certain, then this intention is memorised not only in the brain, but also in the future, which could even impose a determinism that would prevent the brain from forgetting the intention.

For this not to be the case, we would have to suppose that the future corresponding to the course would have to delay its own creation until any indeterminism about transport should disappear, but then we end up with the idea of integral presentism again (something we have rejected), because indeterminism is already present everywhere at quantum level, ready to block any creation of the future, however minimal it might be.

If we suppose that reality does not wait for the passing of time to determine itself, then this inevitably implies that any reliable intention memorised in the brain is as a necessary corollary "memorised" in the future, and the link between this and the brain necessarily implies atemporal mechanics for updating space-time, which would seem to operate by means of quantum gravity or in other words, by means of physical information coming in or going out. Remember, we don't necessarily have to conclude from this that what we are seeing here is free will being exercised, for the new mechanics of the exchange of physical information with the brain may very well remain determinist.

Intention: stimulation of the vacuum

The notion of physical information we use to describe the evolution of space-time corresponds to the reality displayed in its four dimensions. The density of this information along a temporal line is directly proportional to the line's probability. It is important to specify that physical information is inversely proportional to quantum information, whose density corresponds in a complementary way to that of the vacuum, really a "quantum ocean" containing a myriad of non-manifested potentials. Thus, when an intention seems to increase the density of physical information, as in the previous case of the training course, it inversely decreases the quantum information memorised in the vacuum corresponding to the period covered by the course.

Physics teaches us that the whole of the vacuum necessarily contains energy, that is, quantum information, because of Heisenberg's 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 make up the energy of the vacuum. However, each event thus introduced into the vacuum is somehow compensated by an "anti-event" that counter-balances the energy imbalance. This is why the vacuum appears to be empty.

Because the ratio of vacuum energy to the energy of our reality is so dizzyingly high, it is more sensible to think of it in terms of information rather than energy, because of the reasons we have already indicated: although our reality is independent of us, it is still a construction of our brain, or even of conscience itself. Some authors, like François Martin, following in the footsteps of C.G. Jung, prefer to talk about a construction of the "psyche" by extending it to our subconscious, claiming that it is directly connected to exterior four-dimensional space-time by the vacuum[8]. Based on this hypothesis, quanto-gravitational conscience implies that the information in the vacuum is indeed connected to our brain via quantum vibratory structures corresponding to the psyche, both conscious and subconscious. The information contained in the vacuum is not therefore fundamentally probabilistic, the way we conceive it in quantum gravity. It would appear to contain all non-manifest potentials and to be organised entirely by causality, the cement of science.

More specifically, information is used in the vacuum in the form of causal relations forming temporal sequences – or archetypes – interlinked inside a vast network, like some immense hyper-dense rail network where the switches just need to be put into place. A temporal line in the vacuum for this network could then be stimulated locally, after activating the switch that could thus divert a temporal line in the future, long before its entry into the present in terms of experienced reality.

In the new mechanics we are proposing, then, we are no longer starting out from one point in space-time and working out which points will come next along that 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 information". This way, space-time mechanics stops being sequential, or what we might qualify as "computer novice", but instead becomes something more worthy of a clever computer engineer, who merely manages the switches on temporal lines that are updated instantly and atemporally in the vacuum by causality, while auxiliary software carries out the updates themselves.

Fig. 7: Does watering plants help us regain our free will?

One question arises: how does such stimulus of the vacuum actually happen? Are we so perpetually conditioned by our past and our future that such stimulus is impossible? Shouldn't we pull chance back out of the hat again to manage our switches and help us escape our conditioning? As I read through these lines again, an example springs to mind: to prove my own free will to myself, I decided to get up and water the plants, knowing full well that I never do it, my wife always looks after all that. It would take me all of ten minutes, but my past protested, telling me that I was entirely unused to doing it. My future also protested, telling me that if my wife saw that I'd been watering the plants, I'd have to explain to her that it was exclusively for the needs of this article. Wouldn't I do better to refrain from doing it at all, preferring the status quo? In the end, I did water them (Fig. 7). What happened then?

Information from who knows where, the idea of watering the plants, managed to create a state of quantum coherence in my brain, forming a wave upon its space-time fabric and provoking the firing of neurones, which then resulted in the points being switched and my life-tunnel – and that of the plants - thus being displaced for two minutes, before everything went back to normal.

It is even more instructive to imagine that I could just as well have programmed this action in my future, without it being any less effective, just the opposite, in fact: all I had to do was put up a Post-It not to forget to water the plants the next day, or go and see a friend in a week's time, or whatever. So it seems easier to modify our reality in the future than in the present, something that can be explained by the future's greater fluidity.

Let us remember that if we find it so difficult to conceive that our intentions can stimulate the quantum vacuum in order to produce such effects, it is because of the fundamentally illusory nature of physical reality as we irresistibly conceive it, whereas from a strictly objective point of view, this reality is just a set of information passing through our brains, something that does not rule out there being a reality independent of ourselves. We can carry on doing physics, but we must be absolutely logical about it, considering our intentions as physical realities, with the added ingredient that they do not appear to depend solely on our brains but also on an information system outside space-time.

Such an information system would thus have the possibility to change our future, but only if it managed to provoke quantum waves in the present of our consciousness that resulted in the emergence of corresponding intentions. My decision to water the plants, independently of any automatic conditioning, would therefore appear to be the will of a subconscious information system (self) using my conscience (myself) to obtain a change in the future.

One could object that my action of watering the plants had been programmed from my birth, but it is difficult to reconcile ourselves to the idea that a universe exactly identical to our own, excepting the one difference in my not deciding to water the plants, shouldn't be allowed to exist: we need only make my decision dependent on a quantum random number generator to convince ourselves of the existence of multiple futures in space-time, and of the usefulness of a sort of points-switching system.

Maintaining our scientific approach 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 would have to imply the following two entry-exit functions:

(1) Information external to space-time, exerting "intentional pressure", enters space-time mechanically as soon as conscience reduces the brain's determinism sufficiently to allow the germ of an intention to enter.
(2) Information internal to space-time, the result of becoming conscious of the intention and thus transforming it into a decision, sends a "message received" signal or a firing of neurones that collapses a state of coherence, thus activating an update of the temporal line in the vacuum.

Let us note that the two processes may be entirely determinist and that the corresponding functions may be taken in hand respectively by the subconscious, or self, for the first process, followed by the conscious, or myself, for the second, in a manner neuroscientists have yet to discover. This is the direction taken by the work of Penrose and Hameroff.

Fig. 8: Could the brain be a transmitter-receiver for quantum information in the vacuum?

Following this entry-exit exchange, initiated outside space-time with the aim of making certain intentions emerge, switches are stimulated in the vacuum (Fig. 8). It goes without saying that the emergence of intentions can also come solely from the brain, but if that were always the case, no mechanism external to space-time could affect our temporal lines.

What must be underlined is that since such a mechanism is atemporal, it should also act simultaneously on every event-driven point in the future where switches might be activated by the same intention, as long as conscience embraces it by experiencing it as coming from "self" and not in an instinctive manner. Everything occurs as if conscience then informs the information system that something has been learned, so that it can modify all the switches pertaining to it in the future.

The particularity of the present, something that would distinguish it from any other temporal point, might thus consist of being the only point at which the information system itself can be informed, via an update of the future caused by the successful connection with the brain.

Retrocausality – the unavoidable

In any diversion of temporal lines, the future acts like a magnet resisting any prolonged divergence of the line. A phenomenon of retrocausality is inevitably at work here. The shape of the temporal line diverted from its path in the present in fact depends simultaneously on its past and its future, both of which thus act like stabilisers. So we can see that retrocausality, and also causality, are stabilising and even indispensable factors in the dynamics of space-time, in that they allow it to evolve progressively and in a coherent way, preventing tiny changes from having enormous consequences that would become mechanically unmanageable.

Mechanics in real time thus appears to be a true "relaxation dynamic of space-time" based on double causality, something already written into physics equations that operate forwards and backwards in time. This would imply an exchange of information occurring between internal and external space-time, allowing temporal lines to be updated by switching the points, until they grew denser and were eventually "crystallised" by the conscience in the shape of a "recording" of physical information.

Fig. 9: Our temporal lines, fixed in Newtonian time, could move in real time, inevitably resulting in retrocausality.

So there would appear to be no transfer of information between present and future in space-time, but simply the presence of information systems exerting “pressure” external to space-time on the future of each temporal line. We can conceive the positive outcome of this pressure in a similar way to a change in the settings of the psyche of each system. Inevitable, then, that such an influence on the future should sometimes send an “echo” back into the present in a retrocausal if not inexplicable way (Fig. 9).

In my book, *The Road of Time*, I described double causality’s potential for solving or simply shedding light on numerous phenomena of this kind, particularly synchronicities that I explain as follows: “Our intentions cause effects in the future that in turn become the future causes of effects in the present.”. This potential is assuredly broader, for it could contain all sorts of effects on the present of changes affecting the future: intuitions, premonitions etc.

Another potentiality of double causality holds interest for physicists studying relativity, for whom the puzzle to be solved is the question of the chronological protection that is indispensable to space-time in order to avoid the temporal paradoxes permitted by the theoretical possibility of time travel[9]. Retrocausality naturally provides the ideal system, forbidding any return into the past which would be incompatible with the future of the point of return.

Double causality theory could finally cast new light on the great mysteries of physics: dark matter, dark energy…; and of biology: the evolution of living species. As far as dark matter is concerned, the phenomenon of galactic haloes, which are invisible and detected solely by means of their gravitational effect, could stem from changes in the past: light rays emitted by a distant source that succeed in reaching Earth are simply those whose source never changed position at the moment of emission. All the others have necessarily been absorbed elsewhere than Earth, while those that replaced them in the right direction didn’t necessarily have time to arrive, and can still change direction from the moment of emission and throughout the duration of their journey.

Such alterations in the past must of course be considered as the result of changes in the future, and vice versa. Let us note that if the future waited for us to live our lives in order to firm up the changes prepared in the vacuum, then that would once again hint at a certain presentism, along with an obligation for a sort of “reality processor” to be at work, choosing in the present moment what we were to live through in the next. Now physics has never said anything about any such “space-time processor”, something presentism considers mathematically self-evident. And yet it is an idea that is coming to be seen as naïve by information technology engineers, for whom calculating a result no longer has anything to do with actually visualising it (making it 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 sort of virtual network of neurones apparently operating simultaneously throughout the entirety of space-time via living systems.

The function of such a network would thus 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, atemporal mechanics would operate like a huge brain and our temporal lines would undergo permanent changes in the future even if we ourselves had nothing to do with it. We would be involuntarily determined “retrocausally” 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 sensorial extensions.

Let us finally note that given indeterminism, responsible for space-time’s ability to evolve, it is fundamental that this evolution be able to be oriented by information systems that allow a limit to be placed on the field of possible finalities, something that would be completely impossible if reality evolved in the present. If that were indeed the case, not only would we lack the algorithm that makes the choices - preferably something other than God throwing dice - but we would also have to find a solution to the problem of the vacuum which, in spite of its enormous energetic density, is no doubt insufficient to contain the infinite field of possibilities of the multiverse.

Atemporal mechanics

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, independent of the past. Quantum state collapse would appear to correspond to the reading in the present of the last configuration acquired by the observer’s temporal line before the information about the measurement reached him. Thus the observation would serve merely to “crystallise” the line, supposing that the past did not undergo any other subsequent change. Within this operation, any pure randomness disappears because the information observed is already an integral part of the immediate future. This immediate future may even already be entirely crystallised if we are dealing with complete determinism in the short term.

Having reached this stage, it may seem ultra-speculative to dare venture further to define, even at a very simplistic level, the principles on which atemporal mechanics, which are capable of describing space-time evolution, might be founded. Nonetheless, the preceding analysis affords us precious elements that direct us towards the following:

(1) a principle of equivalence between the psyche (conscious + subconscious) and the quanto-gravitational vibratory field that reigns inside the brain and the rest of the body.
(2) a principle for emitting point-switching information that is external to space-time, following the perception of an intention resulting in the stimulus of potentials in the quantum vacuum.
(3) a principle for receiving, inside space-time, information resulting from the finality of the system that regulates all the switches on an individual’s temporal line.

The first principle embraces the idea that an individual’s temporal line can remain totally fixed (conditioned) without taking away his conscience, thus making the latter the fruit of purely temporal quantum fluctuations. In terms of psychology, this principle corresponds to the “id” of instinctive behaviour, or even the “ego” of the perfectly conditioned human being.

The second principle provides competition to today’s prevailing interpretation of vacuum energy, which has God "playing dice": on perceiving an intention, the brain signals reception of the intention by making a decision that stimulates the vacuum. This is interesting because when the intention is actually consciously perceived as having come from the "self", it makes it valid for activating future switches, in which case changing one’s future becomes a very real possibility. In psychology, this principle corresponds to the "me" of individuality capable of evolving through connection to the "self", thus differentiating itself from the "ego".

The third principle implies free will that remains relative, in that it is subject to an information system that may remain determinist without this altering its ability to modify temporal lines. It does, though, stem from a source of information that transcends conditioned human behaviour. This means it corresponds perfectly, on a psychological level, to what we call the "self" or even the "spirit" if we refuse to raise it to the even higher status of free will. We could only conceive of such a status if we attributed a position to the spirit that is external to global space-time, while the me and the self would be part of it, and would therefore be described by vibratory dimensions, corresponding to what we call the soul or the psyche. This would make the psyche an entirely mechanical system, probably composed of six atemporal vibratory functions (several unifying theories introduce six extra dimensions), whose structure or settings might evolve and improve through space-time knowledge acquisition.

Using these three principles as our starting point, we would therefore have three functional levels of conscience that could be linked to physical concepts:

The first level would be that of the automatic "lived" experience of a reality that produces a conscience too limited to awaken any real intentions capable of making its information system evolve in turn, yet sufficient to receive information and as a result maintain a weak state of entropy (animals).

The second level would be one of living a reality with a controllable future, under pressure from a system of mental and emotional information likely to awaken the conscience of the "me" sufficiently to cause knowledge acquisition in the system itself (humans).

The third level would be something that, for humans, would remain essentially subconscious, insofar as it would correspond to the unattainable ideal whereby the project contained in the information system managed to express itself in reality in its entirety. If this were the case, we would have to expect consciousness of "self", a consciousness thus able to perceive its own future.

We can understand how conscience can be limited to "me" alone by imagining how very difficult it might be for "self" to introduce its goal into space-time, considering how incompatible the latter is with a future constantly shifting under the influence of multiple information systems. Added to which, causality tends to increase entropy, whereas the goal of "self" appears instead to be negentropic.

Fig. 10: space-time might be fabricated outside time by some huge virtual brain.

Thus, the principal function of atemporal mechanics, probably relayed by some immense brain (Fig. 10) to which all living beings are referent systems, appears to be progressively to decrease the entropy of space-time.

Conclusion

In order to reconcile the mechanics of a relativist block-universe that freezes our lives for eternity and quantum mechanics that multiplies them ad infinitum, double causality offers an acceptable solution to our human condition, which consists in making space-time evolve within a huge virtual brain that treats all of its information in an atemporal way, using referent systems represented by living beings.

Although this proposal may appear to be breathtakingly fantastical, it unifies physics while restoring 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 - onto the conscience, something generally excluded from the field of physics. It also provides an interpretation for strange aspects of quantum mechanics: indeterminism would appear to correspond to a lack of physical information, superposed states to the complementary presence of quantum information in the vacuum, non-locality to a determinism whose source lies in the future and state collapse to the primary function of conscience, which would be to update physical information by "crystallising" our temporal lines.

This new "information physics" finds its justification in the counter-intuitive nature of reality as depicted to us by present-day physics: curved, elastic space-time, spatialised time, essentially vibratory matter no longer even distinguishable from space itself. From here, it becomes almost imperative to uphold the idea – all in all quite logical – that in the end, our apparent reality is nothing more than a construction of the brain and that real reality is instead a vast field of information very different to what we actually perceive.

This new concept may disturb physicists attached to the fundamental equations of physics, for it cannot help but make these equations appear approximate in two aspects: spatial continuity and temporal determinism. However, the fact has to be acknowledged that these two aspects impose hypotheses that have never been proved, hypotheses that today clash with both theory and experiment.

How, then, can we avoid turning physics into an approximation of reality? Nowadays, the answer is self-evident: all physicists rely on computers to validate their mathematical models. Rather than consider this dependence as a further source of imprecision, to the extent of it posing an ontological problem, why not consider that computers might, via cybernetics, provide us on the contrary with a potential for describing reality that is better adapted than equations ever were?

My experience of computing and neuronal networks, chaos and artificial intelligence has taught me that we can transform any equation at all into algorithms, whereas the opposite is not true. Might this not be a clue that the nature of the universe should be much easier to grasp if we dealt with the information from which physical equations are derived, equations that by their perfection might well reflect the implacable logic of the universe?

After all, if we remove all that is subjective from the appearance of our own reality, everything that tends today to deprive us of things as concrete as time, space and matter, what is there left? The answer could not be simpler: consciousness of reality that can be described in terms of information. We should therefore consider the possibility that information and conscience will be two key words for the physics of the future.