THE QUANTUM DYNAMICS OF LIFE

Joining Matter and Space in an Eternal Harmony

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WE DEDICATE THIS SMALL BOOK TO ALL WHO STILL HAVE THE COURAGE TO DREAM THE WORLD FREE AND PEACEFUL

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Preface

The scientific picture of the world is continuously improving with new discoveries. In this small book we will see that an important discovery is also the understanding of how the mind influences the direct experience of reality. The mind is an active part of any experience. The information of an experiment enters the senses, such as sight, gets elaborated by the mind, and then experience occurs. When becoming aware of the mind's elaboration, a new picture of the universe and life arises : The universe is a timeless self-renewing system in which the development of life is a fundamental part.

We have been told that the root of scientific knowledge must have a mathematical form. This was the mantra of "logical positivism" in the 20th century, reflecting a pan-mathematical view of Science, and a philosophy that all students of the physical sciences implicitly follow through the teachings they receive. This philosophical road has reached a wide gap recently by uncovering the fact that reality **in general** cannot be represented through mathematics, nor can we get to the true base of reality through it. Some call this gap the "end of Science," but it is only the end of that philosophy. Human rational understanding has only limited tools at its disposal, and mathematics is just one of them.

With this in the background, we go back to the forms of experience we are physically going through, and build a picture of reality out of the scientific knowledge acquired in the last centuries, and especially in the 20th. This picture is not the one found in present scholastic teachings, as such are limited by mathematics; it is one that attempts to go beyond the gap, while yet retaining the **scientific method** that allowed the great advances made earlier.

Introduction

Rational vs. Conscious Experience In Time And Space Matters

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Abstract

Does time really exist as a fourth dimension of space? Regarding this question a scientist should trust more his eyes than his mind. With eyes one can perceive time only as a stream of changes in space. So one has to doubt the existence of physical time as a fourth dimension of space. On the basis of elementary perception (sight) the conclusion is that physical time exists only as a stream of changes in space, giving the image of three-dimensional space in which irreversible changes run. This understanding is essential for a further development of science in which conscious experience is included as a consistent part. Rational experience is based on analysis, it deals with the elements of the universe (stars, planets, living beings, atoms and so on) in separated ways. Conscious experience instead reconnects the scientist (the observer) and the universe as a whole. It reaches beyond the duality subject-object.

Keywords: time, space, spacetime, mind, rational experience, conscious experience

Introduction

In the universe the passing of physical time cannot be clearly perceived as matter and space can be; one can perceive only irreversible physical, chemical, and biological changes (hereinafter referred to as "changes") in space. On the basis of elementary perception (sight) one can conclude that **physical time exists only as a stream of changes** that runs through cosmic space [**1**].

The terms "physical time" and "stream of changes" describe the same phenomenon. Physical changes are irreversible, and thus physical time. Change A leads to change B, B leads to C and so on. When B is in existence A does not exist anymore, when C is in existence B does not exist anymore. It is not that changes happen in physical time, changes themselves are physical time. The universe is composed of only two things: space and its content, with both these components **changing**.

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The question then arises: Why is irreversible physical **time** experienced on top of changes as past, present and future with a sense of reversibility in it? The answer is obtained by analyzing the scientific way of experiencing. The eyes perceive a stream of irreversible changes. Once elaborated by the mind, the stream of changes is experienced through **psychological time**, and this phenomenon is a part of the human mind, not a physical quantity.

The Origin of Psychological Time

Let's look at the origin of this psychological time by carrying out an experiment. Take a pen and move it from the left side of the table to the right. You can **perceive** only the movement of the pen in space, but you **experience** that the pen has also moved through time. How come? Perception passes first through psychological time and then the experience occurs. That's why you experience the movement of the pen in time. But on the basis of elementary perception (sight) one can only state that the pen has changed position in space. Mentally, the pen could retrace its path back, so reversibility is implied by the mind in this mental construction process of time; time then appears naturally reversible, but changes are not. Your perception of the movement of the pen enters the senses, goes into the rational part of the mind where it is elaborated through the concepts of linear time (a mental map of the changes), three-dimensional space, logic and mathematics, and becomes an experience.

movement of the pen -> perception (eyes)
-> elaboration through the time and space of the mind -> experience

Time Was Conceived Differently Through the Ages

The rational understanding of physical time has changed over the ages. For ancient Greeks, Indians, and Mayans, time was considered a cyclic phenomenon; time moving in circles, with no beginning and no end. When Judeo-Christian civilization arose in Europe, another understanding of time became prominent - time going forward in a straight line, one shot through so to speak. According to this civilization, time has its beginning with God's creation of the universe and will have its end with the Last Judgment. In Newtonian physics, physical time is an independent quantity (absolute time), running uniformly throughout the entire cosmic space (absolute space). In the General Theory of Relativity, time is no longer independent - it is linked with space in four-dimensional spacetime.[1] Finally, according to the understanding coming from conscious experience (as discussed below) time exists as a physical reality only as a stream of changes in cosmic space. It is a "by-product" of the matter that changes in cosmic space.

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[1] This linkage was invented by a mathematician, Minkowski, not by Einstein, who considered such a linkage only a mere mathematical convenience only useful in the model he constructed. The use of complex numbers for this linkage demonstrated its **unreal** aspect. Einstein's concept of time WAS a stream of changes, i.e. a physical quantity, as much as space was a physical reality in his understanding.[**2**]

An Independent Feature of the Mind

The rate of psychological time does not always follow physical time, it depends on one's well-being. The more relaxed you are the slower the speed of psychological time is. In modern society time passes quickly, in so-called primitive societies time passed slowly. In an altered state of consciousness, such as meditation, ecstatic dance, deep prayer, psychological time stops.

Already in a normal state of health there are, every now and then, aberrations of subjective time such as acceleration or deceleration of lapse of time. Under several mental disturbances (like those characterizing serious mental psychoses, drug-induced states, trances, mediations, as well as other deep "altered" states of consciousness), these anomalies/peculiarities become more pronounced. The flux of time may even cease completely - the sensations usually described as "time standing still", or "suspended, arrested" time, or expand without limit - the feelings of "everlasting now, eternity." [**3**]

In "altered states" one has the capacity to observe his/her mind. This is a function of consciousness/awareness. [**4**] Everybody can observe his/her thoughts and emotions. By observing them the speed of thought and the intensity of emotion calms down. Once the mind stops psychological time stops too. Psychological time is thus independent of physical time.[2]

Rational vs. Conscious Experience

The scientist (the observer, the watcher) is a consistent part of a scientific experiment. He or she observes an experiment and measures it with instruments. Without an observer a scientific experiment cannot exist. When observing the experiment, the observer can also simultaneously observe the way his/her mind elaborates the experiment. He or she becomes aware of how this elaboration influences the experience of the experiment. With this awareness **rational experience** of the experiment is enriched with **conscious experience**. Having conscious experience one grasps exactly what one perceives. Conscious experience is direct, as the mind does not interfere between perception and experience:

conscious experience

universe -> perception (senses) -> conscious experience

On the other hand, rational experience is indirect. **Perception** and **experience** become separated through the rational activity of the mind. Information enters the senses,

[2] Phase 2 of the Origin of Space thesis [**5**] gives a rational explanation for such a separation, by going into the potential *physics* of the mind as a quantum phenomenon in a space separate from ordinary (cosmic) space, with its own quantum time processes.

goes into the rational part of the mind where it is elaborated through logic and mathematics, and then becomes an experience:

rational experience

universe - perception (senses) - elaboration (mind) - rational experience

One experiences physical time **consciously** as he/she perceives it: as a stream of changes in space. Rational experience is enriched with conscious experience by simply allowing the observer to watch his or her mind. Watching is an **individual** research method, using the **imagination** of the researcher, as Einstein saw [**6**]. Rational experience is based on analysis, it deals with the elements of the universe (stars, planets, living beings, atoms and so on) in separated way. Conscious experience instead reconnects the scientist (the observer) and the universe as a whole. It reaches beyond the duality subject-object.[3]

Conscious Experience May Assist Rational Experience

Through rational experience one grasps a stream of changes as linear time (through making a mental map of the changes), while conscious experience reveals this stream as an irreversible process. As we have seen, by observing this stream, humans have developed psychological time through which we rationally experience the universe. However, psychological time is reversible. One can go back into the past. This creates then an idea, i.e. a model that physical time physically exists (notably through its past), but this is not so.

In that line, General Relativity allows a speculation about time travel. Someone could travel through a black hole with a spaceship, go back into the past and kill his grandmother.[4] The consequence is that he could never have been born [**8**]. This shows the lack of causality built into General Relativity, a fact that was of great concern to Einstein as an unphysical feature of his theory. This feature was tied to the fundamental disconnection of space from its contents within the basis of the theory (the "hole" problem), and a problem he dealt with for 2 years before succeeding in making it at least mathematically acceptable for final publication.[**9**] This is still a key problem, showing the theory ultimately to be a crude model of reality, and only acceptable within the limited framework of rational experience.

Traveling into the past is not possible because a stream of changes is irreversible; the past exists only as **psychological time**, through which it is not possible to travel with a spaceship or otherwise (H.G. Wells' Time Machine?). The problem of the "Arrow of Time"

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[3] Or more precisely, from phase 2 of [**5**], through the quantum states of the microtubules within its neurons, the mind updates its model of reality, which is an infinite quantum model instead of a finite classical one, and as such much more fitting since reality is a quantum device also.

[4] This effect is technically covered through the term of "Closed Timelike Curves" in General Relativity, as studied by Hawking, Thorne and others, without questioning GR itself in the first place. The hope is that the quantum somehow can fix this.[**7**]

has been known since the 19th century, as classical mechanics has reversible equations when dealing with the time parameter, while the world is not reversible.[**10**] One could only conclude that classical mechanics was a model ultimately incomplete to represent reality. In the 20th century, quantum mechanics dealt with this through the "collapse of the wavefunction," an irreversible but unexplained process, a pure axiom within the model of the theory. However, even there the Schroedinger Equation is reversible, so quantum processes are still seen as reversible.[5] In all these cases, conscious experience must then correct rational experience.

Time as a Stream of Changes in the Theory of Relativity

We can measure with clocks the duration and "speed" of changes (or amount of changes between known common events). Regarding Special Relativity this means that, in an inertial system moving fast, the amount of changes between known events is less than in an inertial system that moves with less speed. The twin in a fast spaceship is growing old slower than his twin-brother in the spaceship that travels with less speed, and this we know when the twins meet again (a common event). The hypothesis that time as a physical quantity runs slower on the first ship than on the second is our **rational deduction** via reading clocks at the events **where and when** the twins meet. But these clocks measure only the amount of changes, not time, at their location in space **in-between the events**. So rational experience in this case has to assist conscious experience: The comparative features of streams of changes between common events can only be reached through the **model** of physical time constructed through rational experience, not through conscious experience.

Experiments with high precision clocks confirm that changes are less in the parts of space where the gravitational field is stronger, as the model of General Relativity predicts, a rational experience by definition. The speed of clocks near the sea in Venice is slower than on the mountain Monte Rosa because gravity is stronger near sea level. [**1**] Within General Relativity this means that with an increase of the "roundness" of space the speed of changes (amount of changes between common events) is getting less. These changes in the characteristics of space from place to place beg the question: Is space then changing also with changes in its contents?

Changing Space in the Theory of Relativity

Space has to change with changes in its contents, and this as a result of a **conscious** experience, Einstein's. He worked hard to express the beauty and harmony of the universe in a rational model. He initially visualized space as bent by the presence of matter. In this experience that he called "imagination" in the absence of a better word, he experienced the oneness, timelessness, and harmony of the universe. General Relativity is a rationalization of this conscious experience. Subsequent **rational** experience made him

[5] In the 1940s, Feynman and Wheeler seriously considered physical processes running backward in time, and such an approach was seen as perfectly acceptable in a rational experience.[**11**]

then see that space had to change along with changes in matter. In order to keep matter and space in dynamic equilibrium, the conscious image of an **infinite** three-dimensional cosmic space had to be replaced with the rational image of a **finite** Riemannian surface in four dimensions,[6] called "spacetime," with a succession of subspaces called "spacetime slices" that sustain the changes in its contents. This rational experience of a dynamic equilibrium between space and its contents was expressed by the equation (a Poisson equation-type) he worked out, using Grossmann's mathematics.

Through Einstein's model, time was then half integrated with space, with changes in space described through this succession of subspaces, and with the speed (amount) of changes in matter and electromagnetic phenomena measured locally with clocks. This half-integration to space resulted in time being still reversible in the equation obtained by Einstein, and such a feature was considered a failure by him.[**12**] Through his conscious experience, time was a stream of changes of matter within space, with no reversibility possible, and the integration of time to space was complete only through that experience.

With the complete integration of time into the makeup of space, four-dimensional spacetime can be replaced with a three-dimensional space that goes through a stream of changes. The movements of stars and galaxies are then described within this evolving space, with changes in space measured locally by clocks.

The Added Experience of Transient Quantum Realities

By 1935, Einstein realized that an aspect of time and space not considered earlier was implicit in the physical approach that came to be known as "quantum mechanics," and he published an article on this subject with two of his colleagues. [**13**] QM was in effect telling him that the reality of a given particle evolution may be **multivalent**, and that observations by material entities in physics were in fact selecting which reality was to be experienced. Experiments were run decades later (called Einstein, Podolsky and Rosen or "EPR experiments") to confirm this fundamental truth. They demonstrated the fact that a material system has indeed **transient realities** non-local **across space**. [**14**]

These experiments show that two quanta (two "particles"), which have been together and then are sent in space in opposite directions, "know" each other's state regardless of the distance between them (they are seen as "non-separated" in their evolution, even though apart from each other in space). When the spin of one particle is observed, the astounding experimental result is that the second particle's spin can be "immediately" observed in a state related to the state found for the first particle (a complementary spin); the "knowledge" of the first spin transferred to the second particle needs to travel faster than the speed of light. While this transfer may not be simultaneous (limits on the ex-

[6] Provided specific assumptions are made a priori, including an even spread of matter in the universe and an only optional presence of electromagnetic fields; such assumptions were taken before galaxies were discovered, that showed the enormous distances between "islands" of matter, and before quantum theory came up with the ever-present electromagnetic "zero point energy" of "empty space." See Einstein's 1920 lecture describing these assumptions.[**2**]

perimental apparatus prohibits any proof of simultaneity), it nevertheless must connect the two particles across space regardless of distance in some fundamental manner.

As a result of this experimental fact, we can only conclude that a common reality exists called the “classical reality,” and the **selection** is made by this reality **locally** interacting (observing) one of the transient realities of the quantum system, and selecting this reality as a whole ACROSS space. The other realities that are not selected by the observation can only be seen as going out of existence instantaneously, and as a whole, upon such a selection. This process of elimination is called a "wave function collapse" in QM. The observed quantum system is then a **matter-space system** comprised of **self-generated transient spaces** tied to the matter they contain.

There we experience timeless space in a direct way: as the **stream of reality selections**, a stream running across space that creates ordinary reality outside any model of time. Through conscious experience cosmic space is seen as timeless; changes run, but space is just there, unchangeable. As space is timeless, transfer of “knowledge” between quanta has to be immediate (“**information**” is thus undefined in a non-separated system until observed). But this understanding cannot be grasped through rational experience, conscious experience is needed.

Conclusion

The scientific picture of the universe is continuously improving towards what the universe really is. The geocentric model was improved through the heliocentric model, Newton’s space and time were changed into the spacetime of Minkowski and Einstein. A further development is from spacetime to timeless space in which an irreversible stream of changes runs, time being only a “by-product” of the content of space that changes within cosmic space.

Here “watching” the mind is an absolute necessity. It is an individual research method that brings awareness of how linear time as a map of changes and spacetime as a four-dimensional surface exist only in the mind, and are only one way of conceptualizing reality. Watching the mind is the only way that can lead into a rational picture of the universe that is closer to its true makeup.

On the other hand, via the model of General Relativity, rational experience was there to confirm Einstein’s initial conscious experience, something he called “imagination,” that not only the content of space but space itself is changing according to its content. Such a concept needed the assistance of rational experience, for example by comparing clocks at common events, in order to ascertain its validity since not accessible to conscious experience. However, local clock measurements can only be imperfect as they fail to identify the accompanying changes in the non-local characteristics (metric) of space, changes which must be themselves irreversible by being **non-local**, unlike the individual motion of the contents within an unchanging space. Einstein’s equation cannot tell us this fundamental fact by failing to connect the very existence of space to its contents, and thereby

failing to connect the universe as a whole. [**5**] This subject will be developed further in an upcoming article.

As the irreversibility of changes has demonstrated, conscious experience must be used in the first place to set rational experience, especially when it comes to devise its models (such as time), including the bounds of their validity and their conclusions. Rational experience of space and time is indirect, limited by geometrical models through which one **rationally** experiences them, while one can experience cosmic space directly through a **conscious** experience. Time can only be constructed via a rational experience as it is only a model, and thus not in the realm of conscious experience.

Conscious experience thus represents not only an enrichment for scientific research, but a vital part of productive science. This is the conclusion Einstein also reached through his well-known statement [**6**] about **the imagination encompassing the entire world**, contrary to rational experience.

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Conscious Experience of a Self-Renewing Universe

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Abstract

Einstein emphasizes in his lectures (1920-1930) that space has physical properties; i.e. gravitational force was attributed to a space metric. In this article a "density" for space is introduced in order to further describe the characteristics of that space. In order to properly situate this concept, the nature of space as a superposition of electromagnetic entities tied to "islands of matter" far apart from each other is recognized. Then higher the relative electromagnetic flux in a given part of a space generated from the matter in that space, higher is the density of that space vs. other superposed spaces, and the relative effect of its gravitational potential. The density of a given space enters in the description of the complete dynamics between that space with matter, and other space-matter systems. A continuity equation covering such an extended dynamics is envisioned to complement Einstein's, allowing to rationally describe an energetically self-renewing universe instead of one with a beginning and an end.

Keywords: space, matter, dynamic equilibrium, continuity equation, Einstein, Everett, AGN

Introduction – The Assumptions of General Relativity

The previous article has described the need to use conscious experience in order to advance scientific knowledge.[**1**] How did Einstein describe his experience of space being bent by matter to Marcel Grossman in order to develop a rational experience out of this initial conscious experience? We do not have a record of such a discussion, and we will never know its details. Here we will attempt to develop this kind of scientific communication starting as a base from a lecture Einstein gave in 1920 about the meaning of space in his theory, and compare the assumptions he advanced for his theory with the facts as we know them now. [**2**]

Before his work, we were accustomed to see space as “just there,” a mathematical entity, a “form” as Plato would have qualified it. Einstein saw it instead as a physical entity, as this entity generates an attracting force between elements of matter by being bent by

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them, a force called gravitation. A **dynamical equilibrium between space and matter** was then rationally expressed through **Einstein's equation.**

Later, Einstein looked at the sky and saw **a non-zero even average density of matter everywhere**. Combined with the idea existing in his time that **electromagnetic fields do not exist everywhere**, contrary to matter, his conclusion was that space, even though infinite, had to be bounded, with essentially the topology of a ball.

Since then, new facts came to light that are going against these assumptions. First, we recall that, in his time, galaxies as "islands of matter" in the Universe were unknown, and were still called "nebulae" by the time of his death, as they were dimly seen in the sky back then.[7] There was still no appreciation for the enormous distances between such objects. We found since that our own "nebula" was merely one among a fantastic number of others spread as far as our telescopes can see to this day, and at enormous distances between each other compared to their size.

With respect to the electromagnetism assumption, the fact is that the "zero-point energy" of "empty space" was not understood until Quantum Electrodynamics (QED) became a solid theory, a scientific advance that happened only within the time of Einstein's death. The electromagnetic nature of such energy is indubitable as atomic nuclei do not enter into it, the area of space under consideration being by definition "empty," i.e. a vacuum.

Finally, Einstein pointed out in 1920 the fact we could not "**assign the concept of motion to space**." (This was a remark related to the impossibility to measure a "wind" for that space vs. the motion of Earth.) There we have to be careful, as within such a quote space is understood as **all-encompassing**. This is another key assumption of General Relativity, as Einstein expressed it again in his referenced lecture. There was indeed only one space in his mind. But, about such an assumption, we have also acquired quite a different experience: By 1957, merely two years after his death, a graduate student named Everett saw our world to be in fact a "many-worlds" through the message of Quantum Mechanics.[**3**] He pointed out that the Schroedinger equation tells us that there are many superposed matters (realities) for each element that we can observe.[8] With this in mind, if we include the prior experience by Einstein of space as a physical entity, we have to add to Everett's discourse the idea that **there has to be many spaces containing this many-matter**.

The sum of all the above deviations from the basis of General Relativity leads us to a fundamentally different picture of reality. The key deviation we are going to discuss is that space and matter are two forms of the same **elements of our reality that can transform into each other**, and as such space and matter must be related in their existence via another equation expressing the conservation of these elements during such transfor-

[7] Their name came from Latin describing a "vague" object.
[8] This new view has been the base to construct "Quantum Cosmology" thirty years ago.

mations, in other words, a **continuity equation**.[9] Such an equation is yet to be found as we don't have the mathematical tools at this point to construct it.

Instead we are going to describe the conscious experience of a cosmological phenomenon that comes out of the astronomical pictures obtained in recent years, a phenomenon which was utterly unknown in the lifetime of Einstein. We will advance that such a phenomenon is in fact the process permitting space and matter to transform into each other, thereby allowing the Universe to renew itself energetically on a permanent basis.[10]

An overwhelming image appears from such pictures: Gigantic jets of matter and radiation come out perpendicular to the center of **spiral galaxies**, processes called "Active Galactic Nuclei," or AGNs, as well as from systems that are forming stars and planetary systems. These jets have been seen as including blobs of matter emitted in spurts ("blazars"), with the possibility of even having new galactic systems generated under the term of "quasars."[**5**]

If we were dealing with a hydrodynamic system, we could say that we have like a hurricane in space. As a matter of fact, the galactic shape is close to a logarithmic spiral; assuming such a property, a simple calculation shows that space has to be somehow disappearing at a constant rate through the center. Then, what is happening in the eye of that hurricane? Where is space itself going?

Here is first why we can see different spaces moving vs. one another instead of seeing an all-encompassing space, which is the space of General Relativity. We are going to picture the area containing a galaxy as being a space of its own, infinite but bound, and with a definite boundary. How can we get to such a picture? Further, how could a space be moving versus another one?

The Quantum Mechanical Notion of Superposed Spaces

When we look at the sky at night, we get the feel that this entire sphere of stars is rotating versus us. For centuries now, we are in fact accustomed to see us rotating versus it, and this from the knowledge of our place in space since Galileo. Now let's put ourselves at the "edge" of our galaxy, and look at the sky there. The "celestial" sphere at that location is half filled with brilliant stars, and the other half is basically dark. Do we see these stars rotating versus us? Or do we see the distant galaxies rotating? If we take Newton's pail, will it rotate with the stars, or with the far galaxies? We will bet here that it is standing still, as the galaxies are standing still. The reason is simple: If it was rotating with the stars it would continue to do so until we reach another galaxy's edge, and then it would rotate according to the stars in that galaxy. There has to be a point where the pail no longer follows the first galaxy. Here we have to admit that only the solid angle of view

[9] This is in reference to Euler's equation in Hydrodynamics, while Einstein's equation is Poisson's equation for space and matter. [**4**]

[10] This is in reference to Clausius' "heat death" of the universe expressed in the 19th century through the view of classical mechanics and its thermodynamics.

through which we see the galaxy will dictate the influence on the rotation. But what is this "solid angle of view" but the electromagnetic flux from the galaxy, and nothing else.

Then we can picture at last celestial spheres as electromagnetic entities, physical things, no longer what Mach (and everyone else then) understood as "empty space," somehow transmitting the orientation of space via the far presence of "distant stars," a weird effect-at-a-distance made well-known by Newton through his pail experiment to show the value of his **absolute space** vision, a vision that General Relativity never could really incorporate, except via hand-waving arguments.

The existence of electromagnetic phenomena everywhere, coupled with the bounded extent of galactic islands of matter, leads then to the conscious experience of galaxies having indeed an electromagnetic space of their own superposed onto spaces of the same nature belonging to a countless number of other galaxies.

The "hole problem" of GR that Einstein had to solve between 1914 and 1916 addressed the very fact that his theory **cannot assign a definite metric to a vacuum**.[11][**6**] There, Everett's experience comes to the rescue, and confirms that the space containing a galaxy, an "island of matter," **can only remain superposed** to the spaces generated by other galaxies, as there cannot be a "wave function collapse" of the electromagnetic spaces that could combine them into one **quantum** entity since the space in-between is void of any matter that could effect such a collapse. The space metric is then confirmed to remain physically **undetermined**, as matter waves are in quantum mechanics in-between observations by matter.

A key observational fact supporting this understanding has been identified only in the past thirty years,[12] after Einstein's lifetime: Stars and gases in spiral galaxies display a very odd rotation, acting as if these galaxies were rotating solid plates close to their center, with the speed of rotation being rather constant after a short distance out of the center. Of course, if the plate was behaving completely as a solid, the speed of the stars would quickly reach light speed, and we know that they don't. We will not address here the **rational experience** that comes a priori to mind, namely that this behavior must come from unseen matter.[13] We will rather keep on using our conscious experience about the **nature of space itself**, as it leads to a wider understanding of reality.

We shall look now at what is spatially happening around and at the center of these quasi-plates so we can reach a communicable picture of the spatial phenomena at their center.

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[11] Showing then that space is mathematically treated in his theory as a non-physical entity, contrary to his conscious experience. Einstein published in spite of that lack of determination in the rational formulation of his theory, but this remained a fundamental problem for him, as QM became.

[12] Many references exist on this matter. We will not mention any.

[13] The required "non-baryonic matter" in that hypothesis remains only a view of the mind to this date, as particle physics could not identify anything of that sort in the ensuing 25 years after the hypothesis was formulated, in spite of all the efforts spent in that direction since.

A New Space-Matter System Waiting to be Born

Since a space quantum-mechanically corresponds in effect to one of these islands of matter, what happens to the part of that space which no longer can communicate (electromagnetically or otherwise) with the rest of it? In that respect, "singularities" have been indeed found inevitable in General Relativity when matter accumulates under the force of gravitation, creating an isolated part of that space called a "black hole."[**7**] Couldn't this consequence of GR allow in fact the birth of a completely separate space-matter system? On this subject, we have the prior experience of "neutron stars," something our eyes have not seen, but our telescopes and other instruments told us exist. We know that atomic nuclei of the size of a large asteroid can exist. Here descriptions of particle physics told us that in such nuclei we have swirls of nucleons, each appearing as tiny **bound spaces**. and this since their contents, quarks and gluons, cannot leave them individually.[14] [**8**] We also know that such tiny spaces are not of electromagnetic origin. We are then led first to the picture of a system basically governed by interactions between nucleons creating (strong force) bound spaces embedded in an a priori unbound electromagnetic space.

Now, how will such a system evolve when electromagnetic space (the galaxy space) gets bent to sizes that are the size of nucleonic spaces? This space then cannot convey any more its own bending further than the typical extent of one nucleon. [15] What space do we have between nucleons if e-m space itself becomes as limited or bound as them? We are then forced to see the elements of both matter and space in effect prisoner of each other in their "monadic" relationships. [16] [**9**] Where could an out, a "door" be for such a system through which the separated e-m space contained in the black hole could expand and develop into a full space of its own?

Certainly not within the original space, as black holes have no hair there,[17] but an out appears to be possible as a result of the geometry of spiral galaxy spaces: By being a disk rotating versus other spaces, such a spatial system must have a fixed point with respect to its celestial sphere (which, as we have seen, is made out of electromagnetic elements from other galaxies, together with the zero point energy any space has). At that fixed point, we are going to see that the spatial system containing the galaxy must include that door.

A Spatial Sink-Source System

Let's now put ourselves at that fixed point. What do we see? We must be surrounded by darkness as the topology of the galaxy space forbids its electromagnetic elements to go to that fixed point, [18] except for two opposite points at infinity, that are fixed. In which

[14] Only by splitting out as mesons, which are in that picture other bound spaces containing quarks.
[15] Quantum Field theory envisions the strength of all forces becoming equal at the mathematical spatial singularities obtained when space is seen as all-encompassing.
[16] Then the mathematical singularity will never be obtained since the space itself resolves into quantum elements before it is reached.
[17] Per a famous theorem in Modern Cosmology.
[18] Observations of the center of the Andromeda galaxy have shown a complete void, attributed by the observers to an hypothetical "galaxy wind" going from the center. [**10**]

space are we? Well, we cannot feel gravitation from that surrounding rotating dark sky, even though the stuff it is made of is mighty close to us. So we must be out of that stuff's space, which is the space of the galaxy, and we must thus be within the electromagnetic space of the two points we dimly see at infinity.

What is then going to happen to a black hole that happens to come around us?[19] Well, it will have to "evaporate," as the part of the galaxy space it was originally made of is becoming extremely "thick" here compared to the "outside" superposed space **quantum mechanically** reachable at that point. The elements of its contained space will then have to expand in order to balance this local differential in spatial density. Holes will appear at its horizon through which all the nucleons in it will at last leave. After all, there is no gravitation here except for within the space around the "singularity," and these nucleons face only the repulsive pressure built by their accumulation in a black hole space which is now quickly expanding.

The matter in this hole (which is now a **white hole** through the expansion of its space) may take a long while to completely evaporate if it is very large. Its demise may not be smooth as quantum fluctuations are bound to be amplified in this process. The matter and radiation in it may then split up in "blobs" as we can see from afar in the form of a "blazar," or even be ejected almost as a whole, and be seen then as a "quasar."

The 4S Sequence

During a lecture at the University of Nottingham in 1930, Einstein expressed the conclusion that space can be the origin of matter, that space is primary reality and matter secondary reality.[**11**] Here is now this Einstein's "space as matter" idea applied to the above process.

When the spatial density becomes higher than the density of matter, the energy of matter starts transforming into the energy of space. This process increases the amount of space energy versus the amount of matter energy. The difference of density between matter and space is becoming less. At some point, there are as much "nucleons of space" as nucleons of matter. Everything is acting as elements of space, or matter. This is a black hole.

Then we reach the first turning point of the new space-matter system separation process: We are in the eye of the hurricane. As for hurricane processes, the fixed point of the celestial sphere gives the anchor of the system; but unlike hurricanes, the anchor is here at infinity, so the "funnel" will have to go to infinity. By the density of the galaxy space having been reduced there to the "outside" space, a door has opened for the new space contained in the black hole to expand through this anchor, which is then a **Spatial Sink-Source System** (4S).

The second phase of the process is the spread of the new space: The energy of that space starts transforming back into the energy of its matter that gets spread out in it.

[19] Of course it is not "falling" to the fixed point as there is no force to do that. Its motion is entirely governed by gravitation within the galaxy space, and that space does not reach the fixed point.

With the space expanding, matter spreads. This process is over **when the energy of matter and space available in the 4S are back in balance**, which may take a very long while if a steady supply of space-matter components is provided by the mother galaxy space to the fixed point.

According to the first law of thermodynamics one will say that, within a given spatial system, energy cannot be created or destroyed; the sum of the energy of matter and the energy of its space must be always constant:

$$E_{matter} + E_{space} = E_{constant}.$$

In the first moment after the start of the white hole, $E_m = 0$, $E_s = E_k$. In the subsequent moments, E_s structures into E_m, and the transformation is over when E_s and E_m are balanced:

$$E_s = E_m \quad (\text{with } E_s = E_k/2 \text{ and } E_m = E_k/2).$$

The third phase in the above process is formation of new stars in the newly developed space: The **free energy** from the 4S may form stars.[20] With their formation the density of their space also increases. Another 4S may then form if the overall rotation of that newly expanded space-matter system versus the outside space is non zero.[21] The "children" stars would then enter their journey around this new 4S, thereby forming a new spiral galaxy.

A second turning point is reached: Stars start eating each other. When a star is three times bigger than our sun it becomes a black hole. In this second generation black hole the energy of matter transforms again back into the energy of space. This increases the density of the space around the black hole and increases the gravitational force between it and the new 4S. This process leads into the first phase of that 4S.

With the formation of black holes, the transformation of E_m into E_s starts. In its "singularity" the energy of matter is transforming into the energy of space. E_m is falling towards zero, while E_s is rising towards E_k . When the black hole reaches the vicinity of the 4S fixed point, the energy of that space starts transforming back into the energy of matter, and thus becomes an expanding white hole again.

So 4Ses provide a **self-regenerating** process for the universe, generating new space-matter systems, with no foreseeable beginning or end for such generations.[22] The conservation of energy within space-matter transformations could be described formally through a **continuity equation** in order to complement Einstein's, which addresses steady-state space-matter systems.

[20] It may only form proton beams, seen from afar as jets, if the evaporation process is slow.
[21] If zero, elliptic galaxies would have to form.
[22] This cyclic process was described as "cyclic big bangs" in [**12**].

Conclusion and Outlook

The conscious experience we have described is showing us that we have to be careful with theories that are based on conscious experience limited by knowledge at the time of that experience.[23] Einstein saw the universe as an all-encompassing space, and expressed the dynamics of matter and space within it. With the discovery of AGNs within islands of matter called "galaxies" the overall space of the universe can only be open, infinite, with new space-matter systems inherently providing for a perpetual renewal of its free energy.

Such renewals are also predicted by the cosmologic theory of Turok and Steinhardt.[24][**13**] Kompanichenko came to the same conclusion by studying how stars and planetary systems are being formed.[**14**]

We have not touched upon prominent effects experienced from Earth, such as the Hubble expansion and the Cosmic Microwave Background. They are part of the basis of Modern Cosmology following the hypothesis of an all-encompassing space, but they can be easily disposed of within the experience described here by equating the universe with our galaxy, as Einstein originally (and unknowingly) did.

We have also not touched upon the meaning of superposed spaces for General Relativity. One obvious consequence of this concept in that respect is that **gravitation at a given point of the superposition comes from a sum of metrics weighted by the relative "thickness," or density of the various spaces at that location**. We have seen that gravitation disappears in a 4S as a result of a local boundary with another space; this "thinning" of space generalizes to the "edge" of a galaxy, but not in a local fashion as at the fixed point. Here, through the concept of a celestial sphere being a physical entity, we can advance that, just outside a spiral galaxy, and especially on its plane, the celestial sphere becomes quickly filled in majority by the electromagnetic flux from outer galaxies. Gravitation from the nearby galaxy must then disappear accordingly. This is an effect which ought to be astronomically verifiable.

Finally, the differential between gravitational strength in the celestial spheres on the sides of the galaxy disk vs. the spheres at its edges leads also to a fundamental stability for such disks, and this without recourse to unseen matter.

In a subsequent article we will investigate the meaning of the above experience for processes other than cosmological ones.

[23] Rational experience appears indeed not to be all-encompassing as logical positivism, the basic philosophy of Science in the 20th century, made us believe.
[24] Although they saw an all-encompassing process that had to go through universal "big bangs."

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Space and the Basis of Life

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Abstract

The physical nature of space demands the consideration of other states than single layer ones when its quantum origin is envisioned. Knowing that Life has the propensity to use available physical phenomena when they are to its advantage, a confirming study of its evolution tells us that Life must be using this feature of space as the physical basis for its spatial organization beyond the capabilities of the non-living world. A basic example of such use is analyzed here. Through this special self-organizing capability, Life then provides the means for the universe to increase its order negating the entropy that otherwise would limit its future.

Keywords: life, space, entropy, order, biological cell, spatial organization, quantum computation

Introduction – The Quantum Mechanics of Space

From the conclusion of the previous article on the nature of space, [**1**] we are left to wonder what could be other key properties of space we have been missing. We have seen that space in General Relativity has a strange property: Its metric is left undetermined in a "hole" where there is no matter (i.e. vacuum). For mathematicians, this was not a problem at all, but for Einstein this was the proof that his theory treated space as a non-physical entity, something that went straight against his original conscious experience. Space had indeed a physical existence in his approach, and this against the previous centuries of "absolute space" from Newton, and/or abstract mathematical "forms" without physical substance in the tradition of philosophers such as Plato or Kant. So his theory was indeed fundamentally incomplete by lacking a connection to a physical entity that would be present even in the vacuum.

But when he looked at the sky filled with stars, he felt that this lacuna may be ok as the universe appeared to have matter everywhere, so there must be no "holes" to be worried about. This was tough luck, as by the end of his life the universe was found full of large vacuums everywhere. So his successors ought to really worry about that lacuna.

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This is not happening. Instead the world is still taken in Modern Cosmology as having matter everywhere.

By 1935, Einstein officially dealt with a similar challenge about indetermination in Physics. This was the challenge of **Quantum Mechanics**. [**2**] The equations in that new field of physics too had indeterminism all over, and he put out his famous: "God does not play with dice!" statement against this fact. But, after reflection, since there was an indeterminism in matter, why wouldn't there be an indeterminism in space also? This similarity of make-up that he found in his own theory ought to have told Einstein about a possible quantum aspect of space matching matter. But this was not his destiny because he was straight against indeterminism in all physical events as a result of his classical mechanics upbringing.

Now we have seen that space is most likely a **quantum superposition of electromagnetic entities** tied to the elements of matter they contain through emission of radiation by that matter. In the line of quantum behaviors matter displays, such as different quantum states, shouldn't space display also other states besides a **"ground" state**? Its other states could be multiple layers instead of a single layer for this ground state. We advance here that a prominent part of reality does in fact use this hypothetical quantum property, but at a very different scale, i.e. the **scale of Life**.

The Key Supramolecular Structures of Life

One thing biologists-in-training learn quickly is the existence of all sorts of big molecules in living systems. Their number way surpasses the number of flowers in a botanist compendium. However, one kind appears prominent in all biology books of the past 40 years: This is DNA. We will not mention its full chemical term as this is not important, but Schroedinger, as one of the discoverers of the quantum, predicted such (as "quantum crystals") in a lecture he gave years before its discovery. [**3**] It was the hypothetical substance that was going to provide **the order that Life displays**.

Indeed, the world is full of **disorder**, it is measured by the term "**entropy**" in thermodynamics, a science prominent in 19th century classical mechanics, before the quantum was discovered. By that understanding, the inventor of the concept, Clausius, predicted the end of the world in a "heat death" nightmare. So Schroedinger was in effect telling the world not to worry, as **the quantum through Life was there to restore order to the world**.

DNA was the repository of the data to build all the big molecules found in Life. But, was DNA also the computer that was going to **spatially** direct Life in all its processes? Quite unlikely, as we are talking here about 3D organized construction and maintenance capabilities, and the computational power required to effect such is simply not there. DNA only appeared as the basic "warehouse manager" of Life.[25] Manifestly, it could not

[25] Besides its self-induced duplication capability. "Artificial Life" computer studies tend to demonstrate that a lack of spatial organization capability of DNA kept the organisms as single cells. See

be involved further than the warehousing aspect of the entity it is part of, which we call a **biological cell**.

But after DNA was discovered, another prominent supramolecule showed up, almost unnoticed until the 1970s, and to this day yet not recognized as the other key to Life. This was the job of Lynn Margulis: [**5**] To identify this key factor in the evolution of Life. Life was strewn with **symbiosis between smaller organisms**. Lo and behold, some of these organisms did not contain DNA; or if they did, it was a very small type that created one single supramolecule. Even then, it was only optional for the continued life of this supramolecule and its offsprings.

Indeed, this supramolecule, called a "**centriole**," was able to generate children through mere duplication! This short tube was an assembly of **microtubules** (MTs) as they looked like tiny tubes made of identical molecules called tubulin, a protein that the DNA of organisms produces now. Centrioles came from independent organisms called **spirochetes** before some integrated single-cell organisms. These latter fellows were somehow swimming (undulating) in large schools through water, like tiny waving fish, before they integrated cells. Once integrated to a cell, they somehow allowed these cells to organize themselves in groups. It was the beginning of **multicellularity**, an organizational capability ultimately allowing Humanity to develop, of course much later.

One striking phenomenon we will delve on is the duplication of these centrioles. No strings were attached to that process: The child cylinder (a "life crystal"?) just grew at a short distance from the mother, **with its axis perpendicular to it**. But the most amazing thing about it was that its subsequent replications in the host cell were coordinated with the overall cell duplication process, called "**mitosis**." Mitosis is the basic phenomenon of Life, as there DNA replicates also, except that DNA replication has a lot of "strings" attached to it within a cell. These strings are made out of microtubules, bundled in a "**spindle**." Without going into the details, **this spindle was helping DNA split and separate the cell into two cells**.[26]

The other part of this marvel was the "**receptors**" located in the cell outer membrane, allowing communication of the cell with the outside world. These receptors were manifest descendants of spirochetes too.

What is the basic organizational principle under all this? At least, unlike DNA, we are dealing here with rather simple molecules, as MTs are mere polymers of tubulin, and nothing else. We may then have a chance to obtain a conscious experience on what is physically going on with them.

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for example the negative results of Tom Ray's "Tierra" system described in [**4**]. Of course we cannot be certain of this fact, but several years of tries with powerful machines led nowhere.

[26] Here we skip over the fact that DNA can direct cellular duplication on its own. But such a process applies only to primitive single cell organisms.

Space Manipulation by Matter

Let's look closer at these tubes. We find that tubulin can have two "**conformations**," i.e. two configurations of its many atoms, α and β. The key fact is that these configurations are governed by the position of a single electron in one of the internal chemical bonds of the molecule. Others have looked at that strange fact, and deduced that there must be "**cellular automata**" [27] going on at the surface of these tubes, with patterns of conformations moving on it. [**7**] But this assumes a purely classical motion of a large number of atoms. How could a single electron act on the relative location of 100,000 atoms? Well, it does not have to, as it will be postulated here that it is more advantageous energetically to have **space splitting in two layers** where the two conformations are in fact standing still, and the electrons then shuttle between the two layers, thereby **creating a new space**, which we will call a "**leptonic" space**. There will be only electrons and photons in such a space, as no atomic nuclei will be present. We could then say that **this is a vacuum as it can be found in intergalactic space**, just 2-dimensional and curved around the tubes. The overall evolution of the electrons in that space will not display what is called "decoherence" as **thermodynamic disorder can only come from atoms and their nuclei**, and such a space has none of them.

Unlike classical computers using cellular automata, this set-up can be the basis for a true **quantum computer**, with its data inputs and outputs occurring via emission and reception of coherent photons, all within the leptonic space just mentioned (and thus unobservable from ordinary space). A study of how this kind of computer could operate has been made, [**8**] and essentially we have waves of electronic arrangements through the tubes in leptonic space.[28]

If we observe a centriole, we will not see anything happening, as the evolution occurs in another space. This is a major problem for the experimenter, of course. He/she will be obliged to exclusively use conscious experience to get to how this process can direct the function of an organism; observable consequences will have to be obtained **purely from this conscious experience**. This is a key reason why we have stressed the need to use this kind of experience for the sake of a future for Science. [**9**]

Rational experience here tells us hopefully something more: In order to have a full computation process, i.e. a **quantum cellular automata**, the possible conformations of "nearest neighbor" molecules (tubulin) will have to be available as a complete set. [**10**] This can be only if we spatially superpose two of the tubes, with the two resulting leptonic spaces at right angle from each other (as seen from their ordinary space shadow).

The only way to get physically to that arrangement will be for the tubes **to pair with other ones, and this through leptonic space**. How could such a thing happen? Well, here comes the geometry of space as we know it from General Relativity. If we take space

[27] Cellular automata are a mathematical curiosity, which can have the computational power of the basic theoretical computer, called a "Turing Machine." [**6**]

[28] Here a remote image of the physics could be drawn from cyclic hydrocarbon molecules where we have pi electron orbitals as a result of possible dual arrangement of chemical bonds.

as a sheet of paper, we can fold it in a cone where two tubes (straight lines then) can be brought to superpose onto each other. If we flatten the cone, **these tubes will be at right angles**, and we will see the developed (flattened) cone from ordinary space. Since we have observed the duplication of centrioles at right angle from each other, we shall advance that **the quantum evolution of the initial tube curves space around itself in a conical shape**. In this manner, the leptonic space evolution of the tube prepares the place for the molecules of its partner (in the **dance** it yearns energetically to follow[29]) to accumulate and organize into a new tube dynamically complementary to the initial one. The energy to do such a space bending is provided through well-known chemical agents to the tubes, agents that are omnipresent in the cell medium thanks to the warehouse manager called DNA.

A Physical Life Principle and its Experimental Consequences

Here is then, maybe for the first time in the history of Science, a case where an energy neither in the form of "ponderable" matter ($E = mc^2$), nor in radiation form, results in **bending space in a selective manner, as only the molecules that are susceptible of participating to the dynamics will be attracted**. We are facing a new kind of force, not gravitation, not electromagnetism, not even strong forces, as all these forces are non-selective about the internal dynamics of the thing they act on. It is a force coming from pure dynamical requirements, and is developed solely through the intermediary of space state possibilities.[30]

An immediate side consequence of such a bending of space must be observed through a resulting additional measured overall weight for living materials versus dead ones.[**11**] This weight addition has nothing to do with additional mass; it is purely the result of a dynamic process; when the process ends, so does this weight addition. Separately, the initiating centriole tube is observed to be accumulating all kinds of debris preferentially toward its end away from the partner it builds, accumulation called "centriolar feet"; [**12**] this can only be interpreted as a sign of a local sharp gravitational attraction due to the local cone of space bending being located near the partner.

At the end of the partner construction, we will observe a **pair of centrioles** "floating" close to one another in what has been called the "**centrosome**" area of the cell. We observe further that this centrosome resides close to the cell nuclear membrane, and that microtubules (MTs) are coming out of that centrosome (also named "MT Organization Center" or MTOC), and go preferentially to the receptors in the cell membrane. It can be

[29] This is a key generic fact of quantum evolutions: Non-local patterns of electronic evolution are less energetically demanding than more localized ones.

[30] In quantum mechanics, this kind of force may be seen as an "entanglement" force resulting from coupled wave equations through the mere **possibility** of leptonic space. The use of quantum mechanics as acting on space is of course not part of conventional quantum mechanics.

shown that all these location choices are not accidental, or meaningless, for the function of the cell as a whole. [31]

The cell is thus organized spatially through these descendants of spirochetes, and appears to be internally swimming (or dancing) in a very choreographed manner, as schools of spirochetes were doing in their primordial water, just in a more diversified way. This orchestration looks to be coming indeed from outside the DNA, maybe using a fancy sort of **quantum computation** occurring in specialized supramolecules effecting the "microprocessors" of Life.

An Anti-Climax: The Modern Remake of the Golem

In that area of spatial organization, the only theory classical mechanics could come up with is the theory of **morphogens**. [**14**] This theory was thought out in the middle of the 20th century by the biggest figure in Computer Science, Alan Turing. The computers we have today are classical machines (as automobiles are), based on Newtonian mechanics and on the **locally separated** elements of reality that this kind of mechanics sees. No quantum mechanics, and its non-local character, enters in such machines. The intent of Turing was to show that his theoretical (and classical) machine could replace the intelligence of Humans. So if Humans were nothing but (classical) machines, his theory would have much more value. Thinking of morphogens was an attempt at rationalizing the spatial organization found in living systems (especially the development of embryos) through the 19th century **statistical mechanics** of separated elements. Turing's theory assumed that living entities are based on the result of **thermodynamic diffusion** of molecules, themselves treated as identical elements finding themselves "in the same sac" so to speak. Prigogine provided additional tools in that line through his thermodynamics of "**irreversible processes**," [**15**] the most evolved form of this 19th century physico-mathematical science. All this was in retrospect an attempt at reducing Life to a fancy form of the non-living world, just more "**complex**" than steam engines.[32]

The truth is that the "sacs" Life uses, the biological cells that originally were no more than oily bubbles in dirty water, contain an extremely compartmented environment, that appears developed so that stochastic diffusion simply has no room there. Such a situation is in fact necessary for Life to build its organization: Only when the cell dies, will we see such stochastic phenomena coming into play, and the products of death (apoptosis) will be promptly disposed of, as not belonging to the organism.

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[31] For example, the cell shape is determined by "tensegrity" structures build by the MTs and "integrin" filaments. [**13**] Such a design is seen as occurring "spontaneously" by Ingber, through a mysterious way of creation/organization by Nature. This is a non-scientific attitude related to "spontaneous life generation" of previous centuries (a theoretical void related to the void of transport phenomena). In contrast, we state here that such structures can only come from the **common point of the structure**, the centrioles, with directions given to the **nearby** warehouse manager DNA in its nuclear membrane for producing the necessary components.

[32] This is one of the origins of the Complexity "movement" and "Artificial Life" research, paradoxically started as late as the 1990s, trying to explain "order out of chaos" through the novelty of computers and the very classical mechanics of "complex" systems.

The Function of Living Organisms is in Active Relation with Space

A key fact is generic to Life: Organism development and maintenance are based upon **spatial organization** of many different molecules and their movements of one versus the others, with no valid theoretical basis for such in classical mechanics, and its attendant chemistry. The only thing that chemistry can do is identify the various components involved in a given process; it cannot tell us what makes them act or move one vs. the others, as well as cannot identify the dynamics of the (unobservable) quantum processes they act on. Here attempts are made by chemists to fill the theoretical void they know exists by using names such as "signals" and "pathways" for the processes they study, names with the connotation that we know what produces the organized movements found in Life, but this is of course only a make-belief, as the theoretical void remains.

A striking example of unexplained motion is about how viruses invade a cell all the way to its nucleus in a directed way. A virus is a supramolecule with a very sharp geometry (a "Life crystal"); no flagellum is there to effect a classical motion for that molecule. Direct physical observation shows that the motion from the external membrane inward to the nucleus was done via intermediate hopping from one MT to another, "sliding" along each tube along the way. This process works for all kinds of cells to be invaded, so it can hardly be of chemical origin. [**16**] Of course, if we knew the physical basis for the motion, we would have a generic way of getting rid of viruses, but we don't. This theoretical void applies to the omnipresent "transport phenomena" found throughout Life.

Conclusion

The non-living world cannot allow higher states for space, as this demands a too highly diversified order of matter in the first place.[33] The "crystals" of Life have orders of magnitude higher diversity than the ones of that world.

As Schroedinger guessed, then Life appears to be indeed the tool for the renewal of the universe, and this through the "negentropy" it provides thanks to the properties of timeless space: By using the multi-quantum state property of space as we have described through Life, the universe has the ability to increase its order.

The question remains there about the worth of that help, as Life appears to be a mere "froth" on this planet.[34] We shall see in a future article that in fact, through Life, the universe can increase its order to unforeseeable levels. Through that path, we can see an improvement without end in the future of an endless cosmos. It can only be an eternal progress in order ("negentropy"), more than balancing the disorder (entropy) process Clausius worried about in a previous century, being unaware then of the role of Life, a role that his century minimized for cultural and religious reasons.

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[33] Except maybe in the case of high-temperature superconductors, where unobservable "quantum protectorates" may be built through diverse crystal layers. [**17**]

[34] And we see such things as an increase in disorder right now when it comes to the climate of the planet, so Life does have an effect. But what is the real long-term effect?

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The Power of Quantum Dynamical Life

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Abstract

How far can Life go? It has to be limited by the physics of the universe; so such limits are identified first. Subsequently, the means Life used to develop to the levels it is found now are studied, and further means for experimental verification of the approach are identified. We are then in the position to show that Life, through its fundamental connection with timeless space, can provide the path to overcome the entropy generated by the separated elements of reality.

Keywords: life, space, evolution, synapses, order, quantum computation, entropy

Introduction

The theme of Life introduced in a previous article [**1**] was that it was a tool for a renewal of the universe against the entropy of its contents through the negative entropy it provides thanks to the properties of space. **Space itself, as a quantum entity, has no entropy and is timeless**. Life's yearning for organized space was essentially due to energetic considerations found in quantum dynamical evolutions when they are seen as able to mold space for their need. However, Life appears as "froth" on the surface of our planet, insignificant compared to the typical size of cosmological entities and the physical phenomena they display. The question then remains: How can Life with its typical sizes significantly alter the destiny of the universe?

A study of the evolution of Life has led to distinguish basically two long lasting phases, one with single cell organisms, the other with multi-cell ones. Life started from oily bubbles in dirty ponds, places we could call refuse areas of the universe; but from such a lowly and tiny start, it ended up covering this planet, to the point that now little is left unoccupied, i.e. lifeless, on it. Our remote ancestors went in size from the submicroscopic (supramolecular) scale to the meter scale. This would be the equivalent of an organism our size becoming the size of a planet! Is our destiny to be the size of a galaxy?

Leaving aside the incredible aspect of such a vision, we know already from the previous article that Life has had one goal in mind, so to speak: Reducing the amount of disorder in space. **Can Life increase that ordering power, "negentropy," indefinitely?**

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In order to answer such a fundamental question, we shall look at the means Life used to get to the sizes it has reached in our days, and then consciously experience what the potential of these means may ultimately be.

The Limits of Classical and Quantum Mechanics

Going much further in size and impact is quite unlikely within the realm of classical mechanics. This is the setting Life has put itself after its original start within the primordial oily bubbles. However, we know that limits are there when considering that kind of mechanics. We know for example that it would take 10,000 years for light to cross one fourth of our galaxy. The speed of light is a barrier for **separated material elements**, and Life has had to use such elements since its start in order to bend space for its needs as we saw earlier. On the other hand, physics has lately discovered that **this limit may not be there for non-separated elements**: Quantum phenomena are basically "**non-local**," unlike classical mechanics ones, as EPR experiments confirmed in the past 20 years. Such experiments were inspired from Einstein insisting in 1935 that, as classical mechanics understands, **there had to be an element of reality at all points and times of a physical evolution**.[**2**] Quantum mechanics was saying to Einstein that **such elements were not existing until an observation by a material entity was made**. [35]

EPR experiments proved Einstein wrong, and the quantum approach right. [**3**] But what they did not prove was that **a physical system could use exclusively quantum mechanics for its evolution**, as physical systems are just treated as "black boxes" by that mechanics, with no intent or ability to look into such boxes. Bohr, one of the fathers of the quantum approach to physics, said that **this knowledge of the internal behavior of a physical system was unreachable**. [**4**] For example, a composite quantum system, i.e. a set of quantum subsystems interacting with each other, can exist, but **their internal evolution cannot be known**, as the theory limits itself to the **observation of physical systems**. Observations are the inputs and outputs of the system from/to the "outside" world (taken as classical); they are not describing what the system is "internally" doing. Was Bohr wrong too?

We are going to look at such composite systems, and show that, through them, both barriers of classical and quantum mechanics, i.e. the limits coming from the speed of light and from the physical knowledge of reality, are in fact not there. This is a critical fact that will have to be identified, as we shall see that composite quantum systems are used by Life in its conquest of disorder, thereby **reducing the entropy of the universe**. In other words, we need to evaluate the full capabilities of such systems in order to identify the **potential power of Life in the universe**.

In a more pragmatic fashion, a "simple" **amoeba** can do all sorts of feats with its body, yet it is a single cell, and thus in many ways powerless. **What principles will this already fancy organization use as a lever to further order space to allow its continued future?**

[35] The quantum meaning can be seen in other ways. We won't mention the others here.

But is Life indeed Requiring Quantum Mechanical Considerations?

Here first, we need to ask the obvious question: Are the classical laws of physics failing in living materials? At first sight, the answer is: No, the laws are not failing if we see the quantum non-local character of reality as not applicable to Life, and thus classical effects must do the job, being the only ones we seem to identify around in biophysical experiments (after all, we need an explanation no matter how contrived it can be!). So far, apparently, the quantum has been seen in microscopic things in the high-tech world, not in "natural" Life.

However, if we really think about it, in order for Life to exist at all, and a fortiori to exist in its extended multicellular form, **non-local feats** and **"contextual" motions**[36] are needed that go well beyond what classical mechanics and chemistry can do **due to the separated and distinguished nature** of the elements such approaches of physics inherently consider.

Many examples of long-range processes can be found in individual cell functions as well as for overall body maintenance, such as **mitosis**, **meiosis**, the maintenance operation within a cell called the **Golgi system**, **apoptosis** (a cell deciding on its own death for the good of the organism), even molecules dealing with the **circadian rhythm** of the entire body.

We are then led to immediately ask a series of questions:

(1) Throughout the **developing embryo** cells must find their place in order to perform their ultimate function, and such a migration cannot be stochastic, i.e. left to chance, in spite of the wishes of contemporary biophysics. What directs the 3D movement of cells in embryos? For example, when they develop, are neurons just following a local "scent"? If yes, where is the command system spreading this scent?

(2) The **makeup of the brain** shows much more data needed there for its construction than is available in the genes (DNA). How is such data generated in real time?

(3) Where is the **mighty computer** performing the synchronized and parallel non-local jobs required to develop and maintain the organism in a sustainable way?

The First Answer of Life: Use Inherently Non-Local Processes

When considering the self-assemblies and the extended whole systems that look to be created right in front of our eyes (and are us!), knowing that DNA is burdened by delivering its data as a "warehouse manager," another agent working in a symbiotic way with DNA must be providing the needed collective **non-local effects** to build larger entities.

In the previous article we have seen that DNA did find a partner to complement its warehousing task, in the form of a **pair of supramolecules called centrioles** that could act in tandem to see far, and act as far, i.e. across the biological cell where the pair was located (which is not very far), and this by using photons and electrons **in a space that**

[36] Contextual motions have been discussed in a quantum physical way as related to the non-local aspect of the EPR experiments. [**5**]

lined up ordinary space, a space that Life generated in the environment it created for itself. The key advantage of using a separate space was that these photons and electrons were protected from the disorder of "ordinary" space, and thus could have a **non-separated whole evolution, non-local as a composite quantum system is by definition.**[37] Such a pair of supramolecules was also able to make fancy decisions, such as deciding where the cell was to go, or on finding food, in the case of single cells, as a result of its computational capability. In other words, it was **the "microprocessor" of Life**.

The Second Answer of Life: Go Multicellular[38]

The quantum subsystem effected by the centrioles "observes" its memory (another subsystem), which is also in a leptonic space manifold "lining up" the normal space of the cell microtubules (MTs), scanning it via photon pulses in that leptonic space, and acting from this input according to the results of its computation.

Now, the MTs coming out from the area around the pair of centrioles cannot perform a computation due to the limited configuration of these polymers. The electrons there shuttle between fixed dual states in leptonic space, states which correspond to molecular (tubulin) conformations forming a fixed 3-D pattern in ordinary space. Such patterns are dynamical as they propagate through **phonon (sound quanta) waves** (Phase 2, App. B of [**7**]), but no computation can be performed by them. Rather, this non-local dynamical pattern can be seen as at the physical origin of the **synchronized motions** observed for **dynein and kinesin "motors"** used in **intra-cellular transports** along MTs, something identified as "cell transport phenomena" in biology.

The motion of the cell is then effected through a repatterning of the photon pulses coming from the computation in the pair of centrioles, a repatterning which in turn relocates the MTs. **The computation thereby directs, as well as effects, the motion and shape of the cell.** In turn, the motion of the entire cell, or an impact from the outside, triggers **ions motion**, which affect the state of the leptonic space system in the MTs, thereby changing the memory effected by this system.[39]

However, the MTs in a single-cell have to both **control** and **realize** cell motion, and each action is an enormous task by itself. These two tasks must be split if the organism **has to increase its choice of behavior in order to survive**, as of course availability of choices is an immediate tool for survival. Then our hypothesis about the origin of multicellularity will be :

> **Multicellularity Hypothesis:** *Through multicellularity the MT system found a simpler way to survive by splitting the motion control and motion realization functions of the cell.*

Then specialized parts will implement each function with a lot more choices available.

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[37] This situation has been called a "quantum protectorate" by the physics of non-Life crystals. [**6**]
[38] The following description is extracted from Phase 2 of Ref. [**7**].
[39] This kind of system input/output (I/O) is called a "memory-mapped I/O" in classical computers.

We now have to look for how the **control function** is done, as this is the one that needs to be developed **to permit the expansion of Life in space.**[40] We are thus going to look at the system effecting the controls in a multicellular animal environment. This is what biology calls the "nervous system."

The Puppet Master Hypothesis

From the well-known fact that **neurons do not have centrioles**, we shall advance the following additional hypothesis:

> **Puppet Master Hypothesis**: *The computation generating the MTs in neurons must be occurring in the numerous glial cells abutting each neuron, which do contain centrioles. The neurons then are, shape-wise and motion-wise, behavioral puppets of a non-local computation occurring within and across glial cells.*

During organism development, neurons provide the **physical motion** to shape the nervous system, while glial cells provide the **directions how to proceed**. [41]

A protein omnipresent in cells, called **actin**, seems to sense the **boundaries of leptonic space manifolds**.[42] By sustaining such manifolds MTs would then localize actin polymerization, which in turn would realize **axonal growth cones**.[43]

When the organism is completed, neurons become the transmission medium to communicate sensors data and controls to the motor parts of the organism, **which in turn are puppets of the neurons**.

But this scheme still does not address the question of the overall control of the system development: **Where is the Puppet Master?** Well, the goal of the glial cells is **to pool their computational power** in order to increase the **versatility of the organism behavior**, so **they are the Puppet Master, and this** in a collective non-local fashion, far from our classical computers, which are local machines. They are much more than a computer network, as **they are able to change the topology of the network as a result of their own computation**.

Then the MTs in neurons would be "**external spindles**" **between glial cells centrioles** to provide the quanta exchange paths needed to create a common computation, following the model of spindles developed earlier in the mitosis of a single cell. [44] We are

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[40] The realization function can be local, so it is not a problem regardless of the size of the organism. Such local realizations depend on the control program, so some of the characteristics (but not all) of that program may be determined by classical observation of local reactions. A key question will be: Where can the **initial pattern** of the centrioles (their "program") be found in the DNA of the cell? Finding such a pattern would determine the physical behavioral characteristics of the organism.

[41] It would be then interesting to find how the glial cells at some point take over control of neurons when they lose their centrioles.

[42] This as a result of observing their function in cell duplication (mitosis), not described here.

[43] Additional guidance is needed through the influence of local chemicals produced by the DNA.

[44] Not described here – see Phase 2 of Ref. [**7**].

thus reaching a higher level of organization by simply applying the organizational principles of the lower level (single cell organisms).

The question remains: How would such external spindles **physically relate** to the centriole pairs that generate them from outside the neurons (**thereby shaping the neurons**), i.e. exchange quanta through cell boundaries?

The Origin of Synapses

In order for the **centriole pairs** of two separate glial cells to experience a **quantum computation** common to both, a 3-D leptonic space manifold common to the neurons and glial cells is needed for the exchanges of their quanta. The need for such a quantum connection in leptonic space then gives a **physical reason for neural synapses**, as the MTs within the neurons would be then able to provide the exchange paths between glial cells centrioles pairs as they were providing in mitosis within a single cell.[45]

In such a picture, each glial cell pair of centrioles emits a photon pulse through the synapse of the nearest neuron, maybe using neurons cytoplasm elements such as the vesicles "coated" with the supramolecular structure **clathrin**, a substance which encloses cell membrane receptors. As relatives of centrioles, such receptors would sustain a **spherical** ordinary space manifold dual layer (instead of the cylindrical one of MTs), creating an orthogonal 3-D leptonic space connection through electrons shuttling in **separate space layers**. Such vesicles would then be involved not only in releasing neurotransmitters in the synapse cleft for subsequent classical ion pulses, but more importantly act as a **photon pulses redirector** between leptonic space submanifolds, thereby effecting a 3-D connection with leptonic space as centriole pairs do in single cells.

The glial cells connected to a neuron would then direct the selection of **functional** synaptic connections (and modify them as called for by the computation) through forming MTs in the neuron (themselves directing actin for the needed growth cones) via its clathrin-coated vesicles. Such vesicles would then, in a sense, provide **the pulling strings of the Puppet Master.**

Experimental Confirmation

The key experimental data confirming the above approach, and the approach of the previous article, is already known. **Centrioles construction and behavior have been seen through electron microscopes a countless number of times**. There is nowhere in sight a construction apparatus around these large structures, which are quite obvious sturdy structures that seem suspended in mid cell medium without support of any kind, made out of parts that don't even touch each other, and which reproduce and move **without any visible causal means**. Such biological self-assemblies would have been called a miracle in other times. Self-assembly in microbiology leads to similar miracles everywhere in Life. So here is only a typical case for everyone to see, as well as to find

[45] The full description of the leptonic space manifolds connection is given in Phase 2 of Ref. [7].

described in the literature in minute details, but without an explanation, and especially without identifying this void in our understanding.

We shall emphasize that it is not because phenomena have been known to occur for ages without an explanation that somehow the very knowledge of their existence reduces the importance of the message they contain. In other words, the experiments proving the theory were done well before the theory could be formulated. This does not render these experiments useless for such a demonstration, now that the explanation may at last be available. Since there was no rational explanation for what was being observed, the matter was taken as just a fact that somehow could be blended with what was known.[46]

The field of biology to this day is replete with examples of that sort. In the early times of physics there were many cases similar to the present experience in biology. The lesson of the past is that the importance of physical facts cannot be appreciated without a theory. A well-known example centuries ago was the question of weights falling at the same rate, a matter which took hundreds of years for a sensible theory to come up (Einstein's), and finally identify its importance. In the meantime, people (including Newton!) said "So what?" The same thing is happening here.

So here the key to the success of the previous analysis is not only about having at last a rational explanation, but about being able to bring out the theoretical importance of the explanation obtained via our conscious experience. This is why this study needs the support of one like [**7**], which approaches the matter from a very general conceptual angle so that the phenomenon can be fitted in a much larger understanding. The key again is to identify the explanatory worth of the physical concepts in spite of them giving results that have been taken for granted over several generations without an explanation.

So how could the unobservable leptonic space manifolds involved in mitosis be confirmed besides through the well-known and direct evidence of self-assembly phenomena, if such are not convincing enough by themselves (i.e. for believers in miracles)?

We have advanced a first way for additional confirmation in the previous article, [**1**] through indirectly measuring **the change in weight of living vs. dead organisms** that contain centrioles. It will be pointed out at this point that already run experiments on this subject [**8**] have found not only a final weight loss, but also that a weight increase is observed before death occurs, which correlates with the increased computational search the organism starts in order to find an out from the threat it is facing, and that such an additional demand **calls for more computational paths, or strings** for the Puppet Master.

But to further experimentally confirm that there is a *different* **space bending** process occurring in synapses, as we have seen above, **the weight of synapses should be measured separately** though anesthesiological agents, or other products known to "shut

[46] This is similar to the attitude in earlier centuries about "spontaneous life generation." It was then, as now, somehow acceptable that things happen without a physical explanation. It is a fundamental non-scientific attitude leaving the world in ignorance.

down" synapses, and be applied to a whole living body containing a nervous system..[47] If a measurable weight loss is obtained, we would have then a direct confirmation of, not only the Puppet Master Hypothesis, but of the **space bending ability of Life** occurring in different ways, something which is definitely not part of current approaches in physics.

Quantum Links

The 3-D leptonic space connections above would then provide the photon pulses from glial cells with a route to the leptonic space of the neural MTs. The neural MTs electrons would then interact with the photon pulses, changing their quantum states, resulting in the neuron being classically "activated."

This would be just a variation on what a single cell would do for scanning its memory, except here a neuron would be common to many glial cells. Then here, beside providing an **input/output with classical reality**, the neuron MT memory would act also as a **quantum link between the processors in glial cells**.

The multi-processor system then keeps on processing and modifying the data in the neurons, an ongoing process by its inherent nature, and a process which has been externally observed. [48][**9**]

The exchanges of quanta through the nervous system are then part of a coherent whole, and effect a **non-local quantum computational system** across many cells, **evolving in leptonic space**, with the centrioles in glial cells being the **processing subsystems** of this non-local composite quantum system.

Through its evolution as a **multiple-reality computation**, such a system then effects a macroscopic-size "**many-worlds**" as Everett envisioned (albeit for reality at large). All the realities of the computation exist in parallel, unlike what happens in the "outside" world since separated elements comprise that world.

Quanta Exchanges vs. Ionic Pulses

The ionic impulses (the "**nerve impulses**" of biology) observed in and across neurons then **contain no data**, as they merely are **side effects** of coherent photon pulses in the neural "spindles" that exchange quanta between the centriole pairs of the glial cells. The ions would be collectively moved in a **stochastic fashion** by the conformational state changes in the MTs biomolecules. The ionic impulses observed traveling along neural axons MTs would be **"shadows" of quanta** traveling in the MTs 2-D cylindrical leptonic space manifold parallel to their hollow core. **By being of stochastic origin, such effects are not part of Life, just a mere consequence of Life.**

[47] We will not go further here into the details of such an experiment, as they are for the experimenter to identify.
[48] With of course no attendant explanation since seen within classical mechanics.

The Central Computation

At the synapses, the photon pulses would be received by glial cells centriole pairs, which would retransmit them to the next neuron via an output of their computation. These pulses being relayed through the neural/glial cells chain would be ultimately stored as data in neurons next **the last glial cell of the chain**. This data would be patterns within the MTs leptonic space of these neurons, thereby effecting **the input/output memory of the central computation**. The MTs in the end neurons then would hold the input/output memory of the central computation as well as (short-term and long-term) memory used by the computation for itself.

An input to the ongoing process in the central computation can be then provided via a chain of neurons/glial cells transmitting the result of a computation done at the sensory part of the system.

The Sensory Subsystem

The sensory part may be acting as a separate quantum computation effecting a Fourier transform of the input data as a pattern of multiple-reality-coded photon pulses in leptonic space (again, shadowed by classical ion pulses which would contain no data). The information would then spread in a **holographic fashion** to a set of glial cells that would in turn process and store it in neural MTs biomolecular states, holding the data until it is picked up by the central computation. [**10**]

The Brain

This last pickup would be done by the leptonic space photon pulses exchanges between the glial cells, in which the photon realities would be modified by the MTs electrons that had their states changed by the sensory subsystem.

The output from the brain to the outside classical reality would occur in a reverse fashion, but with a twist: The glial cells photon pulses would, through a chain of neurons/glial cells, trigger ion pulses at the motor part of the system. There the shadow ion pulses would at last become of value as they would produce classical effects on the motor parts.

Implications for Neuroscience

In the picture above, the function of neurons is to

(1) provide the medium for the physical interconnections between the various glial cells subsystems to complete a whole macroscopic composite quantum system existing in a space separate from ordinary space, with exchanges of quanta (not ionic pulses!) between subsystems performed in fixed one-dimensional ways through the neural synapses, and

(2) provide conduits and hold the outside classical world inputs and outputs as patterns in a 3D fashion to be picked up by the quantum computations occurring on the centrioles of the glial cells in their leptonic space.

The various kinds of synapses observed would then not come from classical effects at all; they would instead correspond to variable characteristics coming from the unobservable computations in the nearby glial cells. For example, "synaptic strength" as discussed in biology would be a change of behavior in the computation of the glial cell associated with that synapse from prior inputs to the computation.

Quanta exchanges characteristics would likely be influenced by the chemistry occurring in the neurons and at the synapse, through the vesicles function there, and thus involve correlated chemical effects back to the computational process. But **the classical ion pulses called "nervous impulses" would be still side-effects of the quantum process of Life itself**; it would only result in mitigating reactions by the local neural chemistry, and consequent design of neural features (myelin sheath, etc.) to counter the effects of such inevitable ionic transport processes which are really not part of Life. *These classical reactions would be then seen by today's Neuroscience as the "prime moving" process, since not being able to observe the quantum phenomena occurring in leptonic space.*

In this area, **the well-known non-local coordinated and synchronized aspects of the classical process observed in the brain**, the only one immediately accessible to experiments, **is still a deep mystery in biology**. (See for example [**11**], Chap. 17) This is a situation which, we shall advance, must be a consequence of the above mistaken identity between quanta and ion pulses.

Cancer and Leptonic Space

Appropriate **cell-to-cell contact**, thought so far as regulated in some mysterious way through the cytoskeleton, appears to be critical in preventing cells from becoming cancerous. [**12**] Within the picture developed here, the cell cortex (including its membrane) supports the boundaries of the leptonic spaces between cells in the dual-layer leptonic space. Therefore cell-to-cell contact must be present to maintain this **common leptonic space** covering the cells and the cross-cell postulated quantum system it contains. **The leptonic space must be then maintained between cells for the tissues to function properly through such (unobservable) whole evolving quantum system**, as it then allows synchronization and coordination of division processes for living tissues.

So we need to know what could disturb the boundaries of this leptonic space, and find the details of how the cytoskeleton quantum mechanically evolves within that space.

Separately, the origin of the organism's cancerous disruption has been traced recently also to either centrioles pair replication malfunction (multiple duplications instead of one) or "**aneuploidy**," the misdistribution of chromosomes in duplicated cells.[**13**] Here, the segregation of the chromosomes in mitosis being an leptonic space physical effect, **which has nothing to do with the genetic makeup**, the misdistribution would be purely of physical origin, i.e. a **leptonic space manifold receding process**.[49] This process is itself dependent on having the proper number of MTs in the spindle (and maybe other things), and thus **may involve a "bad" program in the cell centrioles**. So we need to

[49] As described in details in Phase 2 of Ref. [**7**]

find where this program is located in the cell DNA and analyze it for defects (once we know how to analyze it!).

Multiple centriole pairs (leading to aneuploidy also) on the other hand appear to come from a **malfunction of the DNA program** affecting **the division messaging to the MT system.**

Meeting the Central Puppet Master

We are now in a position to evaluate the worth of the leptonic spaces picture (1) as an explanatory tool concerning the basic principles of *cognitive science*, **a discipline that has considered so far only classical concepts**, and (2) as a paradigm for future **computer science research**, if the realm of the quantum is to be at all approached there in a complete way. [50] However, the generic characteristics of the computational system identified earlier will not be discussed here. We will refer to Phase 2 of Ref. [7], and mention only that this reference identifies the possibility of a quantum system providing its input/output through a **multiple reality internal observation** in the manner identified by Everett, without any need to consider "wave function collapses."

We are thus getting at a **quantum system observing and acting on the classical world, instead of the usual quantum theory where the classical world measures and acts on the quantum.**

When considering such a way of seeing things, our instruments would be communicating to us, **quantum multiple-reality beings**, a classical set of facts[51] that we would choose to consider or not through our "free will" capability resulting from our very quantum nature.

The Door to the Future

How about applying in a technical manner the idea of **extended computation**, available through the leptonic space concept, to extend Life's reach of space, this time through a system like Humanity's own, which was developed through Evolution, but now built consciously?

For this to be accomplished two things need to be done:

(1) Obtain a formal understanding of such extended computations,

(2) Go beyond the barrier of non-determinism brought about by the present formalism of quantum mechanics through considering systems as black boxes.

For Requirement No. 1, Phase 1 of Ref. [7] attempts to describe an extended computation. As a consequence of Requirement No. 2, **the computation must remain within the quantum system**, including the handling of its inputs and outputs, with no intervention from an outside world "observer," as present quantum theory envisions. So a general theoretical study of "composite quantum systems" remains to be done.

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[50] The present patch on classical concepts called "quantum computation" is a misnomer by its very restrictive definition of scope.

[51] Obtained by scanning the states of the MTs in our neurons, thereby identifying the "mind-body" interface that Descartes was envisioning centuries ago.

Could such self-contained quantum systems (SCQS) be the key to our use of extended computation? SCQS is a "technology" which may have been stumbled upon by Nature eons ago thanks to the **possibility for space to have different states and be generated by its content**. Could we consciously experience then composite quantum systems that we could construct and use to discretely observe the classical world and act on it, as a whole? Such systems would not need to use the complex and material input/outputs strings we call the "nervous system." In that area, we know already that experiments involving **teleportation of quantum states** theoretically permit a SCQS to communicate between its part instantaneously, and beyond the light cones of General Relativity.[52] [**14**, **15**] The only limit would be from the time taken by light to spread the system initially.

Conclusion – A Historical Perspective

Nature's trial and error ways in the development of Life were only a long running last resort after Life reached sizes where whole systems could no longer exist by themselves, and classical means had to be used from then on, with their extremely slow ways, being a **classical computation**, and thus the eons of Evolution.

This does not mean quantum effects were not used to build Life in that process, and Life may very well have done so, still unbeknownst to us as a result of our blindness about really new things. Then Nature discovered the Mind. Darwin called it the "Descent of Man." [**16**] The "Ascent of Mind" sounds like a much more appropriate term for that event, as, with our ability to self-reflect, and see, and act logically on our world, we have in effect ended this miserable Darwinian trial and error process at last,[53] and this through unknowingly using the Quantum, **very much as Life would have originated from**.

Then Nature may have at last found the alternative it was looking for to continue its construction. **We would be then its spearhead**, not animals any more, if we learn how to use our minds for the improvement of our condition and our world, instead of its destruction.

The Book of Nature may be telling us what our purpose is, but it seems that we have not read it enough, and so we are not in a position to give a verdict on the situation of Humanity versus the World, especially by presenting Darwin's work as the complete truth about how the evolution of the World did and thus can proceed. We could only say in that regard that some of the things Science found about the procedures of this world before Humanity arrived are pretty sad; but now that we are here, we are not compelled to proceed in the same way. Nature has at last found us, and has thereby delegated to us the goal, and the choice, to bring the most order to our universe in a more expedient, reasonable and kind way than it could do without our minds.

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[52] This would not violate the limit of the speed of light since the communication would occur entirely within a quantum system, where thermodynamics does not apply.
[53] Called by Jacques Monod a "bricolage" in French (meaning "tinkering"). [**17**]

Via the quantum, there may be an **Organizing Principle** that exists in Life which could give our world new means how to proceed in that goal. Knowing the limitations of classical systems, and provided we really dig deep into what we are, the quantum may even allow us to at last reach the diversity waiting out there far in the sky,[54] thereby fulfilling a basic need to know that Nature, as a set of monadic entities coming from timeless space, has ingrained in us to further its own need to construct a better, larger and meaningful reality.

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[54] And of course then civilizations out there could have reached the same technological level as ours, so the spread of SCQSs would become much faster than light from there on.

Mind over Machine

Roger Y. Gouin[†]

Abstract

Is Life able to do things that machines can't? If yes, then Life is based on physical principles different from the ones of Newton's mechanics. The characteristics of the central computation of Life introduced in a prior article are looked at in this light here. Consciousness and awareness of the self are key features of this computation. Through such a picture, Life is indeed found leading the way for Humanity to construct its future, and in a path that Newton's mechanics, and the worldview of its followers, could never reach.

Keywords: life, space, consciousness, the self, qualia, cognitive science, quantum computation, Everett

Introduction

In a previous article, [**1**] we introduced **self-contained quantum systems** (SCQS) as the space-embedded central controls for Life's **local** functions, allowing Life's mastery of its various parts and the separated environments they face.

> **Definition:** *A SCQS is a **composite quantum system** made out of electrons and photons (which are its **physical support**) embedded within a **dual layer region** of ordinary space. Instead of interacting with photons from all directions at any time as quantum systems do in ordinary space, electrons within a given processing subsystem (a quantum processor) only interact discretely in one-dimensional ways with electrons of other subsystems through separate spatial connections.*

As discussed in another article [**2**], such electrons are separated from the rest of reality by being brought together away from it by the evolution of ordinary space into two layers within the area occupied by the SCQS. Even though the electronic evolutions within each processor would be separate, exchanges of quanta with other processors then create and maintain a space separate from ordinary space. The SCQS would be a whole coherent quantum system evolving as any composite quantum system can evolve, that is, as a **multiple reality with exchanges of quanta between its various subsystems**, with

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the extra benefit of being in its own space, thereby remaining undisturbed and separate from ordinary space and its disordered ("decohered") contents.

To bring this kind of physical system in the perspective of reality at large, we shall make an analogy with the nuclei of atoms. Each nucleon is a space by itself generated out of the evolution of quarks/gluons, embedded within ordinary space. This last space is itself generated by the evolution of leptons/photons, and identified as an **electromagnetic space**. There is a coupling between these spaces because the elementary parts of nucleons can have electromagnetic interactions due to the geometry of nuclear spaces versus the geometry of the common electromagnetic space.[55] A SCQS space - called earlier a "leptonic" space - would be also coupled to ordinary (electromagnetic) space, but its isolation from this outside reality would be effected differently from the isolation of nucleon spaces: Its evolution (computation) would be related to the evolution of ordinary space only through the **records** effected by localized quantum states, its **input/output quantum states**, effecting its **memory**, which would be its "information" interface with the outside **decohered reality**.

A Coherent Multiple-Realities World

Per Everett's interpretation of quantum mechanics, the evolution of external reality is made out of infinitely multiple realities within a **structured** continuum; then, per the **decoherence theory** developed decades after Everett's work, [**3**] these realities would decohere into a single one (through "wave function collapses") due to the impossibility to maintain **coherence** among many quantum systems in **differentiated localities** (that exist through the strong forces) within ordinary space. A SCQS would be able to keep its multiple realities coherent thanks to its generation of a separate space without strong forces. [**4**]

The Reference Reality and Consequent Dreams

The external reality would be then the **reference reality** used by the support of the SCQS (electrons and photons) to collectively structure their multiply parallel computations. When such a reference is not there, "dreams" would occur, being computations replaying reality in their own space and arbitrary time (stream of changes) as constructed by the ongoing computation.

The Creative Evolution - Qualia

Hameroff and Penrose brought out the idea that our psychological life could be explained from the nature of space as General Relativity describes by adding the hypothesis of a "quantum wave function collapse" from the distortion of space geometry (gravitation) within GR. [**5, 6, 7**] This is a definite wishful thinking because (1) **GR does not include a description of how space itself comes into being**, something that bothered Einstein from the beginning of his theory, and (2) on the side of quantum theory, the

[55] We won't go further into this subject here – See [**4**].

creative aspect of the quantum acting on space has been missed from the beginnings of that theory also, with the unstated **assumption that space is merely an arena, and not related in any way to the existence of its contents**. Thus a modified GR theory of the kind above cannot explain the origin of the **internal space** of the mind, with its objects we all experience. GR and QM simply ignore the quantum aspect of space and the features that are inherently attached to this aspect.

This creative feature of space and its contents appears now to be a fundamental necessity for our understanding of the creativity of the mind. Within the picture of a SCQS, our dreams, imagination and concepts are objects generated by such a creative process, and within a space coming out also from that process.

A SCQS would experience[56] objects such as **feelings** (needs, colors, etc.) collectively called **qualia** in Cognitive Science. [57] These would be **objects** (real) built out of (**created from**) elements within the SCQS spacetime through its uncountably infinite (extended) computational process.

Such objects would be **real, as quantum states in the memory banks of the SCQS**, because the SCQS internal evolution is a fundamentally **creative process**: Instead of the **contiguous** arrangements of classical systems, which cannot create anything except large scale patterns,[58] the objects existing in the SCQS spacetime would have new features not part of the computation original data (i.e. the outside world input).

This would be like passing at the continuum limit from a series to an integration process, where, for example, the volume obtained is an entirely new feature of the set of elements used in the uncountably infinite process.

Even though the computation is finite, it runs through quantum **states** of electrons and photons, which are themselves uncountably infinite in number. Then such a computation is in fact an uncountably infinite process. This is a concept fundamentally foreign to the present base of Computer Science since this base originated in classical mechanics, using separated things such as numbers. In other words, the **decoherence** process separating and distinguishing things **within the composite quantum system making up the classical world** renders it discrete, if not finite, but this is not how reality in general appears to be built. [**4**]

We describe below something that can be personally experienced to demonstrate this fundamental creativity of the quantum within us: the superposition effects we experience in **stereovision**. Such phenomena are created through the evolution of the mind's physi-

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[56] Since there is no other example of SCQS than minds at this point we shall look at what minds experience from our own introspection. For an introduction to the concepts see Part II, Section 6 and Part III, Section 12 of [**8**].

[57] Schroedinger addressed this subject in [**9**], Chapter 6

[58] As a classical computation can provide, but with overall features that only a mind could discern as a pattern, and make sense from it as a whole. See for example [**10**]. These patterns cannot be recognized as such by the classical computation, only the human observer who sees the result sees the patterns and thus creates them. Artificial Life experiments depend on the human observer to make sense of the "emergences." Emergences originate ultimately all from the quantum, starting with "simple" chemical reactions, which are localized emergences of quantum phenomena.

cal support (electrons/photons), the SCQS own kind of **particles**, **trajectories** as well as extended (space-wise) objects that could be seen as the **condensed matter** of that world, i.e. the patterns in the memory of the SCQS.

These extended objects have multiple features and patterns (including a **feel**, which is also a created object) that the SCQS can experience and recognize (1) by recording its own evolution as part of the external reality, and (2) through the structured relations built across the subsystems making up the composite system. Such relations are modifiable by the computation, thus potentially realize not only a self-constructing computer as Turing and von Neumann envisioned, [**11**] but also a **self-modifying one according to the needs of the computation**.

An Isolated World

Such objects would exist through the evolution of the SCQS physical support, but, unlike the spaces and quanta of external reality, they would not be separated within the SCQS space through a localization process, and thus would remain as non-local data in its memory. In contrast, the external reality connects undistinguishable units to create separate, distinguishable things extended in both its space and time through the creation of classical features from the quantum via **localizations** that happen thanks to the **localized quanta** existing in that reality called atomic nuclei.

The localized quanta of the SCQS are the states of its electrons in the biomolecules effecting its memory, as well as certain states of its computation that would effect a **dynamic memory**. As in the case of the elements of nuclei, the quarks and gluons, being forever part of nucleon spaces, these phenomena would never be able to be observed by themselves in our classical reality, **being also in an entirely different space**. Unlike quarks however, which can be localized through e-m interaction from the outside, these localized quanta in SCQSs could not even interact with the electron and photon parts of external reality since the SCQS space has no common evolution with that reality except its input/output states. Only the SCQS itself is able to experience them within its quantum environment.

For a mind, nervous impulses would only give a stochastic rendition of quanta exchanges occurring at the biomolecular memory level, not the internal computational world of the mind in any way. The evolution of a SCQS would be able to affect the external reality by the computation selecting which, among its internal realities, is to act on its input/output memory. In the case of a mind, unobservable photon pulses in leptonic space produce classical ion impulses that act on the classical world. [**1**] Conversely, external reality would affect part of the subsequent evolution of the SCQS through changing parts of its memory.[59]

But how can these internal objects be experienced if they are all part of the same system that experiences it? Isn't there a need for some kind of **information transfer** be-

[59] This is a modern answer to the old conundrum of Descartes about the relation between mind and matter, or the **duality subject-object.** [**12**]

tween the various parts of this system for such experiences to occur? Questions like these raise the subject of **SCQS internal features**, which can of course vary according to the complexity of the composite system arrangement. At this point, we can obtain only a very cursory knowledge of such features through **Cognitive Science**. But there seems to be a few that can be identified besides the one discussed above (qualia). Future studies will have to discover the precise physical configurations effecting them in a SCQS.

The "Being"- The Sense of a Whole

As a general feature, a SCQS **knows** the state of its various parts instantaneously in its space through the **observation** by a **supervisory computation** within one of its internal realities of the quasi-infinite set of its other ones (as an **Everett Observer** within a many-realities world, [**4**] not via a wave function collapse). In the case of a mind, this would have allowed the development of a basic **sense of preservation** for that whole, which otherwise could not be present.

The SCQS individual processors constantly scan the input/output memory of the system, so the knowledge is locally updated but is available globally. This **information** is similar to the **differentiated localities and directions** that are created in ordinary reality by the strong forces defining nuclei of atoms and their nucleon spaces.

In a SCQS there is no information transfer, as **information** is the character of a differentiated set of entities, and can only be defined by the states of its various memories, and thus there is only information available to the system through its memory banks, which are themselves **individually local but non-local as a whole**. There is no conflict with the speed of light as a barrier for information transfer since **there is no such transfer** within the SCQS, it being a non-local whole system, as space itself is.

In the case of a mind, the classical world, on its **side**,[60] sees appreciable time lapses for a mind to be informed through its various sensory parts. But this is only due to Nature's limited choice of means through Evolution to keep the central computation updated. In that type of SCQS, the updating had to go through a chain of neurons. [**1**] There could be much more direct alternatives for such a linkage.

On the other hand, the classical world could experience **contextual** choices made by a SCQS: If a SCQS extended in space is considered, with corresponding sensory-motor parts, these choices may then be made in the **spacelike portion of the light-cone of General Relativity**, whereby the external classical observers of such a SCQS would have no clue on the contextuality character of its choices. The SCQS switch of internal reality in its computation, a fundamental quantum feature of space per [**4**], would be instantaneous across space.[61] The maintenance of a leptonic space manifold connection across large distances would be then required, but would not be impossible if means different

[60] In the case of a mind, these are the microtubules of neurons.

[61] Contextual phenomena are related to EPR experiments, but emphasize even more the quantum aspect of space. See Sect. 5.3 and 5.18 of [**5**]. In biology, the common production by DNA of molecules may lead to quantum "entanglements" between molecules within cells and across cells.

from the one Nature found are used. In this respect, the two halves of the brain have such extended connections, via its **commissures**, and these cover pretty large distances to form a single mind when considering biomolecular scales and biomolecular means.

The "Focus of Attention"

The quantum system may be able to shift its **focus of attention** [62] on external or internal events as Dennett describes. [**8**] Such a process is separate from the generic design above. It would be a computational feature that provides the ability to select a set of memories (either affected by the external world, the internal world, or both) in the space of the SCQS through an **overall evolutionary state** of the system modified by **all** the inputs from its memory. It cannot be a Darwinian search as Dennett proposes when the size of the memory banks involved is considered. In a quantum perspective, a much simpler and quicker method is available, more like a change of drumbeat as a result of a computation of the change in drum membrane vibration frequency and mode from the screws amount of tightening around the drum (corresponding to the total qualia experienced by the system).[63]

The "Self"

The quantum system may experience its own **self** [64] and the state of its subsystems by exchanges between undistinguishable parts of the computation, creating an **infinitely recursive process** since being the result of a process involving power of monadic space sets, and thus creating the Self. Such a phenomenon may use a **quantum superposition effect** when the self observes (in the Everett sense) sub-quantum systems, very much as stereoscopic vision appears to be a quantum superposition effect creating the depth **sensation** through creating a subspace within leptonic space.

The fact that stereovision may not be a mere pre-existing mapping of reality but a continuous creation of a subspace out of the recognition of its content, in the way external reality creates its own space,[65] is supported by the **conscious experience** obtained through staring at single 2D images constructed in a special manner. [66]

In the case of minds, schizophrenia, and other mental disorders such as split personalities, point to the physical splitting of leptonic space, and may then point to the origin of the phenomenon of **Self** creation by identifying how the reflection effect above can break down. Exchanges of quanta between undistinguishable entities would still effect unseparable wholes, but then such wholes could only be connected **via the external**

[62] This feature is not in the definition of SCQSs given earlier. It is an addition corresponding to a physical layout of the quantum system components which needs to be theoretically identified. We present here only a metaphoric clue to where the feature may come from.
[63] Feynman would have liked this analogy!
[64] See the earlier note on the focus of attention. It applies here too.
[65] We certainly are not creating that space, as followers of the philosopher Kant believe; the contents of that space do!
[66] Bela Julesz's 3-D perceived 2-D computerized images experiments of 1971 as reported in p.117-119 of [**13**]. For vivid color examples see [**14**].

classical single reality, through separate SCQSs biomolecular memories developed for that purpose,[67] and thus would be distinguishable (through perceived **internal voices**). If no connection is effected, the result would be seen externally as **split personalities**, a behavior occurring unbeknownst to the mind developing it.

Subjective Time

As part of the construction of the Self, a SCQS needs to evolve another **overall computation** in one of its realities **observing** the other computations that occur within different realities. This specific ongoing overall computation leads the SCQS to the experience[68] of a **subjective time** from its output, taking as input the **amount of processing** done by the rest of the system. The time in the SCQS space would then only be loosely coordinated with streams of changes in the outside (reference) reality, and this only through the biomolecular systems effecting the memory-mapped input/output quantum states connecting it to that reality. Dream time would not be connected at all.

Coordinated Sequential Motility

Connected to developing a subjective time, the SCQS internal quantum process would be able to act on the classical world at the level of the entire system only when certain records in the input/output quantum states are modified from e-m space (ordinary space) through **sequential changes**. In a mind this would allow a **speech stream** as a variation of coordinated sequential body movements. Such a conclusion may be clarified by examining prehistoric records. In this respect Calvin provides some ideas on the role of **motion sequential coordination** with speech. [**15**] He goes back to prehistory using records (tools, etc) before Homo sapiens sapiens existed and tries to identify how the language capability may have evolved.

The very notion of "time" as a **rational experience model** must have come also from modeling by the mind of the **stream of changes** experienced in ordinary space. [**16**]

Language vs. Self-Awareness

Did language then precede awareness of the self in the evolution leading to the modern mind? This is envisioned by Jaynes [**17**] through a controversial approach. He understands "**consciousness**" as another word for **self-awareness**, and in that understanding, he estimates it to be no more than 3000 years-old in the Old World, and as recent as the time of the Incas in the New World. From the "**evidences"** he selects, the Homo sapiens sapiens mind would have been split until such times in a paleo-schizophrenic sort of way (labeled as a "bicameral mind" to disconnect the concept from a mental illness).

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[67] This computer can modify itself for the needs of the computation. Certain mental states are then prone to physically develop spurious connections (in a sense "driving someone insane").

[68] With a **focus of attention**, the SCQS can be called an "**observer**" - if the SCQS does not have this feature the term "**experience**" needs to be used as then it just interfaces the outside reality and its own reality in many unfocused ways.

Under such a view **the language ability would be a prerequisite of, but would not necessarily correspond to self-awareness**.[69] Self-awareness would then be a clearly added feature that a mind may display, separate from the rest of its functions, **inferring the existence of a corresponding specific configuration of the physical system**. It would have taken hold through Evolution only by giving a sharp survival advantage.

Of course, before coming up with real clues on the physical design of SCQSs, the would-be science of **paleo-psychology**[70] would have to work out reliable definitions and much more complete evidential backing in order to resolve the differences in approaches and conclusions among its protagonists.

Consciousness vs. Self-Awareness

As a point of comparison, Hameroff thinks from his views on the quantum character of the mind as an anesthesiologist, that **consciousness is a clinical state existing in animal life at large**. He does not differentiate consciousness with self-awareness since an anesthesiologist has no tools to measure the difference. This state would have appeared 540 million years ago (we were worms back then!). If we follow such a line of approach, we would then have to advance from our analysis in previous articles that **paramecia are self-aware**! Then from such an absurd conclusion, we can only conclude that Hameroff's understanding of consciousness is to be the **Being** feature of SCQSs as we identified earlier, a state which merely contains a sense of self-preservation. Clearly if "consciousness" results from a basic quantum computation, then self-awareness demands a very special kind of composite quantum system.

"Free Will"

A mind would be then able to **choose** from such multiple realities from the consideration of the whole, in an **extended computation** way, thereby expressing a "free will," something impossible in any classical system, and thus in classical computers, as Laplace centuries ago pointed out, [71] even when 20th century "deterministic chaos" is considered. It would be something that would not be left to **chance** either as present quantum theory assumes (since this theory uses a statistical formalism and does not include composite quantum systems).

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[69] This conclusion is hotly contested by computer scientists as then the base of their field would be drastically reduced. Their computers would be mere machines, as other products of classical mechanics are. Turing himself thought that language is the sign of awareness. (See the "Turing Test" later in this article.)

[70] This is our coinage. There are several psychologists who have been looking into this matter as Calvin and Jaynes did. One example is [**18**]. There the idea is that the use of external memory (pictures, symbols and writing) changed the **cognitive makeup** of the mind to enable it to self-reflect over generations. It is not clear whether he thinks that this was like a Baldwin effect. Such matters were discussed at the 1995 conference *Einstein meets Magritte*. [**19**]

[71] P. S. Laplace had a universal determining equation in mind, the first "Theory of Everything," in the early 19th century. [**20**]

Physical Behavior and Computational Capabilities

A computer as conceived in today's technology is finite because it is inherently a classical being, having shed all multiple realities, by construction. Then there would be no way under such a picture that a computer could completely and genuinely reproduce the physical behavior of a mind, including its internal physical processes as discussed earlier. However, **physical behavior** and **computational capabilities** are qualitatively two very different things as we describe below, so hasty conclusions on this subject of capabilities must not be drawn.

"Human-Level Intelligence"

We shall stress at this point that we have been discussing physical behaviors that SCQSs may have from comparison with our present limited knowledge of the human mind behavior when it is assumed coming from quantum physics. **Human-level intelligence**, as known in Computer Science, is a completely unrelated subject and concept, where the physical support of the mind is taken as irrelevant to its behavior in general. It was developed by Turing through the idea of a test, known as the "Turing Test," where a computer is pitted against a human subject and the comparison of **behavior** between the two is made via a language. Turing then assumed that the behaviors of the two can be accurately and completely compared that way, **which is not obvious at all** and thus the matter of much philosophical discussions. [**21**]

We shall advance that Turing was confusing **physical behavior** and **computational capabilities**, and this because Turing was unaware of the quantum. If comparisons are made between classical systems, comparisons via language ought to be sufficient as a consequence of the Universal Turing Machine theory, a **classical mechanics theory**. But when considering minds as quantum systems, knowing that the quantum has physical characteristics fundamentally different from the ones of classical systems, and behaviors accordingly as seen earlier, there cannot be any connection between the physical behaviors of minds and our classical (discrete) computers (or so-called "**quantum computers**" for the matter).

Penrose has argued against Turing's claim that **human-level intelligence** can be in principle attained with computers using finite and discrete means available from classical physics. [**22**] ("Intelligence" here is a term referring to computational capabilities, not physical behavior, since tied by Penrose to the mathematical theory of Turing machines.) But, as **Turing was disconnecting the mind from its physical support after Descartes' philosophy**, Penrose made his stand as philosophical as Turing's by missing the crucial fact that **there is no way with our present technology to access the physical makeup of a mind as a quantum device**, so there is right now no way to make any comparison in potential capabilities (behavioral or computational). He attempted to connect the uncomputability of the quantum wave function collapse (a process which is not found in SCQSs) with a supposedly extra computational capability of a mind, but he couldn't ad-

dress how this physical feature was to be such an extra since he has no idea about the overall physical design of a mind. [72]

Further, if Penrose had considered the details of the needed computational configuration he would have had to envision **composite quantum systems**, as we do here. But conventional quantum theory (the theory he uses, of course) cannot address such systems (see Appendix B of [**4**]), so he could not possibly reach the conclusions he wanted to obtain about non-quantum computers.

On top of this, a SCQS evolution does not involve the wave function collapses Penrose considered, so the key on capabilities in that kind of system is about one computational reality observing other such realities, and thus its capabilities must depend at least in part on this feature.

The physical features of the system configuration and the corresponding physical effects are what determines its capabilities. If these features are not known, nothing can be advanced about them. In order to go further in this field, there is then no other way but to rationally identify **composite quantum system configurations that can provide a computation**, and analyze their capabilities and behavior from the specifics of the system layout. This could not certainly be done using an outside means, as then **a classical world link, such as a language** would be needed, which could not represent the quantum situation in any way. Then any generic a priori conclusions on such capabilities must be invalid in principle.

Quantum Computers vs. SCQSs

As Appendix B of [**4**] explains, today's **quantum computation theory** does not use composite quantum systems (where non-interfering quantum realities may be grouped separately), since that theory is grafted onto the **von Neumann classical serial computational process** by applying the conventional wavefunction formalism to that process.

Being able to use **interfering realities** only through a serial set-up, such a computation skips most of the features quantum parallel realities could otherwise provide, [**23**] except for special cases such as factoring numbers.[73] **Non-interfering realities** on the other hand require the use of composite quantum systems using definite, one-dimensional and discrete-in-time interfaces between their subsystems, i.e. SCQSs.

SCQS Computational Capabilities

The question of computational capabilities as of now can be asked only from a classical computation viewpoint, since **numbers** and **variables**, which are the objects of the computation understood in the term "capabilities," are **distinguishable things**. For example, solving any of the **NP-complete problems** of Computer Science in polynomial time [**25**] cannot be addressed. Distinguishable variables are a foreign concept for the

[72] His "Orch-OR model" describes the principles of a semi-local physical process based on an assumed wave function collapse, but he fails to incorporate it into a computational system. [**6**]
[73] The factorization problem [**24**] identifies the location of components of a whole in the space of the whole without distinguishing them, so it is a relatively easy problem for the quantum.

quantum. So the question has no answer (at least no direct one). There has to be a subsystem that, from the input data, **deserializes** them to make them whole continuous entities, then **fits** patterns (as a whole, not as a discrete data matching for pattern recognition in Computer Science) with others in memory. Upon finding the answer, it must distinguish things and **serialize** them back for the output. All these tasks can only be done via successive pattern **resonances**, which are hard tasks for a quantum system.[74]

However, since the system would be using deterministic parallel processing generating realities as it goes along its computation, it may be a "**non-deterministic**" computation in the sense of Computer Science, and thus may have a chance to be qualitatively vastly superior to classical systems in certain tasks. [75]

Separately, the **Self** and other creative processes of the mind are capabilities of SCQSs that are a priori unreachable by classical means. Yet for a definite capabilities score from such features a formalism for **extended computations** would need to be first found. But creativity is not likely to be formalizable, then such a theory appears indeed completely unreachable via mathematics.

Conclusion

SCQSs seem to be the key to our use of extended computation, as Life appears to use, but a lot of theoretical work needs to be done, including developing physical features that could support a **system awareness**. This is a subject which could only be dimly approached rationally at this point since mathematics cannot be used. In that area of Science we have to learn how to use our conscious experience in order to go further. [**17**] Life is indeed showing the way for Humanity to construct its future in a path that Newton's mechanics and the separated world view of his modern followers could never reach. This is definitely the realm of conscious experience.

Both SCQS and the outside reality are quantum entities, i.e. non-local. A mind as a SCQS is thus able to meet the universe in a much more intimate way than we can guess from our separated view of reality, a view itself artificially created by the computation of our mind in order to handle local events. We indeed perceive reality as classical, i.e. with local things making up a "landscape" with separated elements. This landscape is misleading, as space is a whole. The dichotomy between space as non-local and the local nuclear spaces of matter embedded in it creates a tension that Life is resolving by bringing local things back as a whole. This again is due to the basic ability of space to be restructured by matter.

The mind is thus a "hand" with which Life grasps space as its origin, and, as we have seen in [**1**], the mind may have a cosmic future. Even art pieces are telling us that Art is a

[74] See the quantum solution of the factorization problem as an example. We are facing the fact that a "logical" mind, i.e. serialized thinking, is a hard mental attitude to maintain.
[75] Which are the crucial ones for the overall completion of the work, tasks such as the ones that normally Humans do to "prepare the work" for computers, including their programming.

restructuring of reality by the mind for its enjoyment, an obvious playful remake of what the mind keeps on doing on a continual basis.

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Epilogue

BEYOND THE DUALITY SUBJECT-OBJECT

Now that we are at the end of our trip, we would like to give some practical advices on the path that leads into **conscious experience** of ourselves and reality, beyond the separation we saw exists as a result of the mind being a **limited physical entity** embedded in a small part of space. The mind itself can describe this path, but cannot walk on it. The body has to be involved. Self-awareness is needed to watch the mind so it can connect with the **oneness of reality**. By practicing watching the mind regularly, the awareness in you will wake up. In the similar way as jogging strengthens your body, watching the mind awakens your self-awareness.

Practicing watching regularly grows awareness of one's mind as a filter through which we experience reality at large. On one side mind is our bride with the universe, but on the other side it is a barrier because it influences our conscious experience.

One of the methods that increase our awareness is **Observing *The Pendulum:*** Sitting comfortably we observe (watch) the movement of a pendulum. After a few minutes we close our eyes and observe (watch) the image of the moving pendulum inside us. Eyes remain closed for a few moments and then open again. This technique lasts about one hour. By practicing it we become aware of two things. We can only perceive the pendulum moving in space, but not in time. The movement runs in space, while we perceive time only as a stream of changes for the pendulum. Material pendulum and imagined pendulum move in the same space. The division between outer and inner space belongs to the mind. By practicing this technique you will have a first glimpse at the oneness of yourself with the universe. There will be moments where your mind will stop interfering, and you will experience the movement of the pendulum directly. It is important to practice this technique regularly for a few days.

If you don't like this technique, simply sit comfortably, close your eyes and watch your mind. Thoughts are coming in your inner space and going away, but **space remains always there**, unchanged. This space is consciousness, something that is the base for awareness of the self first, and then a larger base for experiencing it as one with the outside world.

For some people watching the mind is not an easy exercise. They find easier to watch the breathing or movement of the body. Whatever you watch or do with awareness will wake up the self in you. You can walk and think what to eat for dinner, you can have a dinner and look television. The result is that you are not one with your actions. This creates tiredness, stress, and/or depression. By being aware of your own actions you become one. You integrate body-mind-consciousness (BMC) in a harmonic unity.

Development of our BMC is deeply related with the quality of three basic inputs: food, breath, and mental input. We have to eat only when hungry. This is a base stone for a harmonious BMC. In daily life we eat to compensate negative emotions. This is where a vicious circle starts. We fight with the boss, we miss the wife that visit mother, we read that the stock market went down, we see on television the danger of war and then we eat in order not to feel all these emotions that have entered. We cannot avoid negativities that enter through mental input, but we can become aware of them. This is how we can neutralize them.

In one sentence we can say: Be aware of the **mind functions**, breathe fully, and eat only when hungry. This lifestyle leads into the integration of our BMC with the entire uni-

verse. We become aware of being an integral part of the eternal universal dance between matter and space that is Life. The feeling of loneliness is replaced with a feeling of spaciousness and overflowing selflessness. We see others as other selves. We leave behind us our small island of existence and join the timeless universe.

In order for Science to become a lighthouse for human civilization we need to search into our conscious experience. The peak of the evolution of the mind is when it becomes self-reflective: It starts searching about how its very existence influences its own experience. Ideas coming from cultural and religious identifications, being conceived essentially outside Science, may be barriers that prevent us to meet as Human Beings. Through "watching" the mind as an individual research method, Science will not only get a background for its own help in finding natural truths, but will work then for the scientific awakening of individual human awareness as part of a whole called Humanity, facing a world otherwise unfriendly to Life. This is the only way to build a free and peaceful society composed out of real individuals deeply rooted into a timeless universe.