On the Origin of Space

Part 6: 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. It
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?

In order to begin 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 examine what the potential of such 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 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. (The quantum meaning can be seen in other ways. We won’t mention the others here.)

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 in a discrete manner (discontinuously) via quanta exchanges, [5] can exist, but their internal evolution cannot be known, as the theory limits itself to the observation of physical systems. Observations
are the inputs/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 evaluated further, 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?

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, and as present biology sees, 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 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. (Contextual motions have been discussed as related in a quantum physical way to the non-local aspect of the EPR experiments. [6])

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 di-
rects 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** (or computer network) 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 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. This situation has been called a “quantum protectorate” in the physics of non-Life crystals.[7] Such a pair of supramolecules was also able to make fancy decisions, such as, in the case of single cells, deciding where the cell was to go, or on finding food as a result of its computational capability. In other words, it was the “microprocessor” of Life.

**The second answer of life: Go multicellular**

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 pat-
tern in ordinary space. Such patterns are dynamical as they propagate through phonon (sound quanta) waves, \([8, 9]\) 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 “directed” 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. This kind of system input/output (I/O) is called a “memory-mapped I/O” in classical computers.

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.

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. In contrast, 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.

We are thus going to look at the system effecting the non-local controls in a multicellular animal environment, i.e. 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. (It would be then interesting to find how the glial cells at some point take over control of neurons when they lose their centrioles.)

A protein omnipresent in cells, called actin, seems to sense the boundaries of leptonic space manifolds. (This is a result of observing their function in cell duplication (mitosis), not described here.) By sustaining such manifolds, MTs would then localize actin polymerization, which in turn would realize axonal growth cones. (Additional guidance is needed through the influence of local chemicals produced by the DNA.)

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 available from the single cell duplication process called “mitosis.” [9, 10] We are 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. (The full description of the leptonic space manifolds connection is given in [10].)

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 [11]) 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 seem to 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 described in the literature in minute details, but without an explanation, and especially without identifying this void in our understanding.

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?” and did not even identify the void in the understanding. 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 article is part of a series that puts it in context, a series which approaches the matter from a very general conceptual angle so that the phenomenon can be fitted in a 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? We have advanced a first way for additional confirmation in the earlier article [1], through indirectly measuring the change in weight of living vs. dead organisms that contain centrioles. It will be pointed out here that already run experiments on this subject [11] 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 down” synapses, and be applied to a whole living body containing a nervous system. (We will not go further here into the details of such an experiment, as they are for the experimenter to identify.) If a measurable weight loss is obtained after the application of the agent, 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,[12] with of course no attendant explanation since then seen from within a classical mechanics world.

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 [5](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 nature, such effects are not part of Life, just a mere consequence of Life.

**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 many-realities-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.[13]

**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 [14], 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. [15] 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. This 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.[16] 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.[10] 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 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 (not addressed here) affecting the division messaging to the MT system.

Meeting the central puppet master

The generic characteristics of the computational system envisioned here will be discussed in a subsequent article.[17] Ref. [5] also identifies the possibility of a quantum system providing its input/output through a multiple reality internal
observation without any need to consider the “wave function collapses” of quantum mechanics by using the Everett approach. 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. Such facts, in that picture, are obtained by us, “self-contained composite quantum systems” or SCQSs, scanning the states of the MTs in our neurons, thereby identifying physically at last the “mind-body” interface that Descartes was envisioning centuries ago.

The door to the future

SCQSs are a “technology” which may have been stumbled upon by Life eons ago thanks to the possibility for space to have different states and be built by its contents.[18] Could we construct and use such systems to observe the classical world and act on it, as a whole? They would not need to use the complex and material input/outputs strings Life found, once the details are worked out. 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.[19, 20] 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. The only limit would be from the time taken by light to spread the system initially.

Conclusion

Nature’s trial and error ways in the development of Life may have been 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 along the way, and Life may very well have done so, still unbeknownst to us as a result of our blindness about really new things.

Then Life discovered the Mind, with its ability to self-reflect, and see, and act logically; it ended in effect the miserable trial and error process at last, and this most likely through the quantum, very much as it would have used for its start. Via the quantum, there may be then an organizing principle that could give our world new means how to proceed in Nature’s organizing goal (“negen-tropy”). Knowing the limitations of classical systems, and provided we really dig deep into what we are, the quantum may even allow us, and Life, to at last
reach the diversity waiting out there in the sky. Of course then some other civilization could have reached the same technological level as ours, so the spread of SCQSs would become much faster than light from there on. We would at last satisfy a basic need that Nature has ingrained in Life to construct a better, larger and meaningful reality.

References:
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