

Consciousness in the Universe is Tuned by a Musical Master Code, Part 2: The Hard Problem in Consciousness Studies Revisited.

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Part 2 of this review article provides a novel conceptual bridge between living and non-living systems, being of relevance for the areas of biophysics, brain research, as well as for mechanisms of biological evolution. As to the latter aspect, the potential role of phyllosilicates (clay materials) in the generation of a primordial biofield is treated and seen as instrumental in a partially guided creation of first life. We hold, in general, that nature is guided by a discrete pattern of harmonic solitonic waves, likely originating from quantum vacuum fluctuations derived from an immanent zero-point energy (ZPE)/superfluid quantum space. Since the whole human organism, including brain is embedded in this dynamic energy field, a comprehensive model for human (self)-consciousness could be conceived. Evidence is presented for a pilot wave guided supervenience of brain function that may arise from a holofractal memory workspace, associated with, but not reducible to the brain, that operates as a scale-invariant mental attribute of reality. This field-receptive, workspace integrates past and (anticipated) future events and may explain overall ultra-rapid brain responses, as well as the origin of qualia as proposed in the so called hard problem of consciousness studies.

Key Words: Musical master code, Life algorithm, novel biophysical principle, coherent EM-scale, solitons and polarons, bio-solitons, coherent electromagnetic frequencies, beneficial and detrimental frequencies, meta-analysis of bio-medical literature, phyllosilicates, clay nano-materials, morphogenetic resonance, non-thermal EM fields, anti-cancer therapy, first life in biological evolution, quantum entanglement, Fröhlich, Einstein-Podolsky-Rosen, Bohm

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5. Brain Function and Consciousness Studies Modeled as a Holofractal Flux of Information with Toroidal Geometry

5.1 Introduction

Consciousness, in a cosmological context, can be defined as a state of a semi-stable system that has developed in a cooperative and cyclic operating mode, so that it became "causally self-observant".

According to Dehaene, (2017), individual human consciousness can be envisioned as the processing of information that not only makes meaningful information available for global broadcasting in the brain, but also offers self-monitoring and quality control. Thereby, it cannot only predict aspects of the local environment, but also can integrate memorized information and future-directed

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projections into a personal worldview that serves individual survival, development and social communication (Forshaw, 2016a,b). Yet, in the present paper an even wider context for consciousness is offered, in which our individual mind is seen as a part of a larger universal consciousness, itself being instrumental in the entire fabric of reality (Meijer, 2019a). In other words, each conscious element in nature and thus each individual is implicitly part of a universal consciousness, for humans: *we are in consciousness*, implying the position of idealist ontology, albeit based on the fundamentals of quantum-(bio) physics and cosmology. This concept integrates a non-material mental framework, submitting that information represents a basic building block of nature (Meijer, 2012), an idea that was earlier framed as *protypocos* by Görnitz and Weizsäcker, (2012; 2016). This concept is also based on our earlier consideration of brain that is encompassing an extended mind (Meijer, 2015) and the earlier treated observation that life processes are sustained by a generalized biophysical principle of discrete pattern of electromagnetic wave frequency bands (Meijer and Geesink, 2016, 2017).

Consciousness, therefore, is not only a human faculty and implies a reflexive state that both involves information integration as well as subjective "feeling" of past and future events. It requires a graded complexity of life systems to deal with the requirements of multi-tasking and ecological maintenance. A central item in brain research is the question whether consciousness should be conceived solely as an *emergent* phenomenon, as related to the extreme neurological complexity of the brain, or rather that the central nervous system is embedded in a much wider context in which it also *receives* (quantum) wave information, partly unrelated to the known senses.

However, it remains an open question how humans develop self-consciousness and obtain basic knowledge of the type called *qualia* (Chalmers, 1995). The *hard problem of consciousness* is the problem of explaining how and why we have qualia or phenomenal experiences and how sensations acquire characteristics, such as colors and tastes. A very interesting treatment of the quantum models of consciousness research, as reviewed by Meijer and Raggett (2014), was given by Wolf-Meyer and Cochran (2015), in the framework of anthropology of science in general.

Kozyrev (1997) considered that all life forms might be drawing information from a spiralling source of energy. He suggested that life could not be formed in any other way, because it is actively drawing off this spiralling vortex-like energy to sustain itself. In this sense, we can think of the living system as possessing efficient resonators for tuning into geometrically organized energy, most likely in the form of toroidal flux patterns. There are recent proposals for toroidal models in the functioning of specific brain cells, neuronal networks, functional parts of the brain as well as the whole brain (Tozzi and Peters, 2015; Knierim and Zhang, 2012). The findings of Tozzi and Peters suggest that nervous structures process information through topological as well as spatial mechanisms (see later). The authors embedded the brain in the 3D space of a Clifford torus and looked on cortical surfaces for antipodal points or shapes in relation to the topological hallmark of a hypersphere. fMRI scanning reproducible topography and propagation found subsets of regions shared across multiple trajectories. For example, it has been hypothesized that hippocampal place cells create topological templates to represent spatial information.

The spherical structure displays a double torus shape, *i.e.*, the trajectory followed by a particle inside the torus is closed. The natural candidate for such a

toroidal information flux is the spatially embedded network of the so-called *human connectome*: a comprehensive map of neural connections in the brain, that may be thought of as its "wiring diagram". More broadly, a connectome would include the mapping of all neural connections within an organism's nervous system and represents a non-stationary, highly dynamical structure characterized by complex topological geometry (Atasoy et al, 2018). Toroidal information flux (Fig. 7), was also postulated by us to provide the basis for the existence of consciousness at different scales of the Universe. There are distinct reasons to choose the multidimensional symmetrical aspects of the double vortex torus, a geometry that may mimic a combination of transversal, longitudinal and circular waves (Haramein, 2014; Bjerve, 2015; Amiot, 2013; Meijer, 2018). The nature of electromagnetic toroidal excitations, as developed in physics, was reviewed by Papasimakis (2016) and their interactions with inorganic matter by Tsytoich (2007), while the potential role as information collectors and carriers in life systems have been discussed by us earlier (Meijer and Geesink, 2016, 2017). Matter and thus particles can be seen as condensations of force fields that interact and both can be described with quantum information, that is actually a form of energy (see later). The special property is to bring the various types of field information together. In quantum theory, energy is quantized: thus, it consists of discrete vibrational units (vibrating strings or loops). The space is also quantized according to the theory, thus divided into small space parts. This matrix of such space units is usually called space foam, bearing units that function as operators. Known examples of such elements are twistors (Penrose), clearly related to nested torus geometry (Fig. 7 I). As mentioned above, such units are supposed to operate on every fractal scale, from very small (Planck scale) to very large (black holes), and

can be conceived as the collection points of the various force fields: gravity-, dark energy-, zero-point energy-, electromagnetic-, and Higgs fields etc. In this manner, such operators integrate quantum information and store it on the edge of each fractal unit, a 2-D hypersphere that in the case of the black hole was called the "event horizon". Thus, quantum information, like energy, is retained in this manner. Verlinde, (2011), used the holographic principle for his entropic gravity theory, invented by the Nobel laureate 't Hooft, (2007, 2016), see for holography aspects of the cosmos (Sieb, 2016; Batiz, 2107; Alfonso-Faus, 2011). *The leading principle of holography is that every object is fully described with information gathered on a screen around the object (the event horizon).*

It follows that also galaxies, suns, planets and likely the entire universe and even life systems are also to be regarded as toroidal organized information fields each projecting digital information on their respective event horizons. According to classical information theory, information always arises through *interactions of wave-particles* and entropy of information represents the *potential* to ask yes/no questions in such an event with regard to a particle system (Lloyd, 2007, Meijer, 2013). According to these concepts, information is in fact the sum of *expected* information obtained from such yes/no questions. An example is DNA in our cells which in itself contains a lot of *potential* information (digitally expressed in Bits), but this can only be clearly expressed in the cell with the help of RNA to produce the gene products: the proteins. The intrinsic (hidden) information of each object is therefore the result of the entanglement of the stored (individual) information from its various constituting particles, providing a sort of global information store of it. This information is fed back to a universal information matrix, that therefore is dynamic in time (Keppler, 2013, 2016).

The zero-point energy field (Laszlo, 2007, 2012; Setterfield, 2002; Nation *et al*,

2012), is an obvious candidate for information storage.

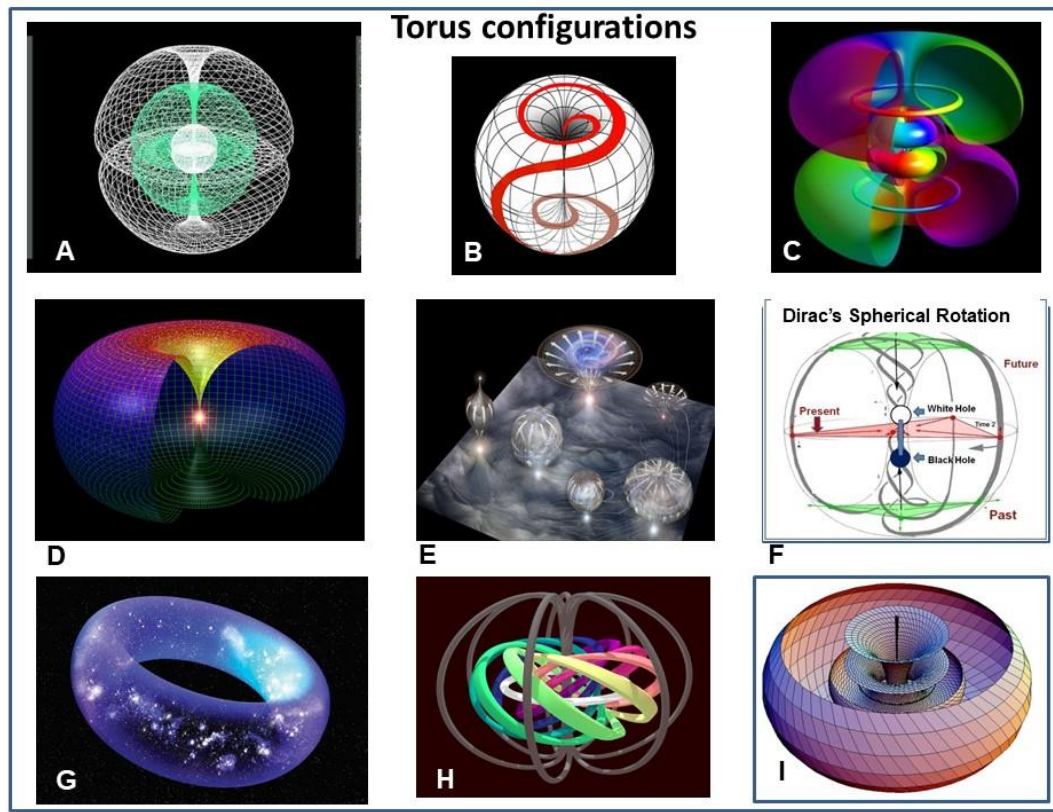


Figure 7. Various modalities of toroidal geometry: A: Nested torus structure B: Torus trajectory (red) C: Atomic structure as double torus, D: Filled space-time structure with singularity, E: Torus network, F: Dirac spherical rotation showing toroidal trajectories in relation to time G: Donut model of the universe, H: Knot structure in torus as metaphor for attractor/standing wave, I: cartoon of a twistor as a supposed space-time unit.

5.2 Cosmological and Holofractal Aspects of Consciousness

In the previous section, we mentioned that even space-time itself may be derived from the above-mentioned quantum fluctuation field and, in particular, through the entanglement of quantum information that is locked in through processing in a connected a wormhole modality. Such wormholes now appear to be present at every fractal scale in the universe up to the Planck scale (Fig. 8). In the latter, it constitutes the aforementioned background framed as *quantum foam* (Haramain, 2016; Ford and Roman, 2000; Lloyd, 2007; Loll, 2011) see also Wikipedia/quantum foam).

It is assumed therefore that information entering a black hole from the outside is never lost, but, as mentioned above, is rather being projected on its outer screen, called the “event horizon” (Maldacena and Susskind, 2013; Pourhasan, 2013; Haggard and Rovelli, 2014; Susskind, 2016; Lloyd, 2007).

The collective information of all entangled black holes in the universe may be holographically projected from the earlier mentioned 2-D- information radiating screens into a 3-D representation of our world. Yet, it is presently discussed in cosmology whether the emitted waves either represent chaotic information or coherent information.

Such coherence could, for example, arise by constructive interference with existing information in the universe and the resulting

information could be instrumental in updating the supposed general knowledge field (Bohm et al. 1980, 1987, 1993).

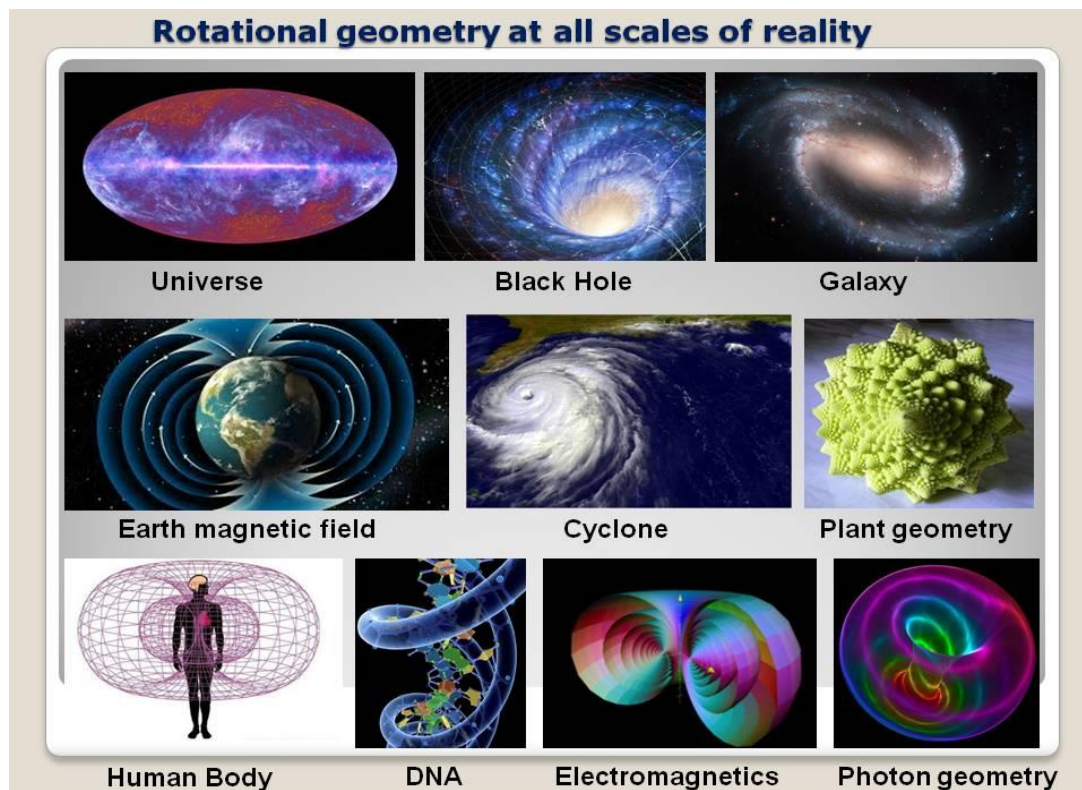


Figure 8. Toroidal geometry shows identified structures in the whole cosmos, from macro-(left above) to micro (right below) scales of the fabric of reality. The inset, left below, depicts the supposed nested toroidal geometry of the human body, heart and brain.

A recent theory (Pourhasan, 2013; Haggard and Rovelli, 2014), claims that information can also pass through the black hole structure, via the connecting wormhole (a sort of short cut in space-time) to arrive in an intrinsic "white hole", that instead has an anti-gravitational character. Some believe that final fusion of all black holes will yield a giant one that can disperse the stored integral information into a new version of our universe (see inset F in Fig. 7), in a rebound or cyclic operating mode.

This model for the final fate of our Universe, the so-called big bounce (Meijer, 2015) might predict that information of a newly formed universe is integrated in a *nested* configuration with the preceding one

(Haggard and Rovelli, 2014; Poplawski, 2010) (Fig.13). The nested torus structure therefore can be seen as a fundamental aspect of quantized spacetime. Interestingly, twistor geometry (Fig. 7), that was intended to unify quantum mechanics and general relativity by unraveling the phenomenon of gravitation, can also be used for solving non-linear Schrödinger equation to obtain solutions for *soliton wave phenomena* (Dunajski et al, 2004). As earlier treated, Hamein et al., (2016), postulated a collective wormhole background on the Planck scale (Fig. 13), that may underly our reality. The presence of a priori information could explain the partially directed character of biological and cosmic evolution, as have also be indicated by

Melkikh and Khrennikov (2016) (see also section 6).

Most investigators agree that maps of the universe clearly indicate that the visible cosmos is fractal (Alfons-Faus, 2011; Anjamrooz et al, 2011; Linden, 2017; King, 2008, 2011; Gaite, 2018) although the discussion on this goes on (see also Wikipedia, Fractal Cosmology). A fractal is a *self-similar* geometric pattern, meaning that the whole pattern is always exactly contained within its parts, as in a hologram and similar patterns recur at progressively smaller scales. By zooming in on a massive cluster of galaxies, the self-similar structure of the universe becomes evident. Most fascinating is how certain snapshots of the far universe look similar to the fractal structure of a brain cell network (Werner, 2010, Leffert, 2019).

Fractals, as mathematical entities, are infinite and this is clearly demonstrated the case of computer-generated fractals. We emphasize that the information processing involved should be seen in a scale-invariant holographic context, which is supported by the increasing evidence for a holographic universe (Ashford et al, 2017), in which at the blackhole level a distinct discretization of spacetime may be observed (Picato, 2017).

As mentioned earlier, EMF oscillations were measured associated with black holes with frequencies that were fully compatible with our GM-scale values (Rezolla, 2003, Geesink and Meijer, 2016). Inspecting nature as a whole, fractal geometry can be observed not only in the cosmos but also in many natural forms such as trees, plants, lightning, clouds, rivers, crystals, blood vessels, veins, mountains, the brain, snowflakes, shorelines, lungs, and other parts of animal and human anatomy (Lefferts, 2019) (Fig.8).

Dynamical systems in the physical world tend to arise from dissipative (actively spreading) systems, a process that always includes some kind of driving force that maintains its motion. The dissipating driving

force tends to balance the initial transients and settle the system into a typical, future directed, behavior, known as an *attractor* (Keppler, 2013, 2016) (Fig. 9). An attractor can even constitute a complex set with a *fractal* structure, known as a *strange attractor*. The latter aspect promotes a *collective and coherent* behavior that can lead to flux-maximization. In the framework of the present model for brain function, both the subjective unconscious and conscious aspects (Tammietto, 2010; Jahn and Dunne, 2004; Bernstein, 2005; Schwartz et al 2005; Rousseau, 2011) can, in principle, be modeled as information flow and recurrent storage as taking place in a nested toroidal setting, since the human brain organization clearly shows functional *circuitries* and obvious *fractal* properties (Gardiner et al, 2010; Bieberich, 2012).

Our suggestion, here, is that the brain is embedded in such an information storing hypersphere, which may help to solve long standing questions concerning our psychological activities such as mind-wandering, memory retrieval as well as the ability to connect past, present and future events (Tozzi and Peters, 2015). The human brain thereby exhibits the unique ability to connect past, present and projected future events in a single, coherent, toroidal screen, glued together in a mental kaleidoscope. Interestingly, these authors see the model of the brain hypersphere as a starting point for further evaluation of a brain-associated 4-th spatial dimension. In this extra dimension, mental operations may take place both in physiological and pathological conditions.

The connectivity patterns at rest might constitute a “signature of consciousness”, reflecting a stream of ongoing cognitive processes. Tozzi and Peters, (2015), speculated that conscious moments might be correlated with specific trajectory states in a “Clifford torus” structure. In this framework it has been proposed that features of EEG brain signals

with spectral peaks in preferred bands (alpha, beta gamma EEG waves) originate from such feature vectors in a 4D Euclidean space. One example of a recurrent toroidal type of brain activity, might be found in the periodically repeating pattern of so-called grid cells in the brain. These patterns have therefore been related to a supposed toroidal architecture of brain wave attractors (McNaughton *et al.*, 2006).

We have earlier proposed the hypothesis that if the brain is exposed to coherent electromagnetic fields in the form of discrete infrared waves, for example related to a zero-point energy field context (Geesink and Meijer, 2016, 2017), it may collect information through resonance of wave information, producing local wave attractors (Keppler,

2013) (Fig. 9). An attractor is defined as an assembly of vortex like fields, whose state evolves in time. Attractor networks in brain are considered to be built from nodes (for example, neurons) that are typically recurrently linked (loops) with edges (like synaptic connections), and the dynamics of the network tend to stabilize certain patterns, at least locally, that therefore can be designated as attractors. For example, a pattern stored in long term memory may be considered as a so-called point attractor, a sub-network of strongly connected neurons. An attractor can also refer to a collection of states that will eventually attract neighboring states toward that collection. In such a manner self-awareness may be created through folding along vortex like fields.

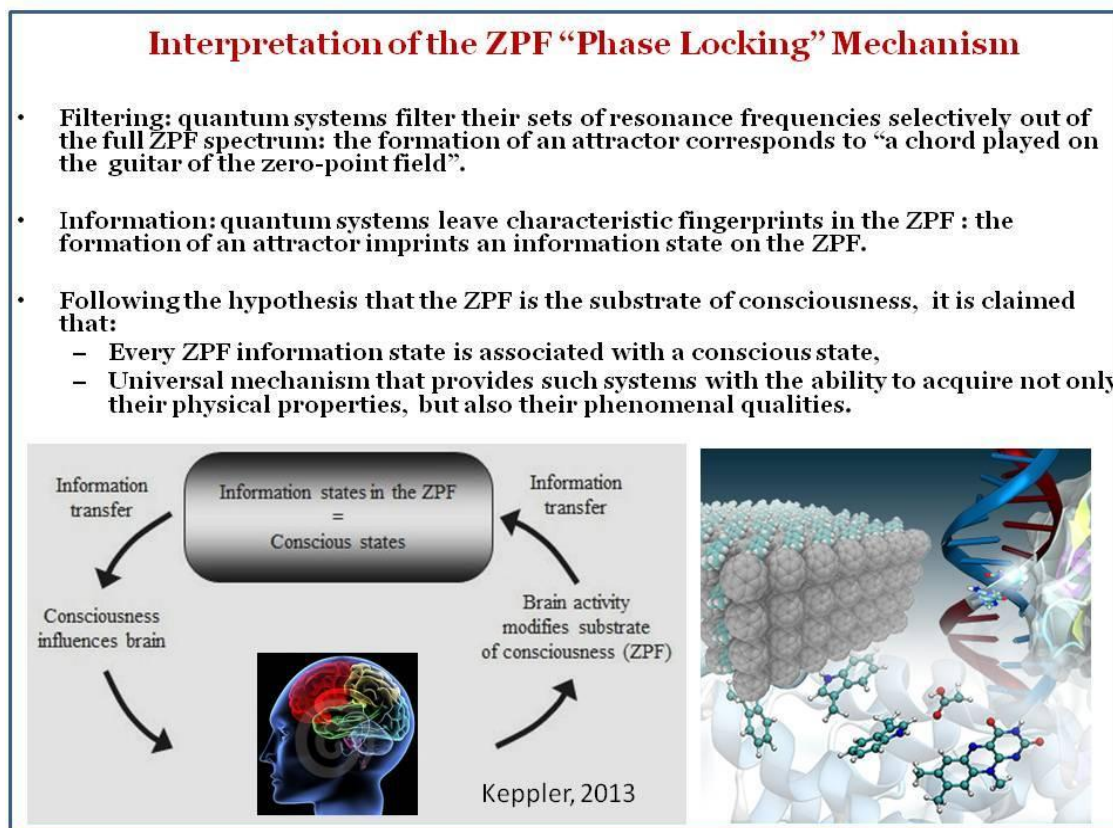


Figure 9: Filtering of resonance frequencies from the ZPE field (modified from Keppler, 2015), by a phase-locking mechanism yields the qualia for our brain function. In reverse, the quantum brain leaves fingerprints in the ZPE field and the resulting dynamic and permanently updated ZPE constitutes the very substrate for consciousness and life processes (inset below right).

Many scientists have earlier suggested that basic information reaches our brain *from outside* (Persinger, 2008, 2015; Grof, 1987, Jahn and Dunne, 2004), since the nervous system may also function as a *receptor* of subliminal signals. One could regard this process as a physically defined “extrasensory perception”. Evidently, we have to take into account a “sixth” sense in the form of a *vibrational, resonance sensitive macromolecular apparatus* in each of our cells (Hameroff and Tuszynsky, 2015). The particular cellular sensors are composed of flexible three-dimensional structures of proteins, oligo-nucleotides and elements of the cell skeleton, that mutually communicate through discrete wave resonances and are sensitive to fluxes of photons, phonons, excitons and related quasi particles such as polarons (solitons) and polaritons. These receivers act at the same time as receptors and emitters of quantum information, and operate as resonant oscillators with specific resonance frequencies, coupled with a natural quantum field (Rouleau, 2014).

This bio-sensing apparatus, situated in an apparently (bio)electromagnetic cell, was tentatively called the *electrome of the cell* (Fig. 1) (de Loof, 2016), being under the continuous influence of natural occurring internal as well as external electro-magnetic fields (Meijer and Geesink, 2016, 2017). In this respect it is worthwhile to mention that, based on quite solid evidence, the brain has been described as an electromagnetic workspace (McFadden, 2007; Pocket, 2012; John, 2001).

Quantum states, as related to discrete far-infrared waves, therefore, were also considered as co-instrumental in the astrocyte/glia/neuronal networks that may play a role in cognitive processes (Pereira and Furlan, 2007; Pereira, 2007). In this respect the inter- and intracellular Ca^{2+} gradients and ion-oscillations may play a pivotal role since Ca^{2+} , due to its electron constitution can function as an outstanding information carrier

(Pereira and Furlan, 2007; Meijer and Geesink, 2016; Meijer, 2015). Especially the established spiral wave movements of Ca^{2+} -ions, called cyclotron modes, are highly promoted by terrestrial magnetic fields (Zioutas, 1996). Cells that are normally rather refractory for external EM wave modalities, become very sensitive to such radiation via perturbation of cytosolic Ca^{2+} oscillations. Rotating spiral Ca^{2+} waves have been reported in many studies (Zioutas, 1996) and photon energy is transformed in kinetic energy of the gyrating ion (gyro-resonance, see further in section 7.5). Quantum coherence of Ca^{2+} can also be attained in decoherence shielded ion-channels (Bernroeder, 2003).

5.3 Multi-dimensional Space-time, Including a 4th Spatial Dimension

Kaluza’s theory (Gabella, 2006) derived the electromagnetic field extending throughout the first three dimensions of a 4D-space. It was postulated that only a 4+1 space-time structure (thus with an extra spatial dimension) allows a unity of relativistic and quantum physical reality (Beichler, 2012c), including time-symmetric operation and backward causation (Meijer, 2012; 2015). This also allows causal and tensed-time modalities that are essential for self-consciousness and reflection (Carter, 2014). Quantum information mechanisms were recently used to model human consciousness as well as the unconscious in relation to conscious perception (Martin *et al*, 2013), in which various modalities of non-locality were discussed. Of note, entanglement and non-locality may not only apply to spatial separation, but also a temporal one. It was proposed by Martin *et al* (2013); Baaquie and Martin (2005) that archetypical information can be stored as quantum information in appropriate fields and that consciousness may be controlled by quantum entanglement from *outside the* classical 3+1-D space-time configuration, in an extra 4th spatial

dimension (Sieb, 2016; Sirag, 1993; Smythies, 2003; Carter, 2014; Wesson, 2014; Luminet, 2016).

Another major finding is that physical information should be seen as a modality of energy and that information and energy can be mutually converted to each other (Berut *et al*, 2012; Toyabe, 2010; Peterson *et al* 2016), confirming previous ideas on three fundamental building blocks for the fabric of reality (Meijer, 2012): matter, energy and information. A study of Aharonov *et al*, (2013), even indicates that information can be physically separated from the matter it describes.

5.4 Biophysics and Brain Signaling Function of Bio-photons and Solitons

Importantly, Wang *et al*, (2010), presented a clear experimental proof of the existence of

spontaneous biophoton emission and a visible light induced delayed ultra-weak photon emission, recently reviewed by Rahnema *et al*, (2011). In their experiments they used in vitro freshly isolated rat's whole eye lens, vitreous humor and retina. As a consequence of their findings they proposed that the photochemical source of retinal discrete noise, as well as retinal phosphenes, may originate from natural bioluminescent photons within the eyes (Bokkon, 2009; 2013). Thus, a potential candidate is a photon/phonon-instrumented messaging network, that may operate parallel with neuronal transmission apparatus, as described extensively by Dotta *et al*, (2013) and Bókkon *et al*, (2009) and on an electromagnetic basis.

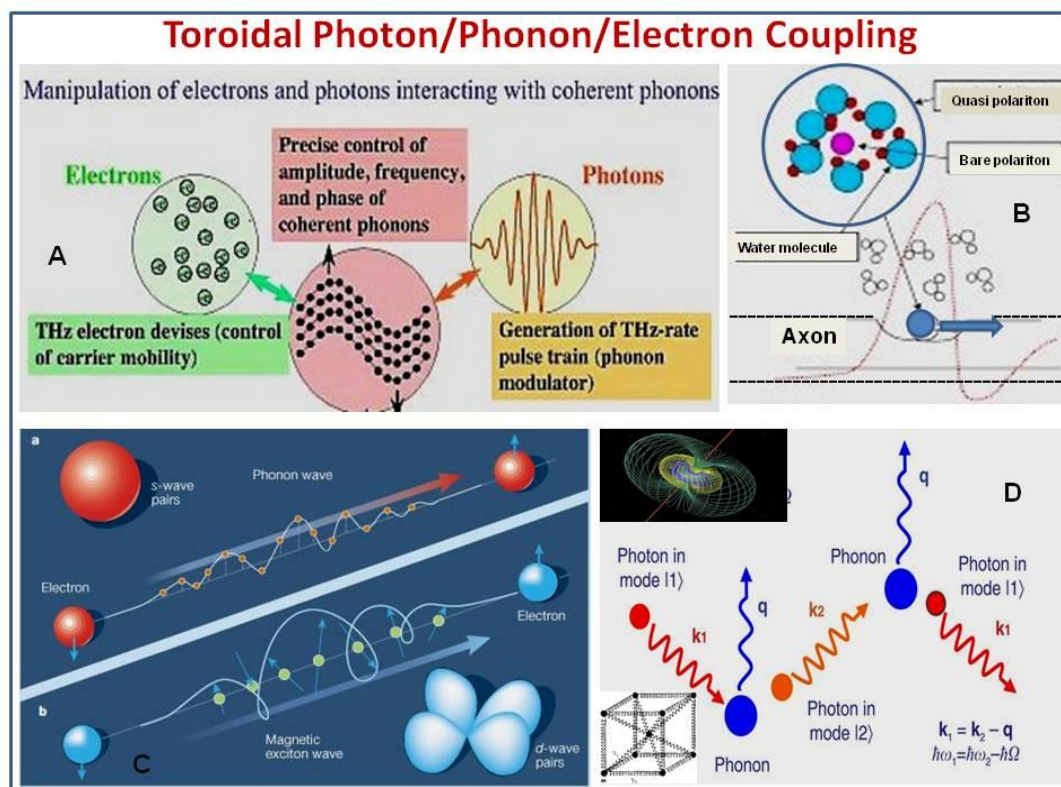


Figure 10: The formation of phonon/electron quasi-particles such as polarons (solitons) and photon-electrons like polaritons and their interactions (A), B: Polariton propagation along neuronal axons in brain. C: Phonon dressing of electrons. D: Phonon/ photon interaction in matrix.

The earlier mentioned classical studies of Popp, (1994) and Fröhlich (1968), respectively, on the morphogenetic guiding role of bio-photons and phonon/solitons, in cell systems seem to be compatible with each other (Meijer and Geesink, 2016). Rouleau and Dotta (2015) and Muehsam and Ventura (2014) pointed out that, at atomic and sub-atomic scales, biological systems can be influenced by subtle energies and that these enable a higher order discourse that influences the metabolic and electromagnetic output of cells. This system can principally interact with outer electromagnetic fields such as the earth magnetic field (Rouleau and Dotta, 2015; Persinger, 2016) and is orders of magnitude more rapid than the neuronal transmission system. The efficacy of such a non-chemical communication system are fully in line with findings on bio-photonic information processing in microtubuli (Mavromatos, 2002). Important in this respect is the concept of quasi-particles, such as polarons (also called solitons) and polaritons that in fact are electrons dressed with phonons or photons respectively, that largely changes electron mobility and matrix interactions.

Georgiev and Glazebrook (2018) presented a detailed analysis of the molecular structure of the synapse, and concludes that the best candidate for the regulation of exocytosis is a group of three proteins collectively referred to as “Soluble NSF Attachment Receptor” (“SNARE”) proteins. He showed that the conformation of these proteins at the neural synapse facilitates the creation of a quantum quasiparticle called a *Davydov soliton* (Fig.10). They further proposed a model based on quantum tunneling of this soliton across a potential energy barrier, and shows that the model is able to reproduce the experimentally determined exocytosis probability *and may thereby promote the entanglement of neuronal structures*. Bessler (2019), in a transparent analysis of this work, links this

mechanism to the innovative studies of Flohr (1998), who showed that impairment of consciousness by anaesthetic agents always involves the N-methyl-D-aspartate (NMDA) receptor, a glutamate receptor which has also been shown to play a pivotal role in exocytosis, and thereby in the creation of extensive neural networks. He suggested that this work of Flohr could well be related to the quantum entanglement aspect of Georgiev as a top-down process of exocytosis mediated neural integration. Thus, *solitonic information transfer*, operating in a top-down mode, could guide the related cortical template to a higher coordination of reflection and action as well as network synchronicity, as required for conscious states.

5.5 Photon/Phonon- and Soliton-mediated Communication in Brain.

A few years ago (Geesink and Meijer, 2016) we stated: “Electromagnetically seen, we may be living in a “diluted plasma” with natural coherent quantum resonances, that can be approached by equations for standing waves”. In this respect the potential role of solitons (polarons, being electrons dressed with phonons) were highlighted (Meijer and Geesink, 2016). Soliton waves exhibit remarkable resistance to distortions and noise interference, keeping shape and velocity even after collision with each other by which they can penetrate into materials without losing their identity. Therefore, they can function as information carriers in the entire universe, and were present at the beginning of life. They can also be regarded as energy-informational system in whole organisms, brain and its components such as proteins, DNA and bioplasm (Adamski, 2019, Meijer and Geesink, 2018, Melkikh and Meijer, 2018). Soliton interactions with macromolecules result in self-trapping of electrons in localized soliton states. Due to these properties they can guide protein folding and also can pass outside te

brain in a sort of extra-cranial communication (Adamski, 2019). Phonon waves can therefore be considered as photon activity expressed as sound vibrations within a solid matrix and the physical similarity between both types of energy are described before in section 5.5. Photon-like waves are permanently present in our body through resonance, since the organism is embedded in the zero-point energy field and are also generated in the brain as the so called *bio-photons*.

Dynamic coupling of the brain with ZPE/SFQS field modes has been proposed as a universal mechanism underlying conscious systems (Keppler, 2016, Sbitnev, 2016), based on stable attractor dynamics by which the ZPE field/Superfluid Quantum Space, in fact, becomes a *substrate of consciousness* (Fig. 9).

In this framework the brain, as a resonant oscillator, extracts or rather filters a wide variety of phenomenal nuances from an all-pervasive stochastic radiation field in the form of phase-locked ZPE wave information states, that are supposedly linked with or correspond to conscious states (Fig. 9).

Thus, Keppler envisions discrete long-range EM frequencies, that are expressed in brain in the well-known gamma and theta oscillations and according to the author are *related to coherent oscillations in cell water*, resulting in information integration as conceptualized by Tononi *et al*, (2008, 2015, 2016). ZPE field is traditionally seen as the domain for quantum fluctuations of pairs of wave/particles and their antipodes (Daywitt, 2009; Setterfield, 2002). Of note, virtual photons, that are also instrumental in the generation of van der Waals forces known from chemical binding, are produced during particle/antiparticle pair fluctuations (*Dirac Sea*). Thus, photons originate from the vacuum, and are generated if dipoles in the field rotate due to interaction with moving charges in, by which a magnetic induction field is produced. In this manner, free charges

perturb the vacuum by polarization, (Daywitt, 2009). A major problem in physics is the estimated 122 orders of magnitude difference between the energy density at the cosmological scale and that predicted by the quantum field theory at the Planck scale (the so-called "vacuum catastrophe"). Recently Hamein and Val Baker, (2019), applied a generalized holographic model and found a potential solution by considering the total mass energy density in a geometry of the universe as a spherical shell. Huang (2013), approached the same item using a superfluid universe model, seen as a self-interacting complex scalar field.

Photons are intrinsically quantum objects and, by their nature, long-distance carriers of information. Annala (2016), stressed their importance in relation to consciousness.

It seems clear that properties of a molecule cannot be inferred from properties of its constituent atoms alone, since they also rely on photons that couple them to their surroundings.

The ultra-rapid brain responses, discussed in a previous publication (Meijer, 2014), were seen as being related to photon/phonon mediated communication, in line with the findings of Bókkon (2009), Dotta (2013) and Persinger (2015). Yet, in this context, the role of the earlier mentioned 4D-mental holographic domain coupled to the concept of a *universal consciousness field*, defined as the implicate order by David Bohm (1980, 1987) should be taken into account (Meijer, 2019a). In this respect, an ZPE stochastic electro-dynamic field as postulated by by Laszlo (2007), Keppler (2016) and Caligiuri (2015), should be seen as the crucial "steering" modality that mutually communicate with the *whole nervous system of the organism*, including its neuronal networks with their conscious and non-conscious aspects.

Bidirectional communication between the brain and such an extended mental workspace

was proposed to occur by toroidal integration of the above-mentioned information spectrum in both the physical and mental domains (Meijer and Geesink, 2017) (Fig.11). Thus, such a mutual communication process is seen as being instrumented by magnetic fluxes and photon/phonon/soliton mediated wave resonance and/or phase conjugation, between the proposed mental workspace and the associated neuronal/cavity landscape of the material brain. It is of considerable interest that Alzheimer models showing memory loss in the hippocampus area can be reactivated by photonic pulses into the corresponding cortical cells, using the technique of optogenetics. This procedure results in restoration of the retrieval of the particular lost information from the engram cells, likely due to formation of new dendritic connections and related protein synthesis, possibly via light sensitive proteins called channel *rhodopsins* (Tonegawa *et al*, 2015). This technique may mimic the supposed photonic communication from the 4-D mental workspace as proposed in the present paper.

5.6 The Holographic Event Horizon Brain concept

It was postulated earlier (Meijer and Geesink, 2017) that consciousness in the entire universe arises through scale invariant, nested toroidal coupling of various energy fields, that may include quantum error correction. Such a toroidal process may cause the coupling of gravitational, dark energy, and zero-point energy fields, as well as that of earth magnetic fields (Fig. 10).

Through the assumed field-receptive workspace, wave information may be transmitted into brain tissue, that thereby becomes instrumental in high speed conscious and sub-conscious information processing. We proposed that the latter crucial process generates self-consciousness and is conceived to be operating from a 4th spatial dimension (hyper-sphere). As treated before, the torus is

envisioned as a basic unit (operator) of energy flow in space-time, among others collecting the array of discrete GM-frequencies that in concert represent an algorithm for coherent life processes. The importance of the concept of the universe as a cosmic hologram has been earlier reviewed in a comprehensive study of Currivan (2017) and was recently nicely reviewed by Lefferts (2019). It was physically described in more detail by St. John, 2018 and related to a fractal 5-D holofractal structure by Linden, 2008. In the brain, the proposed holographic workspace collects active information in its "brain event horizon", thereby producing an internal and fully integral model of the self. This brain-supervening workspace is equipped to convert integrated coherent wave energies into attractor type/standing waves that guide the related cortical template to a higher coordination of reflection and action as well as promotes the network synchronicity, as required for conscious states.

In relation to its scale-invariant global character, extensive support was found for a universal (cosmic) information matrix (Meijer, 2019). The presence of such a field-receptive resonant workspace may therefore provide an interpretation framework for widely reported, but poorly understood transpersonal conscious states (Meijer and Geesink, 2017) and also for an algorithmic origin of life (Meijer and Geesink, 2018; Melkikh and Meijer, 2018; Walker and Davies, 2013). In general, the manifestation of a universal consciousness points out the deep connection of mankind with the cosmos and our major responsibility for the future of our planet.

The striking similarity with the 3-D brain as a "personal universe" (Meijer and Korf, 2014), implies a symmetry breaking as a dominant feature of reality. In this respect, it was put forward earlier that a hyperspherical universe, in which the present universe is nested in a surrounding toroidal hypersphere, can directly be derived from Einstein's

relativity theory on the basis of a re-interpretation of the Klein-Gordon equation, as performed by the famous Italian mathematician Fantappiè (Galloni, 2012, Chiatti, 2007).

5.7 The PSI-framework of Consciousness and Discrepancies with Cerebral Structure

We hold that the collective field concepts, proposed above, may constitute an

interpretation framework for poorly understood phenomena such as mental states such as intuition, telepathy, far distance observation as well as near death experiences (Radin, 1997; Beichler, 2012c; Bókkon *et al*, 2013) and other Psi phenomena (Radin, 1997; Beichler, 2012b; Rousseau, 2011), to mention only some of the many studies available on this topic.

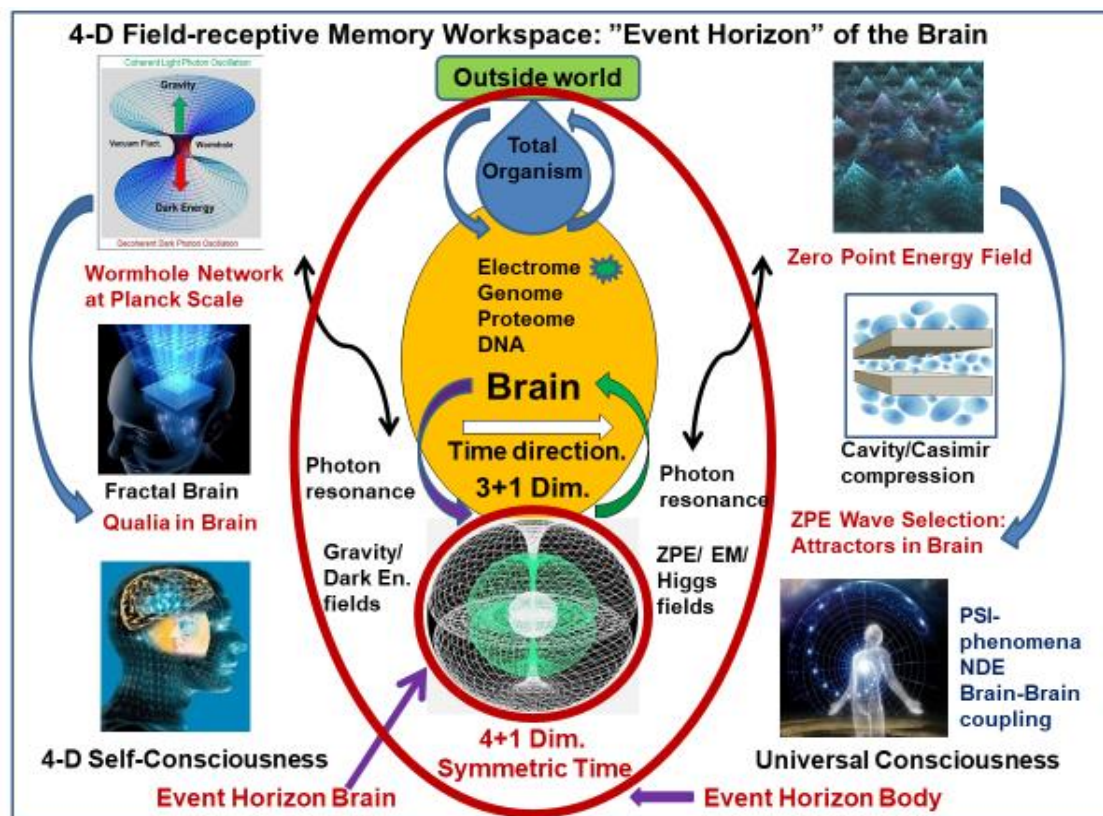


Figure 11. Modeling of brain/ mind relation in a 4+1-dimensional space-time framework (4+1 implies 4 spatial dimensions and one single dimension of time, on the basis of energy trajectories in a nested toroidal geometry). The opposing forces of Dark energy (diverging force) and Gravity (converging force), as well as discrete wave frequencies of electromagnetic fields, are instrumental in the generation and compression of individual life information. The human brain may receive quantum wave information directly derived from the Planck space-time level (left above) through quantum gravity mediated wave reduction, as well as through resonance with the ZPE field (right above). Our brain can perceive only 3+1 dimensions with the one-directional arrow of time. The material brain and its 4+1-D supervening field-receptive mental workspace should be seen as an integral whole, until bodily death of the organism. The 4th spatial dimension allows individual self-consciousness since an extra degree of freedom is required for self-observation and reflection, while in the mental context the time dimension is symmetrical, allowing to integrate past and future-anticipating events. The 4th spatial dimensions is also assumed to accommodate the bidirectional flow of information between the domains of self-consciousness and universal consciousness. The bottom-up information flow from the Planck scale, combined with top-down information conjugation from the ZPE field, constitutes the event horizon of the brain, also integrating gravitational and dark energy related force fields, supervening the physical brain. Event horizons of the brain and the whole body are depicted in the red ellipse and circle respectively.

In addition, such a multidimensional space/time brain structure, being open to external electromagnetic and quantum fields, could also provide a reference frame for understanding of the reported time delay between experimentally induced actions of individuals and their conscious perception of the event (Libet, 2001, 2006). In addition, the subjective experiencing of qualia as well as the subjective experience of transpersonal and extra-sensory events such as clairvoyance and near-death experiences (NDE), seems compatible with such a model (Jahn and Dunne, 2004).

The NDE aspect is documented in thousands of international reports and nowadays open to scientific inquiry (Lake, 2015; Greyson, 2010; Schwartz *et al*, 2005; Bókkon *et al*, 2013). NDE's can occur in life-threatening situations close to dying (asphyxia, near-drowning, traffic accidents and stroke). They can even be induced by deep meditation, that is with full awareness of one's own body (Van Gordon *et al*, 2018).

With regard to stroke and heart failure, the specific components of this experience, often with a long-lasting psychological impact on the recovered patient, include the so called *out of body experiences*, tunnel visions, and a remarkable clear and holistic state of awareness, verbally reported by the particular patients, albeit in retrospect. This conscious state is claimed to occur in the apparent absence of cortical activity, and is clearly different from a general dream state since in that case abundant EEG's activity is observed in the cortical area.

The typical descriptions of a felt dissociation from the body, in addition to a *total life-panorama* (Lake, 2015; Greyson, 2010; Schwartz *et al*, 2005; Pereira and Reddy, 2016), as reported by a part of the NDE cases, may point to an access to a wealth of detailed information of non-neuronal origin, that only can be imagined assuming a

radiant and resonant mind field (Meijer, 2013, 2019b), as proposed above. Such an external source of information resembles the concept of a "personal double" as earlier proposed by Vitiello (2001). This availability of external information can largely influence normal cognitive brain function, and its presence is somehow persisting while other brain functions seem defective. This overall picture of NDE may therefore point at a supervening field character that is not directly dependent on normal brain activity and may operate from a fourth *spatial* dimension (Fig. 12).

In addition, other highly subjective phenomena such as intuition and serendipity, that frequently represent crucial elements in major scientific breakthroughs and/or technological innovations (Meijer, 2017a), should be taken into account in this context. Breaking the barriers between brain and normally hidden information space that, by some, is interpreted as a perturbation of the "filtering" between the conscious and unconscious, may be at stake (Meijer, 2019b) and this is also widely discussed in relation to the potential effects of meditation and induced dream states on such phenomena, (Jahn and Dunne, 2004; Bernstein, 2005; Schwartz *et al* 2005; Rousseau, 2011). A paper of Tononi, (2016), reviewing the earlier mentioned "integration of information concept" in consciousness, mentioned an interesting view of Sullivan (1996) that *another type of consciousness* becomes manifest in meditative states that in fact can be considered as rather *information content-less*, and could reveal a normally hidden part of consciousness that is normally masked or filtered away by the busy default activity of our brain (Jahn and Dunne, 2004; Rousseau, 2011; Martin, 2013 and Schwartz *et al*, 2005).

In this respect biophotonic information transmission also could play a role. Generally, neurologists are hesitant to accept biophotons as an extra messenger system along

with the prevailing related assumptions of the “neuron doctrine”. Yet, in physics the photon is the generally recognized carrier of information between atoms and molecules and (not only for this reason) perfectly fits into the context of a versatile and dynamic brain structure. This is certainly the case if photonic wave information would be protected against de-coherence in the brain environment through the influence of low-frequency phonons, realizing that a dominant aspect of de-coherence is via phonon coupling with the environment and that an acoustical mismatch between the immediate and wider environment of the quantum system could largely prolong coherent states at low frequencies (Davies, 2009, 2014; Lambert, 2013, Marais, 2018).

Any organism (and also organs like the brain) is considered as an open energy system, implying a continuous interaction with the environment. Yet, such an interaction must occur in a noise protected manner, that requires capabilities of feedback control. Indeed, James, Bergson and Huxley, and more recently, Jahn and Dunne (2004) as well as Kastrup (2016, 2017) speculated that part of the brain acts as a “filter” or “reducing valve”, by selectively blocking out external information so that only the registration and expression of a narrow band of perceivable reality is manifest. Possibly, in the course of evolution, the brain was adapted to eliminate most of those extra-sensory perceptions, being incompatible with the urgent needs of everyday survival. One hypothesis suggested a dual development of the brain, namely an evolutionary improvement of technical and logical abilities, at the cost of loss of contemplative/spiritual potential (Bitbol and Luisi, 2011). In Kastrup’s studies the important suggestion was made that the normal filtering aspect of brain function can be largely decreased in a variety of special conditions that can be characterized as an evident *reduction* in overall brain activity.

Carhart-Harris and Friston (2019), in a lucid review on the potential mechanisms of brain actions of psychedelics, state that such agents relax the activity of a so called *high level controlling summary system* that normally compresses information flow from lower centers, leading to ego-dissolution and liberation of compressed information due to an elevated entropic state. This leads to feelings of increased insight, cosmic unitive experience and interconnectedness as well as therapeutically relevant elevated self-knowledge and social openness on the basis of an awakening to the true depths of being. Several directed procedures (Fig.12) can be created to increase self-transcendental experiences and mystical states and open the doors to perception of universal consciousness (Meijer, 2019b).

5.8 Discrepancy Between Cerebral Structure and Cognitive Functioning

The implicit suggestion of a *non-material* and *extra-corporal* mental workspace, that may supervene and complement our neural system. is indirectly supported by observations in fNMR studies that *long-term memory is not correlated with scaled sizes of the brain*. For instance, Savants, that usually have normal brain size, can demonstrate a huge, almost disproportional memory capacity: entire novels and even complete contents of telephone books are memorized in detail in such cases. Even more impressive are the observations with regards to so-called hydrocephalic patients that have only 5% of normal brain volume (called micro-cephaly) and can show quite normal intelligence and social behavior (Forsdyke, 2014; Feuillett *et al*, 2007; Mashoour and Alkira, 2013). Other striking examples are patients with a largely destroyed forebrain that maintain a quite normal life (Sasal *et al*, 2016). Even the known split-brain patients that seem to develop two different types of consciousness in the

isolated, right and left *halves* of the brain, in fact show this aspect. In addition, split-brain patients with disconnected hemispheres even perform better at some cognitive tests (Sasai *et al*, 2016).

Nahm *et al.* (2017), reviewed quite a number of striking cases involving brain dysplasias (abnormal cell development) and brain lesions (cell damage) indicating that large amounts of brain mass and its organic structures, even entire hemispheres, can be drastically altered, damaged, or even absent without causing a substantial impairment of the mental capacities of the affected persons.

These exceptional individuals thus display a notable discrepancy between the condition of their cerebral structures and the quality of their cognitive functioning. This includes cases of gross hydrocephalus having global IQ's between 100 and 130 and verbal IQ up to 140. In some cases, they were married, having a job, while in one case such individual even spoke 7 languages. Thus, the macro- and microanatomy of the brain and its tissue layers differ drastically in people with severe hydrocephalus compared with people with normally developed brains. For example, brain structures such as the thalamus, the amygdala, and the corpus callosum were not visible at their usual positions in the scans obtained from the patient, described by Feuillet *et al.* (2007), but were most likely pressed toward the cranium together with the layers of the 0.5- 1 cm cortical mantle (Fig.19).

Often, such malformations result in impaired mental and motor skills, but apparently, this is not always the case. *The central question is if partial recovery from such conditions is due to plasticity of the remaining cells or, alternatively, is related to the increased volume of the quantum informed, aqueous brain compartments. The latter would provide extra “antennas” for receiving quantum information as a compensatory factor* (see also section 7).

Another case is presented in cases of *hemispherectomies*: how can we explain that the remaining brain structures and its neural activities can “know” that a “language center” is missing now, and how the remaining neurons induce and guide the duplication of this function in the still present hemisphere?. Majorek (2012) argued that this activity requires the existence of a “higher control center” that would be able to detect this gap in function and to initiate steps that lead to its mending, and to imagine where such a control center could be located. On the basis of these different cases of discrepancy between cerebral structure and cognitive functioning discussed above, some authors doubt that the brain serves as a sole comprehensive memory store, arguing that its function more closely resembles that of a receptor or transmitter of memory and allied cognitive processes (Forsdyke, 2014).

Cleeremans (2011), in his “radical plasticity thesis” put the question: “how the brain learns to be conscious”. The author implies that consciousness arises as a result of the brain's continuous attempts to predict not only the consequences of its actions on the world and on other agents, but also the consequences of this activity in one cerebral region on activity in other regions. Therefore, the brain continuously learns to redescribe its own activity to itself, so developing systems of meta-representations that characterize and qualify the target first-order representations.

Such learned redescriptions, enriched by the emotional value associated with them, form the basis of conscious experience in interaction with the world, as a sort of signal detection of the mind. Cleeremans (2011) stated: “Any theory of consciousness has to be able to explain why a person who's missing 90% of his neurons, still exhibits normal behavior”.



Figure 12: The feeling of the reality of a cosmic (universal) consciousness was suggested to be promoted by a number of procedures, of which the listed examples have been experimentally tested/ and or investigated (Kastrup, 2017; Jahn and Dunne, 2004).

Merker (2007), reported on the purposive, goal-directed behavior exhibited by mammals after experimental decortication, as well as evidence that children born without a cortex are basically conscious. The author stated that properly assessed, the behavior of children with early loss of their hemispheres opens a unique window on the functional capacities of a human brainstem deprived of its cerebral cortex early in intrauterine development. The particular studies showed that these children smile and laugh in the specifically human manner.

In opinion of the present authors, the consensus concerning the crucial thalamo-cortical mediated consciousness, under normal conditions, still holds in spite of the abovementioned observations, but they may indicate that consciousness can be *learned or*

received even when only the brain stem remains. The postulate of a supervening integral memory workspace in the present paper is very much in line with this idea. It is tempting to suggest that not only some sort of personal brain is created within our organism, but that somehow, at the same time, an extra-neuronal personal information source is produced, that may be associated with the personal brain but is not reducible to it (Wolf, 1985, 1989). Both aspects of knowledge acquisition may operate in the framework of biological evolution and personal survival (Meijer, 2019b). The human brain should in that case be rather viewed upon as an information interfacing system not only *connecting* individual and universal consciousness, but seeing our consciousness as *directly derived from* a realm outside our

organism. Such a modality forms the very basis for the concept of an “*extended mind*” that is founded in the philosophy of so-called Idealism (Goswami, 1990; Kastrup, 2016).

5.9 Universal/Cosmic Consciousness and Brain Function

The presence of a “steering” functional mind field may provide an interpretation framework for phenomena that still seem to escape current scientific verification. A most important aspect is the, often mentioned, modality of Universal consciousness also called Cosmic Consciousness. This concept, that information can take a universal character and that all information is stored in a general knowledge field or universal consciousness, can be treated from a number of backgrounds and perspectives (Meijer, 2018). As mentioned before, the concept is well known from the work of David Bohm (1980, 1987), who coined the term implicate order and Erwin Laszlo (2007), who introduced the so-called Akashi field concept.

The latter author particularly linked his concept with the physics of the zero-point energy field (ZPE) that, as previously mentioned, was later also applied in stochastic electrodynamic models for consciousness by Keppler (2012), Caligiuri (2015), De la Pena (1994) and Kastrup (2016, 2017).

Such an all-pervading cosmic field can in principle exchange information with the supposed 3-D and 4-D workspaces associated with the brain (Fig.13). An important study from Princeton showed that two, and possibly more, brains can become interconnected, looking at the brain f-MRI scans of speaker

and listener. It was shown that the brain activity patterns of such a communicating couple are clearly correlated in a sort of wave resonance, mirroring, effect (Hasson *et al*, 2012; Wackerman *et al*, 2003; Radin, 2004; Richards *et al*, 2005; Standish *et al*, 2004; Pizzi *et al*, 2004). This study also invites further investigation into mechanisms of telepathy and so-called synchronicity (Schwartz *et al*, 2005; Jahn and Dunne, 2004; Grof, 1987; Rousseau, 2011).

Hardy (2016) takes a space-time approach by positioning individual consciousness and the Self in a *hyper-dimension* in which death is just the severing of the link between this domain and the brain/body, leading to an independent holographic semantic field on a personal basis. This aspect was further worked out recently by Meijer (2019b). The latter phenomenon resembles the proposal of Irwin (2014), seeing consciousness as a quantized space-time language that can be described by quasicrystal mathematics of the E8 geometry.

It was also suggested that self-consciousness could continue outside the body but remains at the level of Planck-scale geometry, as related to generation of biophotons in which visual imageries are coupled to a long-term visual memory. This is supported by a strong indication that an NDE is driven by visual processes (Bókkon *et al*, 2013). In more general terms, the aspect of non-material mental aspects of consciousness has been thoroughly pursued from neurological (Nagel, 2012), biophysical (Keppler, 2016), philosophical (Kastrup, 2016), quantum-physical (Henry, 2005) and evolutionary viewpoints (Grandpierre, 2014).

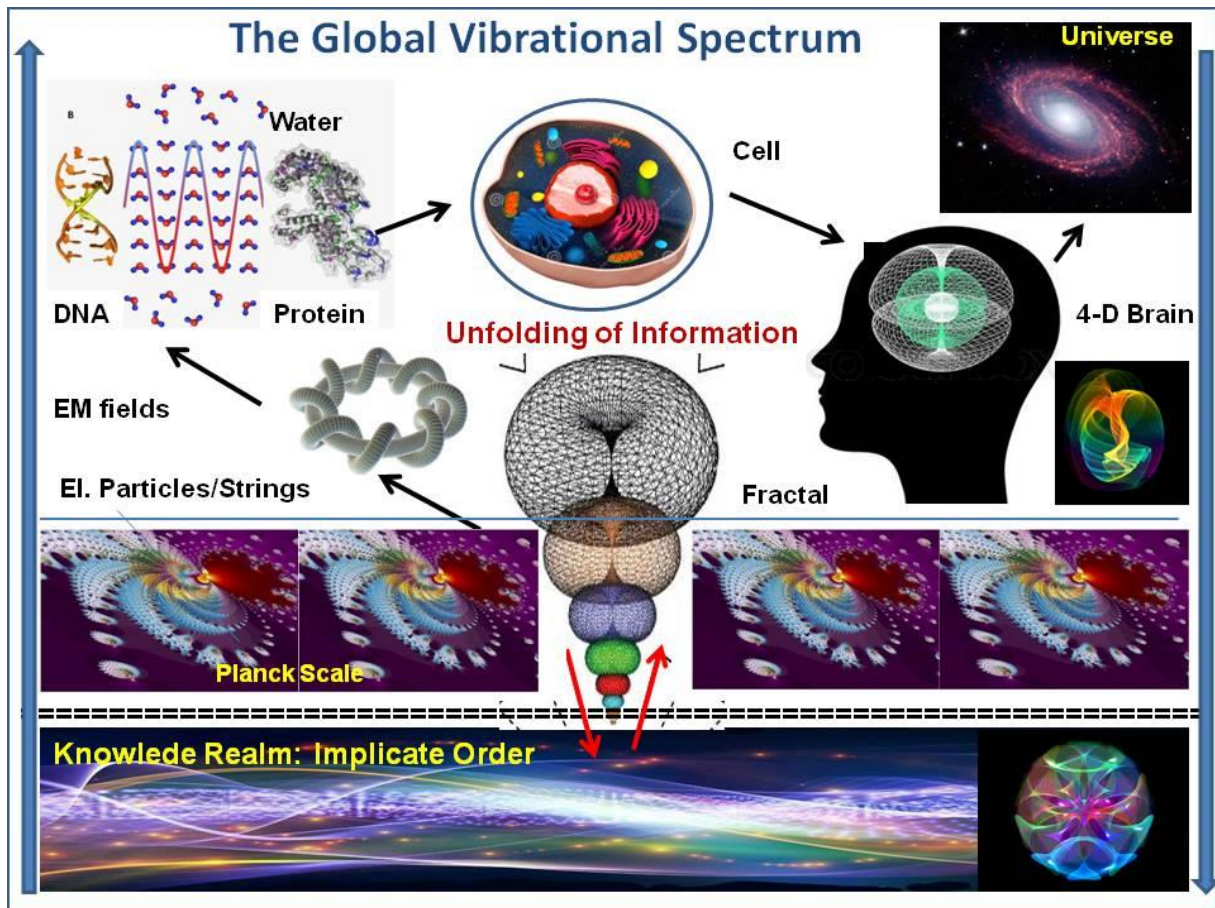


Figure 13: The flow of information in the whole universe from micro- to macro-levels (bottom to top) conceived as a nested toroidal operation that is fractal and scale-invariant and is initiated in a knowledge realm underlying the known wormhole matrix (quantum foam) at the Planck scale. Supposed quantized string activities produce elementary particles, atoms, molecules and life systems. The latter contain dedicated holographic memory spaces at the cellular and organ level. The human brain integrates, internally and externally, guided conscious states. Further fractal and self-similar properties in a quantum fluid universe provide the architecture of cosmic macro-structures.

As mentioned above, Penrose (1989) proposed that spin networks could be fundamental in the description of space-time, that is, in a background (string) lacking manner (see for the latter also Rovelli (1996) and Smolin (2004). In the brain, spin-networks were pictured as electron-unpaired electron spins that represent pixels, collectively forming a “mind screen” that is known to be highly sensitive to fluctuating internal magnetic fields and action potentials. Such perturbations were considered to modulate neural dynamics, but also could enhance synchronization and stochastic resonance as have been noticed in brain (Hu and Wu,

2004). The particular spin physics bridges classical neural activity, serving as input via the magnetic influences on biochemical processing.

Spin network dynamics may enable a quantum decoherence-resistant entangled modality of wave collapse since, through tunneling, they are rather insulated from the environment in decoherence-free subspaces, while repeated attention/intention Zeno effect (Stapp, 2012), may help in promoting coherent quantum states (Hu and Wu, 2004).

Finally, we want to emphasize again that general ordering of the functional architecture of cells is obviously not sufficient to explain

the fine tuning of life: clearly, deeper, more subtle, levels of dynamic organization are required. It was recently pointed out by Görnitz (2016), that we do know very little of the fabric of reality from the size of the electron down to the Planck scales, and that it is a *misunderstanding that going smaller makes understanding more simple*. This is also true for explaining life: Grandpierre (2011), postulated that “DNA works with the help of a factor that is utterly beyond DNA or any other material life system physical capabilities. This something is immaterial yet effective and belongs to science. This is the first principle of biology that acts as a deeper intelligence of the “vacuum,” in the sense that it virtually maps all the possible histories, summarizes the results of this mapping on its own basis and then decides about the biological endpoint and from there, and finally “chooses” the optimum physically realizable path. This may also account for the fact that intelligence is a highly convergent feature in different evolutionary lines of animals that may have highly different brain structures (Seed et al, 2009; Roth, 2015). At the bottom micro-level, such an information flow may be initiated on the level of a string mediated collapse of the wave function (Mavromatos and Nanopoulos, 1995) and/or may operate through spin-dependent transformation of classical and quantum mechanical information, that may also be the basis for the so-called quantum potential or pilot waves of the implicate order proposed by David Bohm (1987). The corresponding 4-dimensional space-time domain also introduces aspects of two-times physics, tensed and causal time.

5.10 Conclusion

In the present essay, it is considered that the brain and its mental aspects are somehow coupled to the universe, in its superfluid domains (Fig.13), meaning that apart from neurobiological QM processes, cosmological QM-ones also affect brain transitions and

dynamics. A unified theory of mind and matter has been postulated earlier on the basis of *information*, viewed upon as the most fundamental element for the description of the fabric of reality (Meijer, 2012, 2013a,b; Samal, 2001; Levin, 2011; Grandpierre et al. 1997, 2013; Carter, 2014). On the basis of such an informational interaction, some aspects of cosmic physics, as for instance the second law of thermodynamics (the entropy law), might apply directly to the brain. In other words: life, with its potential energy and isoenergeticity as well as the ability to screen and collect useful information, does in a way counteract the destructive tendency of increased entropy and at the same time may employ (entropic) gravity mechanisms to materialize essential knowledge. Perhaps this bimodal modality has been foreseen by Erwin Schrödinger (1986), as the potential contribution of quantum processes in creating mental dimension.

6. Potential Roles of EM Fields in Biological Evolution and First Life

6.1 Introduction

The development of science is not a linear way of steady progression; it is more akin to a living organism and knows not only ebb and high tide, but also critical bifurcation points. These are points of major decisions in which current sciences separated from a part of previous achievements as they are no more in harmony with the newly chosen paradigm, (Meijer, 2018).

Since we still lack even a good and generally accepted definition of life, nor a comprehensive theory of the living process, the last decision within the true seekers in biological community centers around the concept of biofields (Preto, 2016, Tzambazakis, 2015, Cifra et al., 2010, Muehsam et al, 2014) and a distinct cosmological context.

Nowadays, the mystery of the origin of life is tightly connected with an increasing number of uncovered exo-planets that

resemble the Earth: is there life anywhere else in cosmos? Life is understood and treated mostly as a molecular phenomenon, as the prevalent contemporary view holds. However, as estimated by the majority of contemporary scientists, life should be widespread in cosmos, though it may chemically differ from the Earth bound (DNA-RNA/proteins) life. Contemporary life, even in its simplest forms, exhibits high complexity and ordering. In terms of informational theory, it has a relatively high informational content that should be stably reproduced from generation to generation. The chemicals that could be reproduced in simple primeval Earth simulating conditions (like ammonium ion, formaldehyde, hydrogen etc.) still lack a clear, persuasive and stable scenario that would lead from them to the macromolecules like the ones presently contained in contemporary organisms (Meijer and Geesink, 2018b, Meijer, 2012).

As it was formulated by Walker and Davies (2013), the starting point for the emergence of life should mean an establishment of causal powers from the side of organized information over molecules. Here information in living systems is not seen as coded in a straight line (as in DNA), but in a diffuse, quantum wave-like non-localized, way. In present concepts this dispersed, organized and operational (active) information only partially resides in the DNA, it is also widespread in the whole living state of the organism. It is well known that *Acetabularia Mediterranea* can reproduce its cap even without the nucleus, therefore with no DNA (Jerman, 2009a 2016, 2018).

Consequently, and in line with Walker and Davies, we may cease to understand organisms only as trivial duplicators with errors. On the contrary, they should be perceived as systems with organized information and a high degree of flexibility (variability). According to this advanced view of the life process whereby it may establish

itself also through some strange organismic forms in larger cosmos, life can be defined as dynamic and highly organized information (Meijer, 2012). Therefore, in our attempts to understand the possible origin of life and its continuation, we should try to identify a vital factor that a) would have a high probability to play an important role in biological processes, b) could maintain a high level of orderliness even in highly diversified chemical systems (systems with no "memory" molecule or genetic code, c) would be able to increase its informational content (complexity) through time (evolution), d) would be capable of specific interactions with a wide range of molecules, with a capability to direct their transformations similar to catalysts, e) would be at least physically feasible, if not probable within a supposed conditions of the pre-biotic world.

In the sixties of the past century, the earlier mentioned British biophysicist Herbert Fröhlich found that due to a high electric membrane field the living state at the level of cells rests on rhythmic and coherent oscillations of polar (macro)molecules (called also polarons, (Fröhlich, 1968) and that these oscillations can bring higher orderliness even into the cellular biochemistry. Fröhlich's ideas were later elaborated by an Italian group of quantum physicists (Del Giudice et al, 2005, Vitiello, 2001, Preparata, 1992) on the level of quantum field theory. This theory, called also the theory of quantum bio-electrodynamics argues that life at the cellular level (biochemistry, molecular movements) is highly organized through coherent (laser like) electromagnetic (EM) field that can behave as manifest particles of a very small mass (see sections 3.1 and 3.2). If the frequency of a coherent EM domain resonantly matches a neighboring molecule, the latter is attracted to its outer surface and is oriented at the same time. The field is also important from the thermodynamic standpoint, namely the output energy of a chemical reaction is not

dispersed since it continues travelling as a polarization wave, the so-called *soliton*. Hence, in an extended coherent region, i.e. the region that comprises many CDs and the space in between the diffusive, Brownian motion of molecules is replaced by a selective dynamic regime, where molecules recognize and interact with one another via *frequency matching*. Since the excitable spectrum of a CD is very rich (Del Giudice and Preparata, 1998), a variety of extended domains can emerge that may assume fractal (nested) architecture, as analyzed by Vitiello (2001).

Extended domains entail two important consequences, namely a defined size of the coherent system, and the appearance of geometrical shapes (Del Giudice and Tedeschi, 2009). To have a precise frequency matching, the relative positions of reacting molecules must assume a specific spatial configuration, corresponding to biological structures.

Therefore, we may safely assume that taking into account primordial conditions of the Earth (not going into the origin of life elsewhere in cosmos), previously enumerated characteristics should not be uncommon, difficult or improbable to find. According to the here presented definition of life we may claim that such organized systems are not yet alive if they do not have a clear possibility (actually a stable trajectory in a complex evolutionary phase space) to evolve into something more complex. With no such possibility, even if highly organized through the coupling between coherent modes (field level) and chemistry (substance level), they would be similar to various autocatalytic cycles. Such tiny bodies in fact strongly resemble living organisms. Their multiplication would indicate that they do possess *active organized information* but do not possess the genetic apparatus distinctive for ordinary living beings and even viruses.

Therefore, if we take into account the here offered definition of life that is bound to specifically organized information expressing

itself through a close and mutual interplay of the coherent field and countless molecular interactions, we may assume that the electromagnetic type of non-local quantum fields that are assumed to have been present from the start of the universe were instrumental in prebiotic processes and first life.

Nevertheless, the story of the origin of life, a tremendously organized and complex process amid a chaotic world of matter and energy, is still a mystery. Our present view on the origin of life does not disregard conventional chemical and physical aspects of life, it only tries to connect them onto a deeper whole by the integration of active organized information. One essential factor of the living process, a coherent field together with partially dynamically ordered water was presented in section 3. As a result, the order of coherent modes of pre-living water vesicles would function as a dispersed systemic memory, that would sustain organized information and would replace contemporary DNA or RNA. No genetic code would be needed – instead, the code of resonant matching between coherent field oscillations and molecular reactions would be in place. Only gradually and presumably long after the first organisms appeared, the natural selection together with laws of the state dynamics would result in the transference of the dispersed memory contained in coherent oscillations into the focused molecular one (based on DNA, RNA).

What all of this implies is that each living cell is radiating or is resonating in a biophoton field of coherent energy. If each cell is emitting such a field, then the whole living system is, in effect, a resonating field, being a ubiquitous nonlocal field. Moreover, since biophotons are the entities through which the living system communicates, there exists a near-instantaneous intercommunication throughout the organism. And this, claimed Popp (1994, 2002), is the basis for coherent

biological organization, referred to as quantum coherence. This discovery led Popp to state that the capacity for evolution rests not on aggressive struggle and rivalry, but on the capacity for communication and cooperation. In this sense the built-in capacity for species evolution is not based on an individual, but rather on living systems that are interlinked within a coherent whole: Living systems are thus neither only subjects, nor are they isolated objects, but function simultaneously as subjects and objects in a mutually communicating universe of meaning in a quantum domain (Davies, 2014; Walker and Davies, 2013; Meijer and Geesink, 2018b).

These relatively new developments in biophysics may imply that all biological organisms are constituted from a liquid crystalline medium, whereby body cells are involved in an instantaneous fractal communication via the emittance of biophotons. Furthermore, DNA itself may act as a liquid-crystal, lattice-type of gel-structure. This implies that all living biological organisms continuously emit light, although in an ultra-weak manner, which thereby forms a coherence field for life communication. (Bishof and Del Giudice, 2013; Preto, 2016; Chifra, 2016).

6.2 Creation of First Life and the Role of Phyllosilicates (Clay Materials)

We found previously that coherent natural and permanently operating wave pattern phenomena are present in typically selected clay minerals, that have semi-conductor- like properties (Geesink and Meijer, 2016; 2017; Meijer and Geesink, 2016): identical EM field eigenvalues could be measured (Fig. 14). Of note, these types of *clay minerals are, apart from being present in the soil, also abundantly suspended in the universe*, including the planet Earth (so called cosmic or extraterrestrial dust) and have been

suggested to provide a semi-conductive medium that produces selective EM wave patterns following excitation by external energy sources.

It is of interest, that such silicates have been reported to be among candidates for the facilitation of oligo-nucleotide synthesis in the creation of first life in the biological evolution (Geesink and Meijer, 2016; Meijer and Geesink, 2016, 2017; Melkikh and Meijer, 2018; Adamatzky, 2013; Hashizum, 2012).

The selected silicates probably act as quantum replicators. They specifically emit EM radiation at GM-coherent frequencies in the surroundings of ordered water molecules. Therefore, such silicate quantum replicators may have been instrumental in the initiation of first replicating living cells at the edge of pre-biotic evolution (Adamatzky, 2013; Hashizum, 2012, Grandpierre, 2014, Melkikh, 2016; Tranter, 1985; Walker and Davies, 2013).

We hold that the organization of precursor molecules for the first life principle molecules fits into a fixed coherent pattern of resonances, and can be described by the proposed semi-harmonic quantum wave equation. Preliminary evidence concerning the transition from inanimate matter to biological systems through the mediation of smectite clay minerals, indicate that this probably occurred through selection and protection and concentration of essential building blocks, in addition to the organization of chemical reactions of organic precursors, yielding the essential macromolecules of life that we know today. Furthermore, quantum processes have probably played an essential role in facilitating the various steps that gave rise to first life and initiation of the first replicating cells, in which atomic resonance creates organic shapes and geometric folding of carbon containing molecules (Davies, 2004; Walker and Daves, 2013; Grandpierre, 2014; Tranter, 1985).

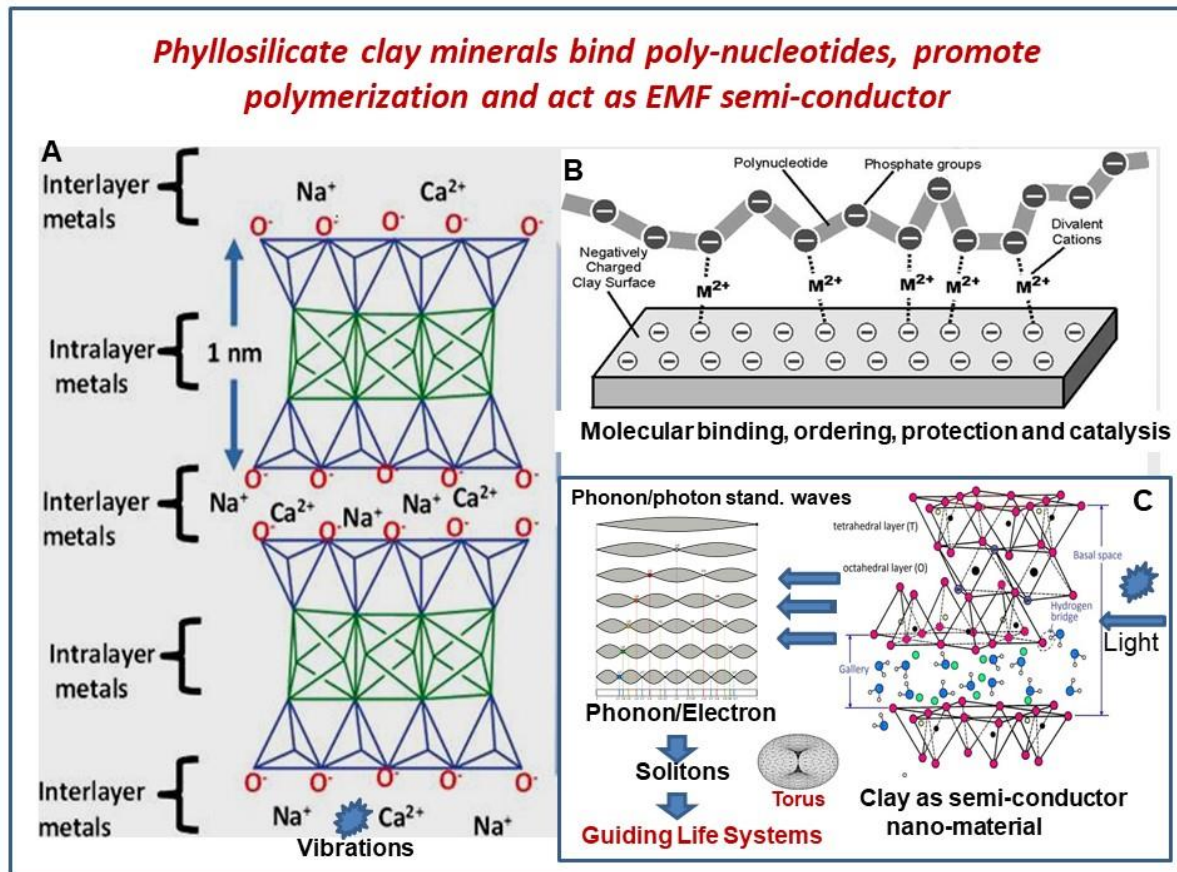


Figure 14. Phyllosilicate clay mineral with stabilized ion/water clathrates. **A:** The metal ion-doped silicate structure exhibits platonic geometries (After G. Sposito). **B:** Surface structure of a clay mineral offers binding sites for negatively charged polynucleotides as assisted by positively charged metal ions. **C:** Clay a semiconductor: EMF wave function, guiding the ordering principle in life processes as an acoustic, standing wave, system, generated by transmitting exposed light to discrete EMF wave frequencies

This should have paralleled the lattice type of organization of dipole water molecules. Together they form a harmonic-like lattice resembling fluid crystals in which life can be viewed as a crystallized form of quantum oscillations. This concept invites us to see the cosmos as a purpose-driven incubator for life. This entire process was also depicted as a kind of “biological music” (see section 3.4) originating from a pre-existing universal law intrinsic to nature, and conceptualized as a toroidal alternative to random self-organization (Meijer and Geesink, 2018; Melkikh and Meijer, 2018). Very likely, syntropic (i.e. neg-entropic) wave information from the zero-point energy field (Irikura, 2007; Sarfatti, 2015; Setterfield, 2002), selected in resonance with the *electrome* (De

Loof, 2016) of the proto-cells played a crucial role in the morphogenesis and building up of functional biochemical networks during pre-biotic processes, (Keppler, 2012, Sbitnev, 2016).

Conclusion: elements in the universe have seemingly assembled themselves in such a way that the organization of matter resulted in the ability to acquire sufficient life-sustaining information from the environment. Over time, highly complex neg-entropic structures arose that could collect, store, retrieve and communicate essential information to maintain stability and survivability. Such pattern recognition ability may have been directed by combinations of EM radiation frequencies through inducing morphic resonance with coherent vibrational elements

(structured water, proteins, oligonucleotides) of proto-cells (Meijer and Geesink, 2019b, 2018b, Melkikh and Meijer, 2018). Here, the 3-D conformation of macromolecules is crucial in attaining a versatile functional state, as treated in the following.

6.3 Long Distance Guiding of Cellular Processes in Life

According to Wolynes (2015), the integral folding process includes random mutations, potential misfoldings / unfoldings, recombinations and selection by successful competition with less optimal protein species, in which the protein finally obtains sufficient stability in subsequent generations of cells. As such the proteins were seen by the author as non-linear elements in cellular networks that arise from a sort of information spaces that, unfortunately, were not further defined. One could also question the supposed random character of this self-organizing process. In other words, how can the selection of non-functional precursors of the particular protein be envisioned? Moreover, by what physical mechanism is a specific function assigned to the particular protein? As argued by Grandpierre (2001), life functions of proteins cannot arise by chance, they can only be assigned by their host cell, but such a cell cannot arise without these functions being already assigned and present. We propose therefore that a primordial biological principle (register of rules) was operating, which acts as a “recipe for life” (Meijer, 2012). This type of a-priori information must have preceded the development of first life and we postulate that all known force fields, that were present from the birth of the universe, should be taken into account (see more later). In addition, quantum processes (Fig.15) have probably played an essential role in facilitating the

various steps that gave rise to first life and initiation of the first replicating cells (Walker and Davies, 2013, Meijer and Geesink, 2018b).

England et al (2008, 2015), derived a mathematical formula they believe is capable to explain the capacity for creating life conditions. The formula, based on established physics (the 2nd law of entropy), indicates that when a group of atoms is driven by an external source of energy (like the sun or chemical fuel) and surrounded by a heat bath (like the ocean or atmosphere), it will often gradually restructure itself in order to dissipate increasingly more energy.

This could mean that under certain conditions, matter inexorably acquires the key physical attribute associated with life. Consequently, according to this hypothesis, as particles in a system move around and interact, they will, through sheer chance, tend to adopt configurations in which the energy is spread out. Eventually, the system arrives at a state of maximum entropy called “thermodynamic equilibrium,” in which energy is uniformly distributed.

It is known that the phenomenon of quantum coherence, assumed to be present in prebiotic systems, may enhance photosynthesis because it simultaneously excites two kernels in the system by the appearance of two interrelated quantum entangled excited states (Tamulis et al, 2013; 2014; Tamulis and Grigalavicius 2014). England (2008, 2015), stated that: “Livings are self-assembled and self-replicating wet and warm, stochastically moving, supramolecular systems where quantum entanglement can be continuously generated and destroyed by non-equilibrium effects in an environment where no static entanglement exists. Quantum entanglement involves the biomolecules inside one living or between other neighboring living entities”.

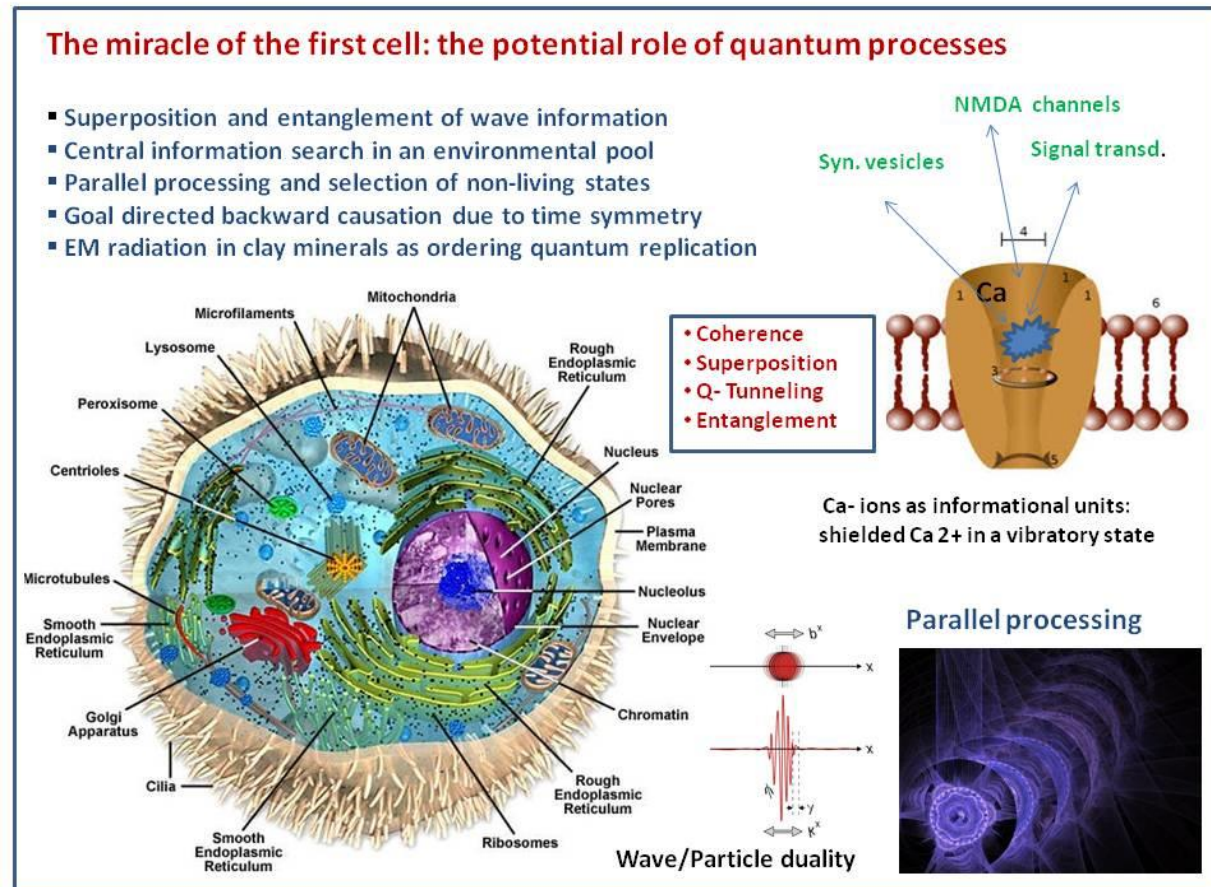


Figure 15. Potential role for quantum processes in biological evolution (listed left above) and the initiation of first life, showing various essential processes. Inset on the right above depicts a Ca^{2+} channel protein with Ca^{2+} -ion in a decoherence protected vibratory quantum information state. Inset right below indicate the process of parallel processing of pre-biotic life information as enabled through environmental search of various quantum states.

However, a number of fundamental questions can be raised with regards to the proposed mechanism of emergence of cellular life especially with regard to the item of self-organization:

- The present authors maintain that such an emergent process will exhibit countless potential solutions of which the evolutionary time would be insufficient to make proper choices for the most optimal ones (Melikh and Meijer, 2018).

- It speaks for itself that in this manner molecules could in principle be formed that are suicidal for the overall process, as it has already been demonstrated for Eigen's autocatalytic hypercycles that would be sooner

or later destroyed by parasitic autocatalytic (hyper)cycles (Cronhjort et al., 1997).

- The scheme of England does not take into account that a potential top-down information flux of future states can in principle operate since local quantum processes allow symmetrical time modalities. This item was touched upon also by Stuart Kauffman in his concept of adjacent possible (Kauffman, 2000).

- We hold that *primordial information* is required, and assume it to be guided by long-distance discrete EMF frequencies as a form of *partially directed* evolution (Meijer and Geesink, 2018b, 2019b, Melikh and Meijer, 2018)

6.4 Biological Evolution Is a Partially Directed Process

In the present paper, we assume a long-distance wave/particle influence on brain function in relation to consciousness. Such a long-range aspect was earlier described by us for a potential soliton-guided protein folding (Melkikh and Meijer, 2018) (Fig. 16).

All this is based on the conjecture that a background field, such as a zero-point energy field or a superfluid quantum space (section 7), plays a crucial guiding role regarding the biological macromolecules and their countless interactions within organisms. A part of this quantized vacuum field could be represented by the generalized music scale biophysical principle (Meijer and Geesink, 2018b, 2019b), that was revealed in both animate and non-animate systems (see section 1). How does the proposed directed evolution relate to human consciousness? In various papers (Melkikh and Khrennikov, 2017; Melkikh and Mahecha, 2017; Melkikh, 2018; 2019), it was shown that thinking (and thereby implicitly also consciousness) is the natural product of a *partially directed* evolution of the universe and that, consequently, new knowledge should, at least partly, explain the already existing knowledge at a much deeper level. Jerman et al. (1998; 2009a,b,c; 2016); and Gregorcic and Jerman, (2009) strongly advocated the significance of a guiding biofield in biological evolution (Tzambazakis, 2015). Such a steering modality exhibits non-linear properties with feed-back amplification and refers to the earlier mentioned high frequency (10E11-10E12), coherent Fröhlich field and the biophotonic field of Popp, that even can be mutually connected. This implies a conceptual extension of the Neo-Darwinian theory, in which environment is not merely considered as a contingently changing source

of selective pressures, but rather as an integrative and formative system with its own dynamic physical laws.

To solve the problem of knowledge acquisition in life processes, the concept of *quantum metalanguage* was developed (Melkikh et al., 2019). Some operations within such a quantum metalanguage can be used to generate new languages from given languages, including replenishing them with new terms, symbols, etc. The physical basis for this is the non-local quantum field embedding the biologically important molecules. We hold that these molecules or rather their collective wave- fields are involved in the organization and work of innate programs, (including the related language programs).

The superfluid quantum/ZPE space, as treated in the present paper, seems an excellent modality for defining the semantic basis for such an underlying metalanguage of nature.

As treated in the foregoing, quantum phenomena are likely at the heart of the brain function of humans and animals. In this respect, the involvement of quantum effects solved the so-called generalized Levinthal's paradox (Melkikh, 2014b, Melkikh and Meijer, 2018). In particular, in the work (Melkikh, 2014b), a quantum model of the interaction of biologically important molecules was constructed.

According to this model, we can write the equations of the dynamics of biologically important molecules as follows:

$$i\hbar \frac{\partial \psi}{\partial t} = \hat{H}\psi + \phi\psi \quad (1)$$

$$\frac{\partial \phi}{\partial t} = g(\phi, \psi) \quad (2)$$

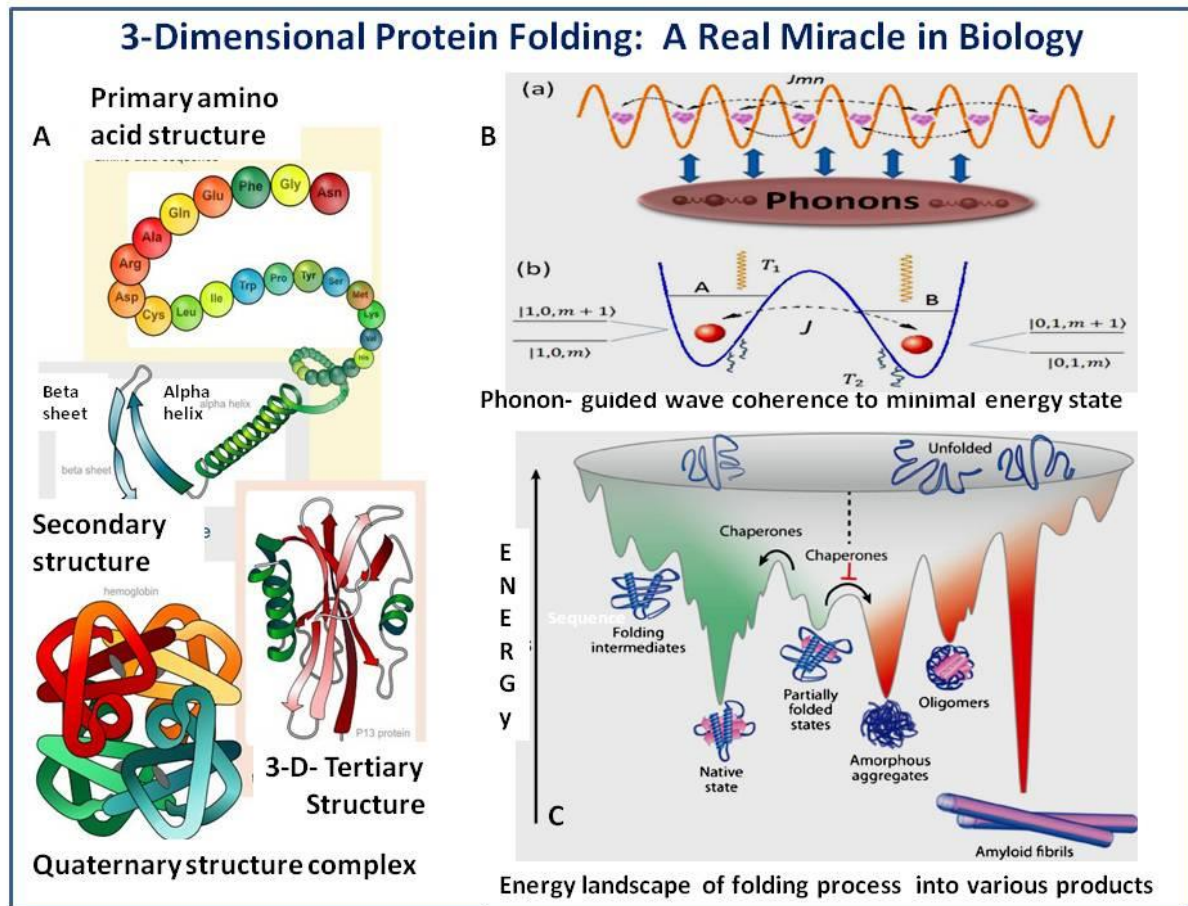


Figure 16. (A): Protein folding from primary to quaternary structure; (B): Influence of phonons on wave coherence, leading to long-lived oscillations through energy dissipation (b) and protection to environmental noise (modified from Zhang and Wang, 2016) (C): Energy landscape with intramolecular (left) and intermolecular aspects (right), producing various end-products.

Here φ is a multi-particle potential, responsible for the long-range interaction between biologically important molecules.

Based on this model, of Melkikh (2019), the formation of synaptic connections between neurons can be modeled as follows:

$$\begin{aligned} \frac{\partial u(\xi_u)}{\partial t} &= \gamma f(u, v, \xi_u) + D_u \Delta u, \\ \frac{\partial v(\xi_v)}{\partial t} &= \gamma g(u, v, \xi_v) + D_v \Delta v, \\ \frac{\partial p_n(\xi_u)}{\partial t} &= \sum_m^{m_{\max}} W_{nm}(\xi_u) p_m(\xi_u) - \sum_m^{m_{\max}} W_{nm}(\xi_u) p_n(\xi_u) \\ \frac{\partial p_n(\xi_v)}{\partial t} &= \sum_m^{m_{\max}} W_{nm}(\xi_v) p_m(\xi_v) - \sum_m^{m_{\max}} W_{nm}(\xi_v) p_n(\xi_v) \end{aligned} \quad (3)$$

where the functions $f(u, v)$ and $g(u, v)$ are responsible for the kinetics of the reactions between substances u (activator) and v (inhibitor), D_i are the diffusion coefficients of substances, and γ is the scale factor, p_n – is the probability that system is in state n , W_{mn} – is the frequency of transition from the state m to the state n . Variable ξ describes internal degrees of freedom of the reacting molecules and their spatial position.

The essential point of the model is its non-Archimedeaness, which is expressed in violation of the principle of superposition for forces and potentials.

Variable ξ describes internal degrees of freedom of the reacting molecules and their spatial position. Thus, in this system of equations, φ , in fact, represents a multi-

particle potential, responsible for the long-range interaction between biologically important molecules.

This implies that life function and thus the quite discrete reaction between these substances will depend on their 3-D conformations, as treated above. Neurons and neuronal networks, in this respect, are seen as a rather rough level of organization. Rather, non-local interactions between biologically important molecules play a crucial role of fine-tuning.

Yet, the system of equations-(3), explicitly, contains long-range interaction, that also could be instrumental in the formation of synaptic connections. The latter refers also to the formation of those new synaptic connections between neurons, that implicitly leads to a change in shape. We hold that this formation process is not only influenced by the state of the neighboring neurons, but is also due to the implicit non-locality, and thus to entangled state with many other (more distant) brain neurons.

In this framework, we see the generalized process of thinking (memorizing and perception, including pro-life decision making), as a natural stage in the directed evolution of life.

Congenital programs of behavior, as well as other intrinsic properties of organisms, are seen therefore as a part of directed evolution (Melkikh and Khrennikov, 2017). Such an evolution, in our opinion, contains *a priori information* about the future states of the evolving system, similar to the already mentioned adjacent possible concept of Kauffman (2008, 2009). At the same time, genetic events are, at least partly, controlled by long-range quantum forces, (Melkikh and Krennikov, 2017; Melkikh and Mahecha, 2017) (Fig. 16). We argue that, in a hidden form, (of force fields) this type of “thinking” exists at any stage of evolution. Such properties of living systems therefore should be implicit in the topological states of the

universe, even before the big bang (also called the Big Bounce).

In the studies of Melkikh, (2018), the hypothesis of a *directed evolution of life* in the Universe was put forward, which can be formulated in the form of the following provisions:

1. Before the Big Bounce (scattering process), the universe was in a pure quantum state. In this state, after scattering, the properties of the universe (field constants, particle masses, etc.) were encoded. This state itself arose by the mechanism of quantum phase transition.

2. At the initial stage of expansion, the universe was still in such a pure quantum state. As a result of an ongoing entropic decay (decoherence) it became hot. Yet, at the same time, some of its subsystems, weakly interacting with others, could even remain in a pure quantum state for a longer time.

3. Further expansion of the universe was somehow controlled by a gradual change in the parameters of dark energy and/or dark matter. The collective values of the constants and fields were expressed in macro-parameters determining the evolving architecture of the Universe and, for instance, allowed stars and galaxies to be formed later. Other parameters, related to force fields created the necessary conditions for the emergence of life at later stages.

4. At a certain stage, given the presence of all of these necessary conditions and following the appearance of atoms and molecules in certain complex systems, *quantum laws* governing the spatial structure and the evolution of replicators began to play an important role. Of note, these laws were also ultimately determined by the state of the Universe before the Big Bounce (by scattering). The presence of anti-matter was largely directed to a supposed adjacent universe (Boyle and Turok, 2018).

5. Subsequently the proposed partially-directed evolution went in the direction of

increasing the complexity of organisms, in relation to their ongoing adaptation to various environmental conditions. It should be realized therefore, that the particular laws of partially-directed evolution, were ultimately the result of the collective laws of physics as well as the initial conditions that characterized the initial forming of the Universe.

Notably, the here proposed model of a partially directed evolution of the universe,

including the further emergence of life in it, demonstrates a striking similarity of the becoming of the universe with that of the evolution of living organisms. Because of this striking similarity, we may infer that our universe itself can be considered as a living modality. In this case, all existing lifeforms, with respect to the universe, can in fact be regarded as endo-symbionts of a cosmic super-organism.

References

- Adamatzky A. 2013. Game of Life on Phyllosilicates: Gliders, Oscillators and Still Life. *Physics Letters.*;377:597-1605.
- Adamski A, 2019. The historical aspect of the development of quantum consciousness at the beginning of the XXI century. *Gerontol & Geriatrics Stud.* 4, GGS.000588.2019
- Aharonov Y, Popescu S, Rohrlich D, Skrzypczyk P. 2013. Quantum Cheshire Cats. *New J. of Physics*; 15, 1-8.
- Aharonov Y, Popescu S, Tollaksen J. 2010. A time-symmetric formulation of quantum mechanics, *Physics Today*, November 2010; 27-32.
- Alfonso-Faus A, 2011. Cosmology, holography, the brain and the quantumvacuum, <https://arxiv.org/ftp/arxiv/papers/1102/1102.0443.pdf>
- Amiot E. 2013. The Torii of Phases. In: Yust J, Wild J, Burgoyne J A (eds) *Mathematics and Computation in Music. MCM 2013. Lecture Notes in Computer Science.*;7937.
- Annala A, 2013. On the Character of Consciousness. *Front. Syst. Neuroscience*, March; arXiv:1308.4802v3 [hep-th] 7.
- Anjamrooz *et al.*, 2011. The Cellular Universe: A New Cosmological Model Based on The Holographic Principle. *Int. J. Phys. Sciences*; 6, 2175-2183.
- Arani R, Bono I, Giudice ED, Preparata G, 1995. QED coherence and the thermodynamics of water. *International Journal of Modern Physics B.* 9: 1813-1842
- Atkins P, de Paula, J and Friedman R, 2009. *Quanta, Matter, and Charge: A molecular approach to physical chemistry*, N. Y.: W. H. Freeman
- Afshordi N et al, 2017. From Planck data to Planck era: Observational tests of Holographic Cosmology. *Phys. Rev.Lett.* 118 (2017) no.4, 041301, arXiv:1607.04878 [astro-ph.CO].
- Atasoy S, Deco G, Kringelbach ML, Pearson J, 2018. Harmonic Brain Modes: A Unifying Framework for Linking Space and Time in Brain Dynamics. *Neuroscientist.* Jun;24(3):277-293. doi: 10.1177/1073858417728032. Epub Sept 1. 2017
- Baaquie BE, Martin F, 2005. Quantum Psyche. *Quantum Field Theory of the Human Psyche. NeuroQuantology*; issue 1, 7-42.
- Batiz Z, Milovanovic D. 2017. Quantum Holography and Agency: Toward a Formalism of Schema QD. *NeuroQuantology*; 15, 45-59
- Beck, F and Eccles, J C, 1992. Quantum aspects of brain activity and the role of consciousness," *Proc. Natl. Acad. Sci. U S A*, vol. 89, no. 23, pp. 11357-11361,
- Beichler JE. 2012a. The Evolutionary Imperative of Consciousness *Journal of Biological Physics*, Volume 38, pp. 113-120.
- Beichler, James E. 2012b. "The neurophysics of mind and consciousness: A theoretical model of emergence, evolution, psi and survival." A presentation made at the SMN/SSE Conference at An Grianan AEC, Ireland, October, "http://www.neurocosmology.net".

- Beichler, James E. 2012c. The neurophysical basis of mind and consciousness: An electromagnetic model of the neuron. A presentation at the annual Spring Meeting of the OSAPS, Ohio State 68 University, April
“<http://www.neurocosmology.net>”.
- Bernroider, G, 2003. Quantum Neurodynamics and the Relationship to Conscious Experience. *NeuroQuantology*, **1**, 163-168
- Bernstein P, 2015. Intuition: What science says (so far) about how and why intuition works.in: *Endophysics, Time, Quantum and the Subjective*, ed. by Rosolino Buccheri *et al.*, World Scientific Publishing, Singapore
- Bérut A B, Arakelyan A, Petrosyan A, Ciliberto S, Dillenschneider R, Lutz E. 2012. Experimental verification of Landauer’s principle linking information and thermodynamics, *NAT URE Letters*; 483, p 187-190.
- Bessler P, 2019. Some Macroscopic Applications of Georgiev’s Quantum Information Model. *NeuroQuantology*, **17**, 29-35
- Bieberich E, 2012. Introduction in the Fractality Principle of Consciousness and the Sentyon Postulate. *Cognit Comput.*; **4**, 13-28.
- Bischof M and Del Giudice E. 2013. Communication and emergence of collective behavior in living organisms. A quantum approach. *Molecular Biology International*.; **1**. doi: 10.1155/2013/987549
- Bitbol M, Luisi PL. 2004. Autopoiesis with or without cognition: defining life at its edge. *J R Soc Interface.*; **1**(1):99–107. [PubMed: 16849156]
- Bjerve, A, 2016. The Fractal-holographic Universe, <http://holofractal.net/the-holofractographic>
- Bohm D F & Hiley B J., 1993. The Undivided Universe. An Ontological Interpretation of Quantum Theory.
- Bohm D, 1952. *Phys. Rev.* **85**, 166 and Bohm D, 1980. *Wholeness and the implicate order*. London: Routledge & Kegan Paul,
- Bohm, D, Hiley BJ, 1993. The undivided universe. An ontological interpretation of quantum theory, London: Routledge
- Bókkon I, Mallick BN, Tuszynski JA, 2013. Near death experience: a multidisciplinary hypothesis. *Frontiers in Human Neuroscience*; **7**, 1-11.
- Bókkon I, D'Angiulli A, 2009. Emergence and transmission of visual awareness through optical coding in the brain: a redox molecular hypothesis on visual mental imagery. *Biosci. Hypotheses* **2**; 226–232. doi:10.1016/j.bihy.2009.01.009.
- Boyle L, Finn K, Turok N, 2018. CPT-Symmetric Universe. *Physical Review Letters* **121**, 251301
- Caligiuri LM, 2015. Zero-Point Field, QED Coherence, Living Systems and Biophoton Emission. *Open Journal of Biophysics*; **5**: 21-34.
- Campbell RJ, Bickhard MH, 2010. Physicalism, Emergence and Downward causation; <http://www.lehigh.edu/~mhb0/physicalemergence.pdf>
- Carhart-Harris RL, Friston KJ, 2019. REBUS and the Anarchic Brain: Towards a Unified Model of Brain Action of Psychedelics. *Pharmacol Reviews* **71**, 316-344
- Carter PJ. 2014. Consciousness and Perception in Higher-Dimensional Quantum Space-time. *NeuroQuantology*; **12**: 46-75
- Chiatti L, 2007. Fantappiè-Arcidiacono Theory of Relativity Versus Recent Cosmological Evidences : A Preliminary Comparison, , <https://arxiv.org/ftp/physics/papers/0702/0702178.pdf>
- Cifra M, Fields JZ, Farhadi A, 2010. Electromagnetic cellular interactions. *Progress in Biophysics and Molecular Biology*; **1**-24, doi:10.1016/j.pbiomolbio.2010.07.003
- Cleeremans A. 2011. The Radical Plasticity Thesis: How the Brain Learns to be Conscious. *Front Psychol.* **2011**; **2**: 86. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3110382/>
- Cronhjort, M.B. and Blomberg, C., 1997. Cluster compartmentalization may provide resistance to parasites for catalytic networks. *Physica D: Nonlinear Phenomena*, **101**(3-4), pp.289-298.
- Currihan J, 2017. The Cosmic Hologram. Information at the Center of Creation. Inner Traditions, Rochester Vermont, USA
- Davies P C W, 2009. The Quantum Life. *Physics World.*; July, pp 24-28.
- Davies P C W, 2007. The implications of a Cosmological Information Bound for Complexity, Quantum Information and Nature, <http://power.itp.ac.cn/~mli/pdavies.pdf> of

- Physical Law,
<http://power.itp.ac.cn/~mli/pdavies.pdf>.
- Davies P C W, 2014. Does quantum mechanics play a non-trivial role in life? *BioSystems* 2014; 78: pp. 69–79.
- Daywitt, William C. 2009. The Planck Vacuum, *Progress in Physics*, Vol. 1, 20-26
- De Loof A. 2016. The Cell's Self-Generated "Electrome": The Biophysical Essence of the Immaterial Dimension of Life? *Communicative & Integrative Biology*.,9(5): e1197446.
- Dehaene S, Lau H, Koulder S. 2017. What is consciousness, and do machines have it? *Science*, 358,486-492
- Del Giudice E, De Ninno A, Fleischmann M, Mengoli G, Milani M, Talpo G, Vitiello G, 2005. Coherent quantum electrodynamics in living matter. *Electromagnetic Biology&Medicine*, 24: 199-210
- Del Giudice E., Tedeschi A., 2009. Water and Autocatalysis in Living Matter, *Electromagnetic Biology and Medicine*, 28: 46–52
- Del Giudice, E., Spinetti, P. R., Tedeschi, A, 2010. Water dynamics at the root of metamorphosis in living organisms. *Water* 2:566–586
- Del Giudice E, Spinetti PS, Tedeschi A, 2010. Water Dynamics at the Root of Metamorphosis in Living Organisms. *Water*, 2: 566-586.
- Dotta, BT. 2013. Ultraweak photon emission in cells: coupling to molecular pathways, applied magnetic fields, and potential non-locality, thesis
- Dunajzki, M. 2009. Twistor theory and differential equations. *J. Phys. A: Math. Theor.*; 42: 404004.
- England, J L, Park S, and Pande V S, 2008. "Theory for an order-driven disruption of the liquid state in water." *Journal of Chemical Physics*. 128, 044503
- England, J L, 2015. Dissipative adaptation in driven self-assembly. *Nature Nanotechnology* **10**, 919-923
- Feuillet, L , Dufour, H and Pelletier, J, 2007. "Brain of a white-collar worker," *The Lancet*, vol. 370, no. 9583, p. 262
- Flohr H, 1998. On the Mechanism of Action of Anaesthetic Agents. In Stuart R. Hameroff, Alfred W. Kaszniak & A. C. Scott (eds.), *Toward a Science of Consciousness II*. MIT Press; 2--459.
- Forsdyke DR, 2014. Long-term memory: scaling of information to brain size. *Front. Human Neuroscience*; 8, 1-4.
- Forshaw SD. 2016. Memory of a universal mind. Galactic structures and their existence as cognitive operators in an emerging universally conscious machine. *ResearchGate*; 309209078.
- Forshaw SD, 2016. The Third State. Towards a quantum theory of consciousness. *NeuroQuantology*; 14, : 49-61.
- Fröhlich H, 1968. Long-range coherence and energy storage in biological systems. *Int. J. Quantum Chem.* 2: 641–649.
- Gabella M, 2006. The Randall-Sundrum Model; <https://wwwthphys.physics.ox.ac.uk/people/MaximeGabella/rs.pdf>
- Gaite j, 2018 The Fractal Geometry of the Cosmic Web and its Formation. *Advances in Astronomy*, vol. 2019, Article ID 6587138 <https://arxiv.org/abs/1810.02311>
- Galloni G M, 2012. The heresy of Fantappiè and Teillard and the converging revolution. *Syntropy*, 2; 1: 79-84.
- Gardiner, J, Overall R, Marc J. 2010. The Fractal Nature of the Brain: EEG Data Suggests That the Brain Functions as a "Quantum Computer" in 5-8 Dimensions. *NeuroQuantology*; 8, 137-141.
- Geesink J H and Meijer DKF, 2016a. Quantum Wave Information of Life Revealed: An Algorithm for Electromagnetic Frequencies that Create Stability of Biological Order, with Implications for Brain Function and Consciousness. *NeuroQuantology*, vol. 14, pp 106-125, <file:///C:/Users/Dick/Documents/911-2447-1-PB.pdf>
- Geesink J H and Meijer DKF, 2016b. Bio-Soliton Model that Predicts Non-thermal Electromagnetic Frequency Bands, that Either Stabilize Living cells. <https://arxiv.org/pdf/1610.04855> and *ELECTROMAGNETIC BIOLOGY AND MEDICINE*, 2017, vol. 36, no.4, 357-378 <https://doi.org/10.1080/15368378.2017.1389752>
- Geesink JH and Meijer DKF, 2017. Electromagnetic Frequency Patterns that are Crucial for Health

- and Disease Reveal a Generalized Biophysical Principle: the GM scale. *Quantum Biosystems*, 8, 1-16
[https://www.academia.edu/35199978/Electromagnetic Frequency Patterns that are Crucial for Health and Disease reveal a Generalized Biophysical Principle the GM scale](https://www.academia.edu/35199978/Electromagnetic_Frequency_Patterns_that_are_Crucial_for_Health_and_Disease_reveal_a_Generalized_Biophysical_Principle_the_GM_scale)
- Geesink J H and Meijer D K F, 2018a. Evidence for a Guiding Principle in Quantum Physics. *Quantum Biosystems*, 9, 1-7
[http://www.quantumbiosystems.org/admin/files/QBS%209%20\(1\)%201-17%20\(2018\).pdf](http://www.quantumbiosystems.org/admin/files/QBS%209%20(1)%201-17%20(2018).pdf)
- Geesink J H and Meijer D K F, 2018b. A harmonic-like electromagnetic frequency pattern organizes non-local states and quantum entanglement in both EPR studies and life systems. *J. Modern Physics* 9, 898-924
[https://www.academia.edu/36384076/A_SemiHarmonic Frequency Pattern Organizes Local and Non-Local States by Quantum Entanglement in both EPR-Studies and Life Systems](https://www.academia.edu/36384076/A_SemiHarmonic_Frequency_Pattern_Organizes_Local_and_Non-Local_States_by_Quantum_Entanglement_in_both_EPR-Studies_and_Life_Systems)
- Geesink J H and Meijer D K F, 2018c. Semi-Harmonic Scaling enables Calculation of Masses of Elementary Particles of the Standard Model. *J. Modern Physics*, 9, 925-947
<https://pdfs.semanticscholar.org/e576/b8da181ff3e598618dfe440bb5c5904f61a2.pdf>
- Geesink J H and Meijer D K F, 2018 d. Mathematical Structure of the GM Life Algorithm that May Reflect Bohm's Implicate Order. *J. Modern Physics*, 9, 851-897
<https://www.scirp.org/journal/PaperInformation.aspx?PaperID=83681>
- Geesink, J H and Meijer, D K F, 2019a. Superconductive properties in animate and inanimate systems are predicted by a novel biophysical quantum algorithm, *Quantum Biosystems*.
[https://www.academia.edu/38224924/Superconductive properties in animate and inanimate systems are predicted by a novel biophysical quantum algorithm](https://www.academia.edu/38224924/Superconductive_properties_in_animate_and_inanimate_systems_are_predicted_by_a_novel_biophysical_quantum_algorithm)
- Geesink, J H and Meijer, D K F, 2019b. Water: the cradle of life in action, water in cells is guided by coherent quantum frequencies as revealed in pure water. In the press in *WaterJournal*
https://www.researchgate.net/publication/331976119_Water_the_cradle_of_life_in_action_cellular_architecture_is_guided_by_coherent_quantum_frequencies_as_revealed_in_pure_water
- Geesink J H, Meijer D K F, Jerman I, 2019c. Clay minerals: Primordial Biofield and Fractal Quantum Information Network ?, submitted to *Quantum Biosystems*
- Georgiev D D, Glazebrook J F, 2018. The quantum physics of synaptic communication via the SNARE protein complex. *Progress in Biophysics and Molecular Biology*, 135, 16-29
- Giesa, T., Spivak, D.I., Buehler, M.J. (2011) Reoccurring Patterns in Hierarchical Protein Materials and Music: The Power of Analogies, *BioNanoScience*. Volume. 1. Issue 4/
- Gonzales A, 2012. Earth magnetic field is singing. This is what it sounds like,
<http://io9.gizmodo.com/5947951/earths-magnetic-field-is-singing-this-is-what-it-sounds-like>
- Goodman G, Poznanski R R, Cacha L Bercovich D, 2015. The Two-Brains Hypothesis: towards a guide for brain-brain and brain-machine interactions. *J. Integrative Neuroscience*, 14, 1-13
- Görnitz T, 2012. Quantum Theory as Universal Theory of Structures. Essentially from Cosmos to Consciousness . <http://cdn.intechopen.com/pdfs-wm/28316.pdf>
- Görnitz, T , 2016. A Century of Quantum Theory-Time for a Change in Thinking, versus The Popular Belief that Material Building Blocks are the Basis of the Reality.
https://www.researchgate.net/publication/301895324_A_century_of_quantum_theory_-_time_for_a_change_in_thinking_Versus_the_popular_belief_that_material_building_blocks_are_the_basis_of_the_reality
- Goswami A, 1990. Consciousness in Quantum Physics and The Mind-Body Problem. *The Journal of Mind and Behavior*; 11, 1, p. 75-96.
- Grandpierre 1997. The Physics of Collective Consciousness Published in: *World Futures. The Journal of general Evolution*, 48(1-4): 23-56,.
- Grandpierre, A. (2001) Phenomenology of Space and Time. Book 1. The Forces of the Cosmos and the

- Ontopoietic Genesis of Life. In: Tymieniecka, A.-T. Ed., *Analecta Husserliana*. <http://www.springer.com/philosophy/book/978-3-319-02014-3>
- Grandpierre et al. 2013. Multidisciplinary Approach to Mind and Consciousness. *NeuroQuantology*, 11, pp 607-617
- Grandpierre A, 2014 a. Biologically Organized Quantum Vacuum and the Cosmic Origin of Cellular Life in: *Phenomenology of Space and Time Book 1. The Forces of the Cosmos and the Ontopoietic Genesis of Life. Analecta Husserliana*.;116:107-133.
- Grandpierre A, 2014b . Does the Universe have a Physical, Biological, or Psychological Nature? In: *Brain, Mind, Cosmos: the nature of our existence and the universe* (Sages and Scientists Book).
- Gregorcic A and Jerman I, 2009. On the structure of the theoretical evolutionary space in relation to biological laws. https://www.researchgate.net/publication/44658843_On_the_structure_of_theoretical_evolutionary_space_in_relation_to_biological_laws
- Greyson B. 2010. Seeing Dead People Not Known to Have Died: "Peak in Darien" Experiences, *Anthropology and Humanism*; Vol. 35, Issue 2: pp 159–171
- Greyson B, 2013. Nature of Mind and Consciousness. Is Consciousness Produced by the Brain? http://sfm.scienceformonks.org/SciencePrograms/MonasticGraduates/Conference/CosmologyAndConsciousness/Resourses/Text_Is_Consciousness_Produced.pdf
- Grof S. 1987. *Beyond the Brain; Birth, Death and Transcendence in Psychotherapy*; New York: State University of New York Press.
- Haggard HM, Rovelli C, 2014. Black hole fireworks: quantum-gravity effects outside the horizon spark black to white hole tunneling.; arXiv:1407.0989v2 [gr-qc] 6 Jul 2014
- Hameroff S, Tuszynsky J, 2010. Quantum states in protein assemblies: The essence of Life? <http://www.quantumconsciousness.org/sites/default/files/PaperIntlSocOptEngineeringQuantumStatesinProteinsandProteinAssemblies.pdf>.
- Haramain N, Brown W D, Val Baker A. 2016. The Unified Spacememory Network: from Cosmogenesis to Consciousness. *NeuroQuantology*. 14(4):657-671. doi: 10.14704/nq.2016.14.4.961
- Haramain, N., Rauscher, E.A., 2016. 'Collective Coherent Oscillation Plasma Modes in Surrounding Media of Black Holes and Vacuum Structure - Quantum Processes with Considerations of Spacetime Torque and Coriolis Forces,' The Resonance Project Foundation, www.theresonanceproject.org
- Hashizume H. 2012. Role of Clay Minerals in Chemical Evolution and the Origins of Life. *Life Physics Letters*.;377: 597-1605; doi: 10.5772/50172
- Hasson U, Ghazanfar AA, Galantucci B, Garrod S, Keyzers C, 2012. Brain to brain coupling: A mechanism for creating and sharing a social world. *Trends Cogn. Sci.*;16: 114-12.
- Henry R C, 2005. The Mental Universe, *Nature*; 436(7): 29.
- Hu H and Wu M, 2013. The Relationship between Human Consciousness & Universal Consciousness. *Scientific GOD Journal*, 4, 209-225
- Huang, K, 2013. Dark Energy and Dark Matter in a Superfluid Universe. <https://arxiv.org/abs/1309.5707>
- Irwin K. 2014. A New Approach to the Hard problem of Consciousness: A quasi-crystalline language of primitive units of consciousness in quantized spacetime. *J. Consciousness Exploration & Research*; 5: 483-497.
- Jahn RG, Dunne BJ, 2004. Sensors, Filters, and the Source of Reality. *Journal of Scientific Exploration*; 18(4): 547–570.
- Jerman I, 1998. Electromagnetic Origin of Life, *Electro- and Magnetobiology*, 17 (3): 401-413, https://www.researchgate.net/publication/232054835_Electromagnetic_Origin_of_Life
- Jerman, I, 2009a. Evidence for Biofield. https://www.researchgate.net/publication/321686137_Evidence_for_biofield
- Jerman I, Krasovec R, Leskovic R T, 2009b, Deep significance of field concept in contemporary biomedical medicine. *Electromagn Biol Med*. 2009;28(1):61-70. https://www.researchgate.net/publication/24249639_Deep_Significance_of_the_Field_Concept_in

- Contemporary Biomedical Sciences doi: 10.1080/15368370802711060.
- Jerman I, Dovc P, Ratajc, P, Krapez V, 2009c. Existence, nature and significance of biological field (the biofield). <https://www.researchgate.net/project/Existence-nature-and-significance-of-biological-field-the-biofield>
- Jerman I. 2016. The Origin of Life from Quantum Vacuum, Water and Polar Molecules. American Journal of Modern Physics. 5(4-1):34-43. <http://article.sciencepublishinggroup.com/html/10.11648.j.ajmp.s.2016050401.16.html>
- Jerman I, 2018, Emergence of organisms from ordered mesotropic states of water (liquids). Physical instead of chemical origin of life. https://www.researchgate.net/.../Manuscript_18_Jerman_Emergence...
- John ER, 2001. A field theory of consciousness. Consciousness and Cognition; 10:184-213
- Joye S R, 2016. The Pribram-Bohm Holoflux Theory of Consciousness: An Integral Interpretation of the Theories of Karl Pribram, David Bohm and Pierre Teilhard de Chardin. Cosmos and History: The Journal of Natural and Social Philosophy, vol. 12, no. 2, 2016
- Kauffman S A, 2008. Reinventing the Sacred: A New View of Science, Reason, and Religion, Basic Books
- Kauffman SA, 2009. Towards a Post Reductionist Science. The Open University.
- Kastrup B, 2017. Self-transcendence correlates with brain function impairment. Journal of Cognition and Neuroethics 4 (3):33-42 <https://philpapers.org/rec/KASSCW>
- Kastrup B, 2018. The Universe in Consciousness. J. of Consciousness Studies, 25, 125-155
- Kastrup B, 2017. There is an Unconscious, but it May Well Be Conscious. Europe's journal of Psychology, 1841-0413
- Keppler J A, 2012. Conceptual framework for consciousness based on a deep understanding of matter. Philos Study, 2(10):689-703
- Keppler JA, 2013. A new perspective on the functioning of the brain and the mechanisms behind conscious processes. Frontiers in Psychology, Theoretical and Philosophical Psychology; pp1-6.
- Keppler JA, 2016. On the universal mechanism underlying conscious systems and the foundations for a theory of mind. Open J. of Philosophy; 6: 346-367.
- King C C, 2003. Chaos, Quantum-transactions and Consciousness, NeuroQuantology, 2003; 1(1): 129-162.
- Knierim JJ, Zhang K, 2012. Attractor Dynamics of Spatially Correlated Neural Activity in the Limbic System Ann. Rev. Neurol. 10.1146/2012; 062111-150351.
- Kozyrev, 1997
- Lake J, 2015. The near-death experience: implications for a more complete theory of consciousness. Quantum Biosystems; 6: 131-138.
- Lambert N, Chen Y N, Cheng Y C, Li C M, Chen G Y, Franco N. 2013. Quantum Biology. Nature Physics.; 9(1):10-18. doi:10.1038/nphys2474
- Lambert, J-F, 2015. Origin of Life: From the mineral to the biochemical world. Web of Conferences 4, 00012
- László E, 2007. The Akashic Field. New York: Dutton,.
- Laszlo E. 2012. Cosmic Symphony: A Deeper Look at Quantum Consciousness.; http://www.huffingtonpost.com/ervin-laszlo/cosmic-symphony-a-deeper_b_532315.html
- Lefferts M, 2019, Cosmometry. Exploring the Holofractal Nature of the Cosmos. Cosmometria Publishing.
- Levin M, 2012. Molecular bioelectricity in developmental biology: new tools and recent discoveries: control of cell behavior and pattern formation by transmembrane potential gradients. Bioessays.; 34:205-217.
- Levin, M, 2016. Reading and Writing the Morphogenetic Code. Foundational White Paper of the Allen Discovery Center at Tufts University.
- Libet B, 1996. Conscious Mind as a Field J. theor. Biol.; 178: 223-224.
- Libet B, 1994. A testable field theory of mind-brain interaction. J. Consciousness Studies; 1: 119-126

- Linden R F J, 2009. The Universe as a Multi-Dimensional Fractal. <https://bruceleeeowe.files.wordpress.com/2009/10/fractal-universe.pdf>
- Lloyd NJ, 2007. Black hole computers, <https://www.scientificamerican.com/.../black-hole-computers-2007>.
- Lloyd S, 2011. Quantum coherence in biological systems. J. Phys.: Conf. Ser. 302, 012037 Journal of Physics: Conference Series 302 (2011) 012037 doi:10.1088/1742-6596/302/1/012037
- Loll, 2011. Quantum Gravity at the Planck scale: getting a hold on spacetime foam,; <http://physics.technion.ac.il/~conf/Waves/RenateLoll.pdf>
- Luminet JP., 2016. The holographic Universe,; <https://arxiv.org/abs/1602.07258>
- Majorek M B, 2012 Does the Brain Cause Conscious Experience? Journal of Consciousness Studies 19(3)
- Maldacena J, Susskind K 2013. Cool horizons for entangled black holes, High Energy Physics - Theory (hep-th),; DOI: <http://arxiv.org/pdf/1306.0533v2.pdf>
- Marais A, Adam B, Ringsmuth, A K, Ferretti M, Gruber J. M, Hendrikx R, Schuld M, Smith, Samuel L, Sinayskiy I, Kru T P J, Petruccione F. and van Grondell R 2018. The future of quantum biology. J. R. Soc. Interface 15: 20180640. <http://dx.doi.org/10.1098/rsif.2018.0640>
- Martin F, Carminati F, Carminati G, 2013. Quantum Information Theory Applied to Unconscious and Consciousness. NeuroQuantology; 11: 16-33.
- Mashour GA, Alkira M., 2013. Evolution of consciousness: Phylogeny, ontogeny and emergence from general Anesthesia. PNAS, 110, 10357-10364
- Mavromatos NE, Merishin A, Nanopoulos DV, 2002. QED-cavity model of microtubules implies dissipationless energy transfer and biological quantum teleportation. International Journal of Modern Physics B; 16: 3623.
- McFadden J, 2007. Conscious electromagnetic (CEMI) field theory. NeuroQuantology; 5(3):262–270.
- Mc Naughton BL, Battaglia FP, Jensen O, Moser EI, Moser MB, 2006. Path integration and the neural basis. Neurosci.; 7(8):663-78.
- Meijer D K F, 2012. The Information Universe. On the Missing Link in Concepts on the Architecture of Reality. Syntropy Journal, 1, pp 1-64. https://www.researchgate.net/publication/275016944_Meijer_D_K_F_2012_The_Information_Universe_On_the_Missing_Link_in_Concepts_on_the_Architecture_of_Reality_Syntropy_Journal_1_pp_1-64
- Meijer D K F, Korf J, 2013. Quantum Modeling of the Mental State: the Concept of a Cyclic Mental Workspace. Syntropy Journal,;1:1-41. . <https://www.semanticscholar.org/paper/Quantum-modeling-of-the-mental-state%3A-the-concept-a-Meijer-Korf/b14f9211c9ff958ffc681149eea7251f512ba889>
- Meijer D K F, 2014. The Extended Brain: Cyclic Information Flow, in a Quantum Physical Realm. NeuroQuantology, 12, 180-200. <http://www.neuroquantology.com/index.php/journal/article/view/754/651>
- Meijer D K F and Raggett S, 2014. Quantum Physics in Consciousness Studies. The Quantum Mind Extended. (review, 180 pages). <http://quantum-mind.co.uk/wp-content/uploads/2014/11/Quantum-Ph-rev-def-2.pdf>
- Meijer D K F, 2015. The Universe as a Cyclic Organized Information System. An Essay on the Worldview of John Wheeler. NeuroQuantology, 1, pp 1-40, <http://www.neuroquantology.com/index.php/journal/article/view/798/693>
- Meijer D K F and Geesink J H, 2016. Phonon Guided Biology. Architecture of Life and Conscious Perception are mediated by Toroidal Coupling of Phonon, Photon and Electron Information Fluxes at Discrete Eigenfrequencies. NeuroQuantology, vol.14, issue 4, pp 718-755 <http://www.neuroquantology.com/index.php/journal/article/view/985>
- Meijer D K F and Geesink J H, 2017. Consciousness in the Universe is Scale Invariant and Implies the Event Horizon of the Human Brain. NeuroQuantology, 15, 41-79

https://www.researchgate.net/publication/320267484_Consciousness_in_the_Universe_is_Scale_Invariant_and_Implies_an_Event_Horizon_of_the_Human_Brain

- Meijer D K F 2018. Processes of Science and Art Modeled as a Holoflux of Information Using Toroidal Geometry. *Open Journal of Philosophy*, 8, 365-400.
https://pdfs.semanticscholar.org/cddd/d1975ad29ee4cbb653a933f204f5120f640.pdf?_ga=2.106736387.1244523350.1576662063-1419431810.1574855531 doi: 10.4236/ojpp.2018.84026.
- Meijer D K F and Geesink J H, 2018a. Favourable and Unfavourable EMF Frequency Patterns in Cancer: Perspectives for Improved Therapy and Prevention. *J. Cancer Therapy*, 9, 188-230
<https://www.scirp.org/journal/PaperInformation.aspx?PaperID=82944>
- Meijer D K F and Geesink J H, 2018b. Guided folding of life's proteins in integrate cells with holographic memory and GM-biophysical steering. *Open Journal of Biophysics*, 8, 17-154
https://file.scirp.org/pdf/OJBIPHY_2018071615175972.pdf
- Meijer D K F and Geesink J H, 2018 c. Is the Fabric of Reality Guided by a Semi-Harmonic, Toroidal Background Field? *International Journal of Structural and Computational Biology*, November
<https://pdfs.semanticscholar.org/43a5/dbabe7ce98c06d45451e2329a19327c42dbc.pdf>
- Meijer D K F, 2019a. Universal Consciousness. Collective Evidence on the Basis of Current Physics and Philosophy of Mind. ResearchGate, https://www.researchgate.net/publication/328538224_Universal_Consciousness_Collective_Evidence_on_the_Basis_of_Current_Physics_and_Philosophy_of_Mind_Part_1
- Meijer D K F, Geesink J H, (2019b). Life and Consciousness are Guided by a Semi-Harmonic EM Background Field. *NeuroQuantology* ,Vol. 17, Issue 4, 37-44
<https://www.neuroquantology.com/index.php/journal/article/view/2074>
- Meijer D K F ,(2019b). Anticipation of of Afterlife as Based on Current Physics of Information, available on ResearchGate, https://www.researchgate.net/publication/336531043_The_Anticipation_of_Afterlife_as_Based_on_Current_Physics_of_Information
- Melkikh, A V, 2014a. The No Free Lunch Theorem and hypothesis of instinctive animal behavior. *Artificial Intelligence Research*, V. 3, No 4, 43-63.
- Melkikh, A.V, 2014b. Congenital programs of the behavior and nontrivial quantum effects in the neurons work. *Biosystems*, 119, 10-19.
- Melkikh A V 2016. Quantum-like model of partially directed evolution. *Progress in Biophysics and Molecular Biology*; 1-16.
- Melkikh AV, Khrennikov A, 2017. Quantum-like model of partially directed evolution. *Progress in Biophysics and Molecular Biology*. V. 125, 36-51.
- Melkikh, AV, Mahecha, DS, 2017. On the Broader Sense of Life and Evolution: Its Mechanisms, Origin and Probability across the Universe. *Journal of Astrobiology & Outreach*. V.5, issue 3, 1-13.
- Melkikh, AV, Meijer DKF, 2018. On a generalized Levinthal's paradox: the role of long- and shortrange interactions in complex bio-molecular reactions, including protein and DNA folding. *Progress in Biophysics and Molecular Biology*, 132, 57-79.
<https://www.sciencedirect.com/science/article/pii/S0079610717300846>
- Melkikh, AV, 2018. The universe as a superorganism. *International journal of astrobiology and aerospace technology*. IJAAT-104. DOI: 10.29011/IJAAT-104 100004.
- Melkikh, AV, Khrennikov, A Yampolsky, R, 2019. Quantum metalanguage and the new cognitive synthesis. *Neuroquantology*. V.17, issue 1, 50-74.
- Melkikh, AV, 2019. Thinking as a quantum phenomenon. *Biosystems*. 176, 32-40
- Melkikh A.V. Theory of directed evolution. Lambert Academic Publishing. 2020.
- Merker B, 2007. Consiousness without a cerebral cortex: a challenge for neuroscience and medicine. *Behavioral and Brain Sciences*,

- Feb;30(1):63-81; discussion 81-134.
<https://www.ncbi.nlm.nih.gov/pubmed/17475053>
- Muehsam D, Ventura C, 2014. Life Rhythm as a Symphony of Oscillatory Patterns: Electromagnetic Energy and Sound Vibration Modulates Gene Expression for Biological Signaling and Healing. *Glob Adv Health Med.* 3(2):40-55. doi: 10.7453/gahmj.2014.008
- Nagel T. Minds and Cosmos, 2012, Why the materialist neo-darwinian conception of nature is almost certainly false,; Oxford Univ. Press. New York
- Nahn et al., 2017. Discrepancy Between Cerebral Structure and Cognitive Functioning: A Review *Journal of Nervous & Mental Disease* 205(12):967-972
- Nation P, Jahansson J, Blencowe M, and Nori F. 2012. Stimulating uncertainty: amplifying the quantum vacuum with superconducting circuits. *Review of Modern Physics*; 81(1):1.
- Papasimakis N, Fedotov VA, Savinov V, Raybould TA, Zheludev NI, 2016. Electromagnetic toroidal excitations in matter and free space, *Nature Materials*; 15: 263–271, doi:10.1038/nmat4563.
- Penrose R. and S. Hameroff, 2011. Consciousness in the Universe. *Journal of Cosmology* 14 (URL <http://journalofcosmology.com/Consciousness160.html>).
- Penrose R, 2014. On the Gravitization of Quantum Mechanics 1: Quantum State Reduction". *Foundations of Physics*; 44: 557–575.
- Pereira A, 2007. Astrocyte-Trapped Calcium Ions: the Hypothesis of a Quantum-Like Conscious Protectorate. *Quantum Biosystems*; 2: 80-92
- Pereira A, Furlan F. A. 2007. Biomolecular Information, Brain Activity and Cognitive Function. In: *ARBS Annual Rev of Biomedical Sciences*. 9:12-29.
- Pereira A, Nunn C, Pregnotato M, Nixon G, 2018. Consciousness and Cosmos. Building an ontological framework. *Journal of Consciousness Studies*, 25(3-4), 181-205
https://www.researchgate.net/publication/319632327_Consciousness_and_Cosmos_Building_an_Ontological_Framework
- Pereira A, 2007. Astrocyte-Trapped Calcium Ions: the Hypothesis of a Quantum-Like Conscious Protectorate. *Quantum Biosystems*; 2: 80-92.
- Pereira C, 2015. Electromagnetic Radiation, a Living Cell and the Soul, A Collated Hypothesis. *NeuroQuantology*; 13: 426-438.
- Pereira C, Reddy JSK, 2016. Near-Death Cases, Non-locality/ Disembodiment via Quantum Mediated Consciousness. *J. Consciousness Exploration & Research*; 7: 951-968.
- Peterson JPS, Sarthour RS, Souza AM, Oliveira I S, Goold J, Modi K, Soares-Pinto DO, Céleri LC. 2016. Experimental demonstration of information to energy conversion in a quantum system at the Landauer limit. / *Proceedings of the Royal Society A-Mathematical Physical and Engineering*.
<https://royalsocietypublishing.org/doi/10.1098/rs.pa.2015.0813>
- Picato D, 2017. A spacetime discretization and black holes properties in a holographic representation.
[iv:1703.10795](https://arxiv.org/abs/1703.10795)
- Pizzi R, Gelain F, Vescovi A, 2004. Nonlocal correlations between separated neural networks *Proceedings of SPIE - The International Society for Optical Engineering* 5436:107-11
- Pockett S, 2012. The electromagnetic field theory of consciousness: a testable hypothesis about the characteristics of conscious as opposed to non-conscious fields. *Journal of Consciousness Studies*; 19 (11-12): 191-223.
- Pockett S, 2013. Field theories of consciousness. *Scholarpedia*; 8: 4951.
- Popławski NJ, 2010. Radial Motion into an Einstein-Rosen Bridge. *Physics Letters B* 687 (2-3): 110, DOI: [10.1016/j.physletb.2010.03.029](https://doi.org/10.1016/j.physletb.2010.03.029)
- Popp, F A., Quao, G., Ke-Hsuen, L, 1994. Biophoton emission: experimental background and theoretical approaches, *Modern Physics Letters B*, 8 (21-22).
- Popp F A, Chang JJ, Herzog, A, Yan Z, Yan Y, 2002. Evidence of non-classical (squeezed) light in biological systems. *Physics Letters A*, 293(1-2): 98-102.
- Pourhasan R, Afshordi N, Mann RB, 2013. Out of the White Hole. The Holographic Origin for the Big Bang. *arXiv:1309.1487v2 [hep-th]* 22 Sep.
- Preparata G, 1992. "Coherence in QCD and QED" in "Common Problems and Ideas of Modern

- Physics". T. Bressani, B. Minetti and A. Zenoni eds., World Sci., Singapore () p. 3.
- Preto J, 2016. Classical Investigation of Long- Range Coherence in Biological Systems. *Chaos*.
- Radin D, 1997. *The Conscious Universe. The Scientific Truth of Psychic Phenomena*. New York, , HarperEdge.
- Radin DI, 2004. Event-related electroencephalographic correlations between isolated human subjects. *J Altern Complement Med*;10(2):315-23.
- Rezzolla L, Yoshida, S, Maccarone T J and Zanotti O. 2003. A new simple model for high-frequency quasi-periodic oscillations in black hole candidates. *Monthly Notices of the Royal Astronomical Society*; 344(3):L37-L41.
- Richards TL, Kozak L, Johnson LC, Standish LJ, 2005. Replicable functional magnetic resonance imaging evidence of correlated brain signals between physically and sensory isolated subjects. *J Altern Complement Med*;11(6):955-63.
- Roth, G., 2015. Convergent evolution of complex brains and high intelligence. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 370(1684), p.20150049. (The article itself: <https://www.ncbi.nlm.nih.gov/pmc/article/PMC4650126/pdf/rstb20150049.pdf>)
- Rouleau N, Dotta B T, 2014. Electromagnetic fields as structure-function zeitgebers in biological systems: environmental orchestrations of morphogenesis and consciousness. *Frontiers in Integrative Neuroscience*.;8:84.
- Rousseau D, 2011, Understanding spiritual awareness in terms of anomalous information access. *The Open Information Science Journal*; 3: 40-53.
- Rovelli C, Smolin L. 1990. Loop space representation of quantum general relativity *Nuclear Physics B* 331, 80-152
- Samal S and Geckeler. K. E. Unexpected solute aggregation in water on dilution. *Chem Commun (Camb)*. 2001 Nov 7;(21):2224-5.
- Sasal S, Boly M, Mensen A, Tononi G. Functional split brain in a driving/listening paradigm, 2016; *Proc Natl Acad Sci U S A*. 2016; Dec 13;113(50):14444-14449, Epub Nov 28. <https://www.ncbi.nlm.nih.gov/pubmed/27911805>
- Sbitnev V I, 2016 a. Dark matter is a manifestation of the vacuum Bose-Einstein condensate URL <https://arxiv.org/pdf/1601.04536.pdf>
- Sbitnev V I. 2016 b. Quantum Consciousness in Warm, Wet, and Noisy Brain. *Modern Physics Letters B*.;30 <https://arxiv.org/abs/1606.00258>
- Sbitnev, V I , 2016c. Hydrodynamics of the physical vacuum: I. Scalar quantum sector, *Foundations of Physics*, vol. 46, no. 5, pp. 606-619 <https://arxiv.org/abs/1504.07497>
- Schrödinger, 1967. *What is Life?* Cambridge Press https://archive.org/details/WhatIsLife_201708
- Schwartz J M, Stapp H, and Beauregard M, 2005. Quantum physics in neuroscience and psychology: a neurophysical model of mind–brain interaction. *Phil. Trans. R. Soc. B* **360**, 13091327
- Seed A, Emery N. and Clayton N, 2009. Intelligence in corvids and apes: a case of convergent evolution?. *Ethology*, 115(5), pp.401-420.
- Setterfield B. 2002. *Exploring the Vacuum*. J Theoretics <http://www.setterfield.org/exploringvacuum.htm>
- Sieb RA, 2016. Human Conscious Experience is Four-dimensional and has a Neural Correlate, Modeled by Einstein's Special Theory of Relativity. *NeuroQuantology*; 14, 630-644.
- Sirag SP, 1993. Consciousness, a hyperspace view,; <http://www.williamjames.com/Theory/Consciousness.pdf>.
- Smolin L, (2013). *Time Reborn*. <https://www.amazon.com/Time-Reborn-Lee-Smolin/dp/0544245598>
- Smythies J, 2003. Space, Time & Consciousness – *Journal of Consciousness Studies*; 10, (3): 47-5.
- Standish LJ, Kozak L, Johnson LC, Richards T. 2004. Electroencephalographic evidence of correlated event-related signals between the brains of spatially and sensory isolated human subjects. *J Altern Complement Med*;10(2):307-14.
- Stapp, H. (2012). "Reply to a Critic: "Mind Efforts, Quantum Zeno Effect and Environmental Decoherence". *NeuroQuantology* 10 (4): 601-605.
- Sullivan PR, 1995. Contentless consciousness and information processing theories of mind. *Philosophy, Psychiatry & Psychology*; 2: 51-59.

- Susskind L, 2016. Copenhagen vs Everett, Teleportation, and ER=EPR.
- t'Hooft G A. 2016. Fundamental Theories of Physics, The Cellular Automaton Interpretation of Quantum Mechanics.;185.
- t'Hooft G A, 2007. Mathematical Theory for Deterministic Quantum Mechanics. Journal of Physics: Conference Series.;67.
- Tammietto M, de Gelder B, 2010. Neural basis of the non-conscious perception of emotional signals. Nature Reviews Neurosciences; 1-13
- Tamulis A, 2011. Grigalavicius, M, Quantum entanglement in photoactive prebiotic systems. Orig Life Evol Biosph 41:51-71.)
- Tonegawa S, Pignatelli M, Roy D S, Ryan TJ, 2015. Current Opinions in Neurobiology; 35: 101-109
- Tononi G, 2008. Consciousness as Integrated Information: A Provisional Manifesto. Biol. Bull.; 215: 216-242.
- Tononi G, Boly, M, Massimini M, Koch C, 2016. Integrated information theory: from consciousness to its physical substrate. Nature Reviews Neuroscience; pp 1-12.
- Tononi G, Koch C, 2015. Consciousness: here, there and everywhere? Philosophical Transactions R. Soc.; 370.
- Toyabe S, 2015. Supplementary information for information heat engine: converting information to energy by feedback control; arXiv:1009.5287v2 [cond-mat.stat-mech]
- Tozzi A, Peters JF, 2015. Brain Activity on a Hypersphere. Quantitative Biology Neurons and Cognition.; arXiv:1512.00036 [q-bio.NC].
- Tozzi A, Peters JF, 2016b. Towards a fourth spatial dimension of brain activity. Cognitive Neurodynamics; 10 (3): 189-99 PMID: 27275375.
- Tozzi, A. and Peters, J. 2017. Plasma-Like Brain: Collective Movements in the Extracellular Nervous Spaces. https://www.researchgate.net/publication/304777768_PLASMALIKE_BRAIN_COLLECTIVE_MOVEMENTS_IN_THE_EXTRACELLULAR_NERVOUS_SPACES
- Tranter GE, 1985. Parity-violating energy differences of chiral minerals and the origin of bio molecular homochirality. Nature.;318:172–173.
- Tsytoich VN, Morfill GE, Fortov VE, Guseinzade NG, Klumov BA, Vladimirov SV, 2007. From plasma crystals and helical structures towards inorganic living matter. New Journal of Physics; 9.
- Tzambazaki A, 2015. The evolution of the biological field concept. https://emmind.net/openpapers_repos/Endogenou_s_Fields-Mind/General/EM_Various/2015_The_evolution_of_the_biological_field_concept.pdf
- Van Gordon, W., Shonin, E., Dunn, T. J., and Griffiths, M. D. (2017). Meditation awareness training for the treatment of fibromyalgia syndrome: a randomized controlled trial. *Br. J. Health Psychol.* 22, 186–206. doi: 10.1111/bjhp.12224
- Verlinde EP, 2016. Emergent gravity and Dark Universe; <https://arxiv.org/abs/1611.02269>
- Vasiliev B V, 2013. Superconductivity and superfluidity URL <http://arxiv.org/abs/1008.2691>.
- Vasiliev B V, 2015. Superconductivity and Superfluidity (Science Publ. Group, N. Y.).
- Verlinde E P, and Zurek K M, 2019. Observational signatures of quantum gravity in interferometers. <https://arxiv.org/abs/1902.08207>.
- Verlinde EP. 2011. On the Origin of Gravity and the Laws of Newton; JHEP. [arXiv:1001.0785](https://arxiv.org/abs/1001.0785) Bibcode:2011JHEP...04..029V. doi: 10.1007/JHEP04(2011)029.
- Vitiello G, 2001. My Double Unveiled: The Dissipative Quantum Model of Brain.; John Benjamins Publishing.,
- Wackermann J, Seiter C, Keibel H, Walach H, 2003. Correlations between brain electrical activities of two spatially separated human subjects. *NeurosciLett.* ;336(1):60-4.
- Walker S I and Davies P C W. 2013. The Algorithmic Origin of Life. Journal of the Royal Society Interface.
- Wang Ch, Bokkon I, Dai J, Antal I. 2010. Spontaneous and visible light-induced ultra-weak photon emission from rat eyes. *Brain Res.*; DOI: 10.1016/j.brauinres.2010. 10.077\

- Wang X.-J., 2010. Neurophysiological and Computational Principles of Cortical Rhythms in Cognition," *Physiol Rev.*, vol. 90, no. 3, pp. 1195-1268
- Wang, Z, Wang N, Li Z, Xiao F, Dal, J, 2016. Human intelligence is involved in spectral redshift of biophotonic activities in the brain. *PNAS* ,113, 8753-8758
- Werner G, 2010. Fractals in the nervous system: conceptual implications for theoretical neuroscience URL <https://arxiv.org/abs/0910.2741>.
- Wesson PS, 2014. Looking for the fifth dimension. *Physics International*; 5: 5-7.
- Wolf FA, 1989. On the Quantum Physical Theory of Subjective Antedating. *J. Theor. Biol*; 136: 13-19.
- Wolf FA, 1985. The Quantum Physics of Consciousness: Towards a New Psychology. *Integr. Psychiatry*; 3:235: 4-25,
- Wolf FA. 2006. Why nerve cells work faster than the theories allows,; <https://www.mpg.de/535717/pressRelease20060418>.
- Wolf-Meyer M and Cochran C, (2015). Minor science. Unifying minor sciences and minor literatures: Reproduction and revolution in quantum consciousness as a model for the anthropology of science. *Anthropological Theory*, Volume: 15, issue: 4, page(s): 407-433 <https://journals.sagepub.com/doi/abs/10.1177/1463499615615739>
- Wolynes, P.G. (2015) Evolution, Energy Landscapes and the Paradoxes of Protein Folding. *Biochimie*, **119**, 218-230. <https://doi.org/10.1016/j.biochi.2014.12.007>
- Zioutas K. 1996. On the interaction of extreme-low-frequency (ELF) radiation with living matter's coherent spiral states. arXiv:patt-sol/9601001v1.