

Consciousness in the Universe is Tuned by a Musical Master Code, Part 3: A Hydrodynamic Superfluid Quantum Space Guides a Conformal Mental Attribute of Reality.

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In Part 3 of this review we postulate a field-receptive workspace, associated with the brain, that integrates past and (anticipated) future events and may explain ultra-rapid brain responses as well as the origin of qualia (see also part 1 and 2). Information processing in the brain is shown to be largely facilitated by propagation of hydronium (proton/water)-ions in aqueous compartments. The hydronium ions move freely within a hexagonally organized H₂O lattice, providing a superconductive integral brain antenna for receiving solitonic wave information. A nonlinear Schrödinger equation describes the quantum aspects of the transfer of wave information mediated by H⁺ and Ca²⁺ ion flux over long distances at cerebrospinal, inter-neuronal and gap junction spaces. The latter processes enable ultra-rapid soliton/biophoton fluxes that may orchestrate overall brain binding and the creation of coherent conscious states. In a cosmological context, we envision a scale invariant information processing, operating through a toroidal/wormhole mediated information flux. Our concept touches upon the earlier postulated hard problem in consciousness studies. This implies an intrinsic cosmic connectivity that is mirrored in the human brain. The assumed hydrodynamic superfluid background field is proposed to guide the ongoing fabric of reality through a quantum metalanguage that is instrumental in the manifestation of universal consciousness, of which human consciousness is an integral part. The present concept is compared with currently available theories in consciousness studies and finally put into perspective of an integral model for the fabric of reality.

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 (EPR) phenomenon, David Bohm

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7. Quantum Consciousness Is Steered by Hydrodynamic Mechanisms from a Superfluid Quantum Space

In the following section we will pay attention to question how our brain may communicate with cosmic fields such Zero-point energy/Superfluid quantum space, as previously treated in section 3.2. We argue that consciousness is partly *received* from quantum wave information derived from these fields in a bi-directional interaction with our organism and here we address the potential physical mechanisms involved. This implies that we should identify the potential field receptive medium in and around brain tissue, according to quantum mechanical principles. This serves two major problems in current understanding of neurology and brain physiology: the origin of so-called qualia and the supposed broadcasting functions of neural networks that may explain the binding of distant brain nuclei (Baars et al., 2013). The assumed broadcasting mechanism should afford an instantaneous integration of the various sensory input that underlies our integral observation of the world around us. However, the physiological or biophysical process responsible for such broadcasting has not been identified until now, although a field type of mechanism seems plausible.

As mentioned earlier, we hypothesize the permanent involvement of photon- and phonon-dressed fermions such as electrons and protons (of which the quasi-particle soliton is one example). We hold that these are crucial in the function of our entire organism, with special reference to our brain (Meijer and Geesink, 2016, 2017, 2019b). The necessity to involve such a special mechanism has various backgrounds: a) to be able to deal with the ultra-rapid brain responses that are not compatible with the relatively slow synaptic process of neurotransmission (Cacha and Poznanski, 2015), b) in order to explain the abovementioned binding and synchronicity phenomena in brain function c) to understand the unexpected cognition capabilities of patients with severe brain damage (section 5.8), and d) to address the presently unexplained

subjective experiences in the category of Psi phenomena. All of these phenomena point to some kind of *ultra-rapid communication at a distance* in brain tissue and/or between different individuals. This may also be related to a non-local connection of humans to some kind of information domain that may explain phenomena such as precognition and near-death experiences.

We stipulate that our hypothesis does not deny current models of neuronal transmission: it is rather meant as a complementary, but essential, aspect. Alternatively, the structures that underlie neuronal function may be involved in brain function in another manner than the classical neural mechanisms generally assume. As mentioned before, Georgiev and Glazebrook (2018) presented an intriguing model of synaptic communication, in which quantum tunneling on the basis of solitonic interactions with SNARE protein complexes at synaptic vesicles is essential. The latter seems a modern version of the earlier presented brain model of Beck and Eccles (1998).

We hold that biological evolution may have selected all available biophysical processes for intra- and inter-cellular communication. In this respect, a “Two-Brain hypothesis” was postulated earlier by Goodman et al (2015): postulating an electro-ionic modality, related to the well-known neuro-humoral transmission, and another that may be rather electromagnetic field-based. The latter could be related to (bio)photon transmission that is *extrinsic* to classic neuronal brain circuitry. Implicit in the latter photon-mediated mechanism, is the particular speed of the process with inherent rates that are many orders of magnitudes higher than that of chemical neurotransmission. Also, it remains in principle possible that the quantum field type of transmission uses material elements that are also instrumental in classical circuitry. For example, it has been proposed that connective tissue/water assemblies may afford superconductive properties (Ho, 2012) and that myelin-based white matter in brain may

function as optical wave guide (Kumar et al, 2016).

In any event, we should also take into account that the study of mental aspects of brain function and consciousness may require aspects of entanglement, non-locality and wave coherence, not offered by classical physics. Of note, such phenomena are experimentally demonstrated now in various cellular processes in Quantum Biology. Such processes also open the potential for top-down and retro-causal elements, as well as wave mediated action at a distance. They also invite a less reductionistic and more holistic top-down approach in the study of life in a cosmic context (Schwarz, 2019).

7.1 The Potential Role of Microtubules in Neurons

How consciousness arises from physical or material activity in the brain was, as earlier mentioned, framed as the hard problem in the study of consciousness (Chalmers, 1995; Nader, 2004). A radical solution involving quantum measurement as a process of consciousness was proposed by Stuart Hameroff, together with Roger Penrose. Their model (Orchestrated Objective Reduction: Orch OR (Hameroff and Penrose, 2014) (Fig.17), suggests that quantum superposition and a form of quantum computation occur in microtubules, that form cylindrical protein lattices of the cell cytoskeleton within the brain's neurons. Of note, microtubules are actually present in all cell-types of our body and not only in brain. Here the microtubules play a role of detectors on which a collapse of wave functions is somehow executed. According to that theory, the latter involves a crucial "fitting modality" related to quantum gravity on the Planck-scales of spacetime geometry. Their conjecture is that there is an orchestrated connection between wave collapse in the brain's biomolecular processes and this deepest basic structure of the Universe.

We agree with this cosmic connectivity aspect, but the present theory of a zero-point guided EMF background field, based on a

holographic memory workspace context, in principle, does not require wave collapse *per se* for creation of conscious moments.

As soon as the "Orch OR" model was published, it was severely criticized by Tegmark, (2000), whose primary remarks concerned the following egregious discrepancies: (a) the collapse of the wave function is much shorter than that of relevant dynamic timescales of neuron firings; and (b) the wet warm brain, working at room temperature, cannot provide supporting quantum computations. Thermal noise of the brain would, in his opinion, completely exclude such delicate computations. This criticism, however, was later extensively and quite satisfactorily addressed (Hagen et al, 2002).

It is important to note that the microtubule hypothesis was experimentally supported by the innovative studies in Anirban Bandyopadhyay's group (Agrawal et al., 2017, 2018; Sahu et al., 2013, 2015). In the latter studies, it was shown in life visualizations of processes in living systems, that self-assembly of tubular proteins can be obtained under the influence of discrete EMF frequencies in the kHz, MHz and GHz ranges and that many of the registered resonance peaks of tubulins seem compatible with the earlier treated fractal GM-scale revealed by us (Meijer and Geesink, 2019b).

It is of great interest that these authors found clear evidence for a fractal information theory-derived geometric musical language, that may guide brain-inspired hypercomputing as a basic phenomenon underlying consciousness, (see section 4), a concept that is very much in line with the concepts in of the present paper. Taking into account the earlier mentioned criticisms, let us look at the Hameroff-Penrose theory from another side: the side mentioned by Tuszynski, (2014).

By inspecting the Hameroff-Penrose solution on the central role of oscillating microtubular proteins, an enormous matrix of oscillating tubular elements is occupying the whole brain, especially if other organelles such as mitochondria and nuclear DNA are involved at the same time.

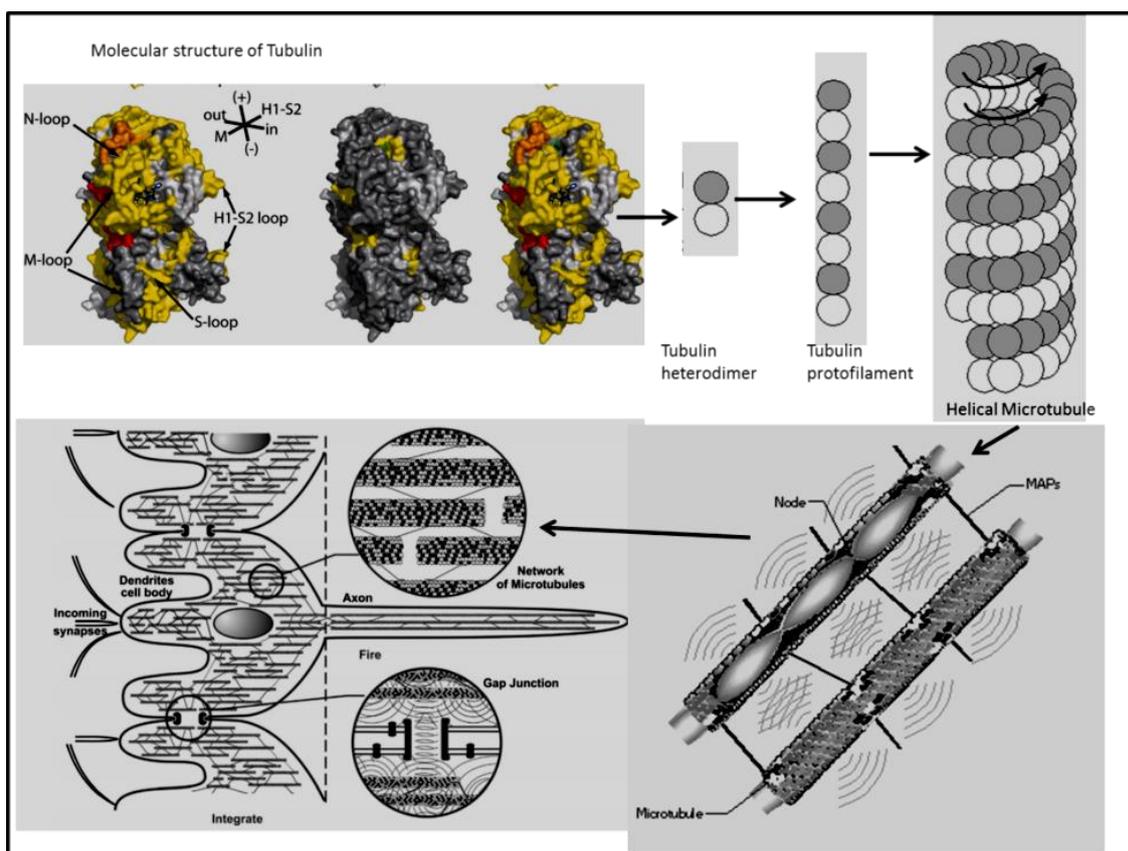


Figure 17. An 'integrate-and-fire' brain neuron and parts of other such neurons are shown schematically with internal microtubules interconnected by microtubule-associated proteins. The figures are taken from (Hameroff, 1998).

This entire vibratory machinery is embedded everywhere in the brain in the intracellular water. In the present study, however, we also emphasize the importance of cerebral and interstitial fluids, that in concert with coherent water domains in the cells, could be involved in the guiding of consciousness originating from realms outside the brain. Interestingly, micro-tubuli, in this context, are not only 'scaffolding' instruments of cells but may also serve as warehouse for memory and memristors (Chua, 1971; 2011), as instrumented by heavy ions, such as *calcium ions*. In the past (Meijer and Raggett, 2015), but also more recently, a number of attractive quantum brain models have been proposed (see later, table 2 and 3), that are at least partially compatible with the present model (Fig. 18, below).

7.2 Water Configurations and the Wave Antenna Role of Protons

Living brain is a biological organ which operates in a slightly salty liquid environment at room temperature. Most widespread chemical substance in the living body is liquid water (Chaplin, 2016, Geesink, Jerman and Meijer, 2019b).

Water is the main liquid medium in the brain, where important events related to consciousness occur. Although dendrites and axon terminals of neurons of the brain penetrate through the whole brain space densely, there are spaces relatively free of the nervous filaments. These spaces are ventricles of the brain filled by the cerebral liquid. As treated in section 5.8, in medical practice, there is a peculiar case in which a 44-year-old patient with postnatal hydrocephalus of an unknown cause (Feuillet et al, 2007). Magnetic resonance imaging (MRI) showed that his brain had hypertrophied brain ventricles (Fig. 19 D).

The deficit of the filamentous organization demonstrates massive enlargement of the

lateral, third, and fourth ventricles, with a very thin cortical mantle and a posterior fossa cyst.

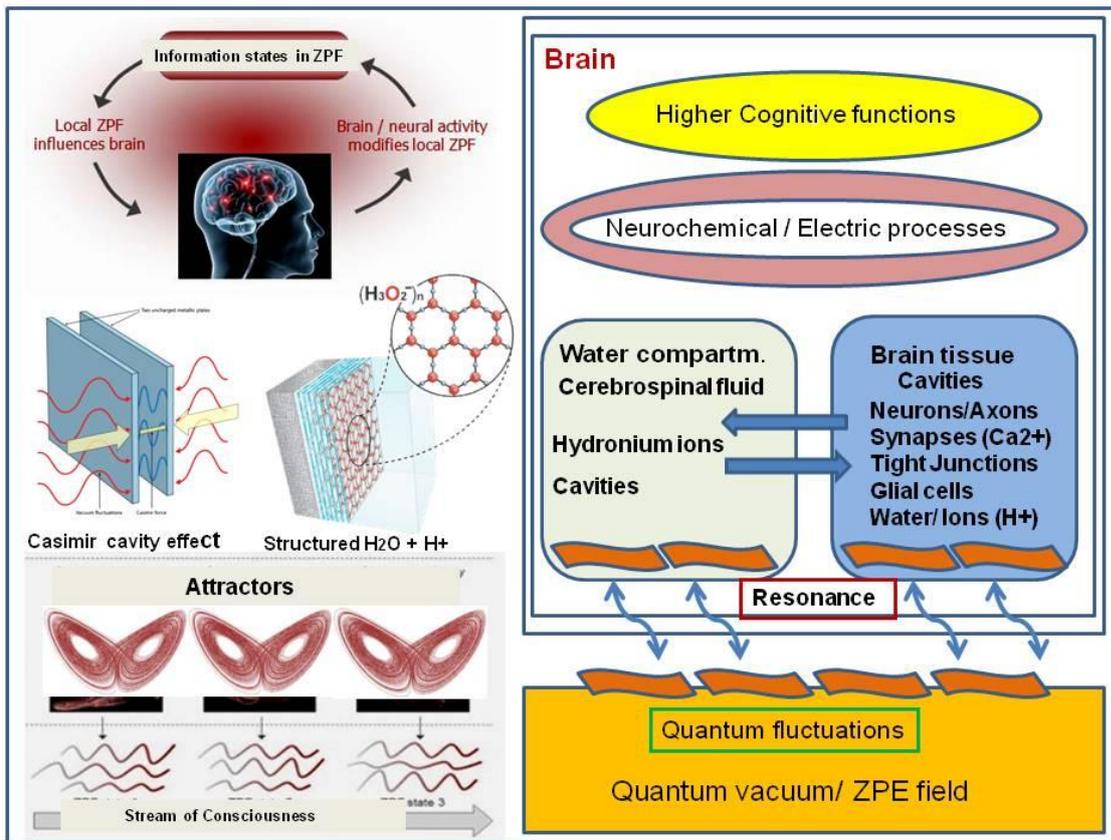


Figure 18: Model for wave-coherence-mediated conscious states: The brain water compartment functions as a receiver and conduit for discrete quantum wave frequencies via (i) excitation of hydronium ions in brain fluids that promote coherent domains in structured water (inset middle right) and other interacting cavity modalities or (ii) through cyclotron EM wave activity resulting in perturbation of delocalized ions such as Ca^{2+} in dedicated channel proteins, that through vibratory states can become quantum entangled. Both these events are leading to syntropic flow of information and increased functional binding and synchronization of neuronal centers that are known to promote conscious states. Information is, apart from the known senses, obtained by quantum resonance with the vacuum (zero-point energy field) and in the non-linear organized brain produced attractors that are the building blocks of conscious states (see Fig 18, left).

Surprisingly, however, this patient possessed quite normal social functions, and exhibited an intelligence quotient (IQ) of around 75. This example provides an indirect hint that the cerebral liquid, a slightly brackish water, may have a direct relationship to cognitive functions of the brain.

We assume that the proton plays an important role in the transport of subcritical information through the brain liquid. At room temperature, the liquid water consists of many fluctuating hydrogen-bonded clusters (Chaplin, 2016). The hydrogen bond is strong enough to maintain the coupling of atoms during some

time under thermal fluctuations. As treated above, water can be depicted as consisting primarily of a mixture of clusters of water molecules with different degrees of hydrogen bonding in an equilibrium. Under thermal fluctuations, some hydrogen couplings are broken but other arise.

On average, the equilibrium distribution of different cluster sizes is maintained. Fig.20, illustrates the hydrogen-bonded chain mechanism (DeCoursey, 2003), called the Grotthuss mechanism, by means of which protons tunnel from one water molecule to the next via hydrogen bonding (Chaplin, 2016;

Hassanali et al, 2013). Consciousness may arise through information transfer to this structured water from the ZPE-field.

It can be shown that the thermal action parameter of a proton ($b=kBT\delta\tau$) is in the same order of magnitude as the Planck constant, h . (Sbitnev 2016). With k_B =Boltzmann constant= $1.38E-23$ J/K, T =temperature= 298 K, $\delta\tau$ =lifetime of a Hydronium ion = $2E-13$ s, $b=8.2E-34$ J.s vs h =Planck constant = $6.6 E-34$ J.s. This means, that the hydrogen ion may behave itself as a particle, exchanging its energy permanently with the vacuum zero-point energy and also with brain water. In other words, the hydrogen ion can act as an intermediary

between the physical vacuum (i.e., the superfluid quantum space) and the water environment of the brain (Sbitnev 2016). The quantum mechanical zero-point energy is also mentioned by Beck and Eccles, in their article (Beck and Eccles, 1992) entitled "Quantum aspects of brain activity and the role of consciousness".

The mobility of the hydrogen ion in water leads to an average lifetime of $2 \cdot 10^{-13}$ s (Bell, 1959, 1973). Hydrogen ion, that is a proton, is considered here as a bit of information transmitting across the cerebral liquid of brain by the Grotthuss mechanism (Chaplin, 2016), (see Fig. 20).

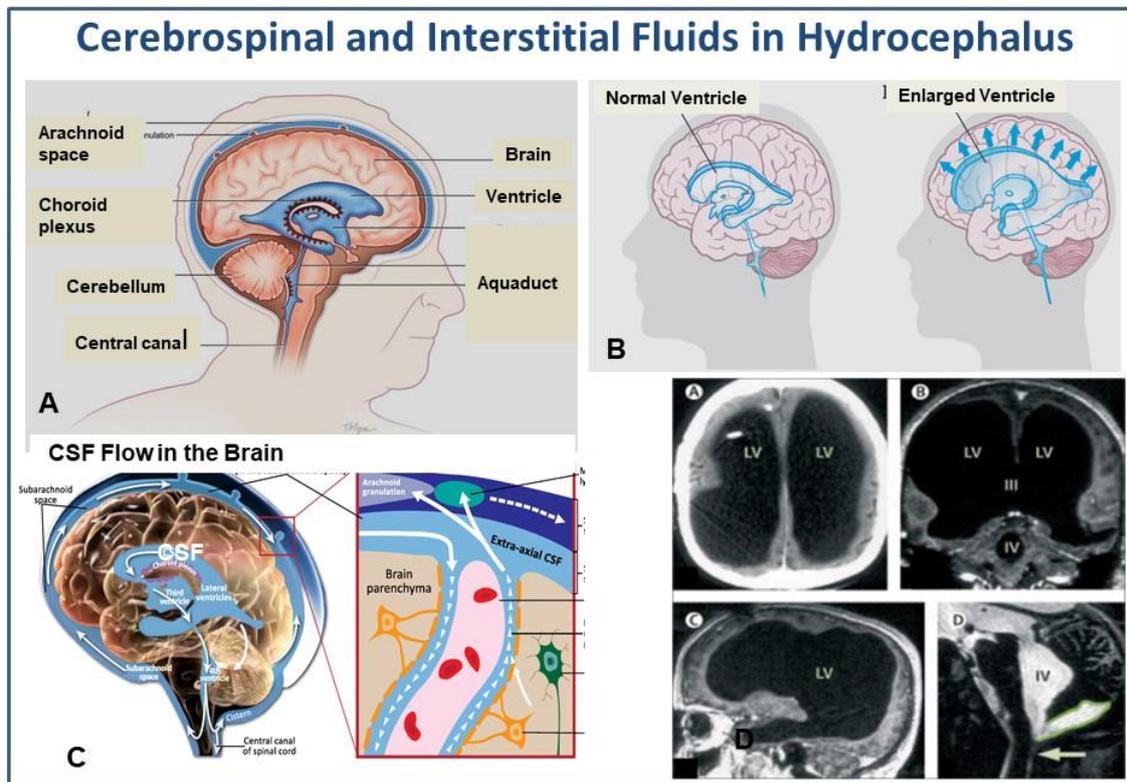


Figure 19: A: Cerebrospinal fluid compartments within and surrounding brain. B: Enlarged ventricle compresses brain tissue. C: Circulation of cerebrospinal fluid and contact with interstitial fluid. D: Massive ventricular enlargement, in a patient with normal social functioning: (A), (B), (C) MRI with gadolinium contrast at different cross-sections; (D) T2-weighted MRI. LV=lateral ventricle. III=third ventricle. IV=fourth ventricle. Arrow points to Magendie foramen. The posterior fossa cyst is outlined in (D). The figure is taken from Feuillet et al. (2007), see also section 5.8.

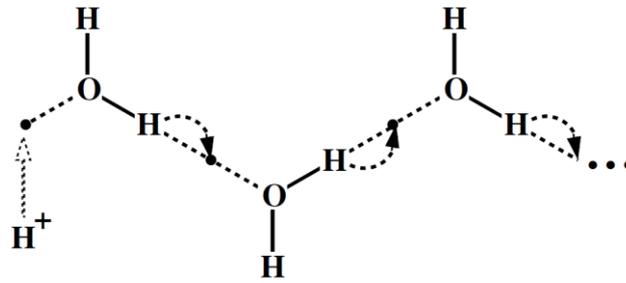


Figure 20: Diagram illustrating the hydrogen-bonded chain mechanism for proton migration (Grotthuss mechanism): a proton enters the chain from the left side and then, as a result of the series of proton hops indicated by the arrows, a proton exits the chain on the right side. This chain represents a hydrogen-bonded 'water wire' (Chaplin, 2016).

The mass of the quasi-particle, which they assumed in their article, was in the range of the mass of the hydrogen atom. Besides, they noted that the thermal energy $k_B \cdot T$ of external environment ($T = 298$ K) expressed in units of the electron-volt lies in the range of voltages where neurons operate.

$$E_\epsilon = k_B T / e \approx 26 \text{ mV.}$$

It means that thermal noise may have an impact on the electric activity of nerve cells. It is instructive, to draw attention in this article, to the time of the metastable instability of electronic transition, τ , evaluated by the authors to be about $10^{-13} - 10^{-14}$ s. Their estimation shows a relatively good agreement with the average lifetime of the hydrogen ion, $\delta\tau = 2 \times 10^{-13}$ s.

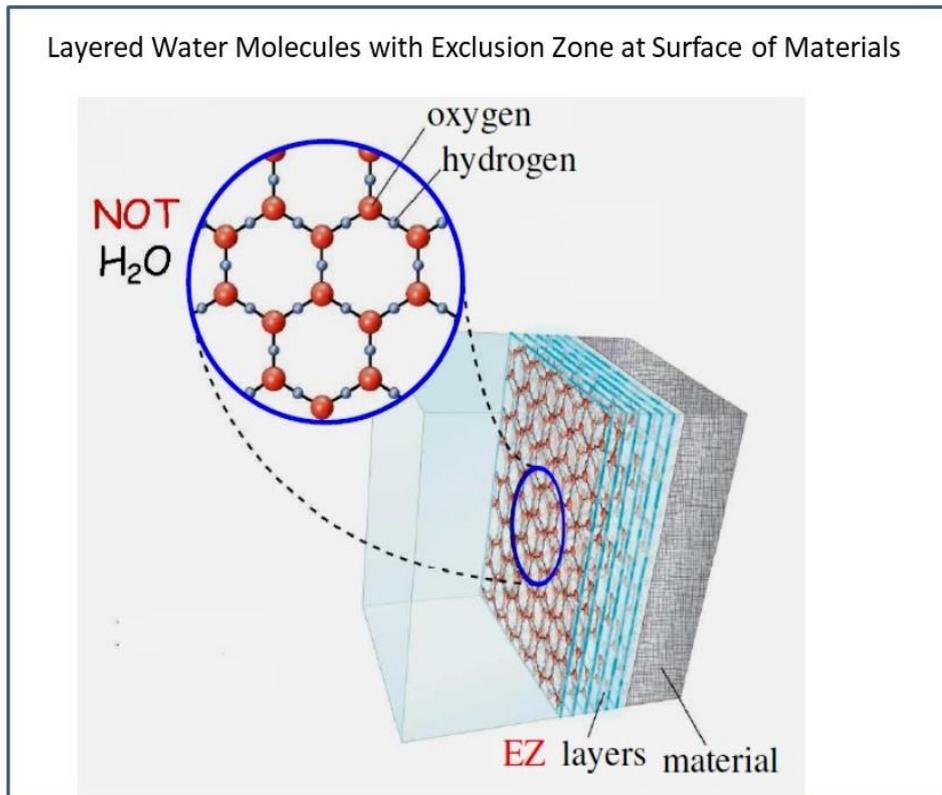


Figure 21. The "fourth phase of water" that can be found close to hydrophilic surface represents the ordering of the water molecules by a hexagonal lattice (Pollack, 2013).

In the transport of protons, the so-called exclusion zone (EZ) phase of water could play a significant role; see Fig. 4 and 21. This special "fourth phase" of water arises near hydrophilic surfaces that abound in living tissues. Water molecules are ordered into hexagonal lattice (Fig. 21), and the exclusion zone (EZ) water (Pollack, 2013) expels any foreign inclusions so that EZ water molecules are more constrained (see also sections 2.3; 3.1 and 3.2). An assembly of EZ water molecules is more stable. EZ has negative charge, which is friendly to the resting membrane potential of neural cells. EZ absorbs light at the wavelength around 270 nm. These unique properties make the water a perfect conductor of the hydrogen ions through itself by the Grotthuss mechanism (Agnom, 1995, see Fig. 20 and 22; Peng et al, 2015).

The hydronium ion can obtain a *soliton character*, since when moving along some surface it scrolls a mass of matter composed of a substrate along with it during this moving. In other words, the soliton can obtain a *torque mode*. If its core carries a charge, for example, the positive charge of the hydrogen ion, then due to the torque it is covered by a coat of negative charges. In particular, due to this coat, the soliton lives longer than with a naked charge. Surprisingly, excess protons can create their own pathways, 'water wires', before protons can migrate along (Peng et al, 2015).

Here we will try to understand what pathways are available for the moving protons. As was noted above, a main mechanism is the Grotthuss one, that can be effective when water is in the "fourth phase" as expected to exist near the countless subcellular structures and the cellular membrane of neurons as well as in the brain fluid molecular material. In that case, water molecules are predominantly arranged according to the hexagonal symmetry (Fig. 22).

As shown in Fig. 22(a) the hexagonal symmetry can provide an eightfold path for the hydrogen ion entering on a hexagon configuration assembled from water molecules. At the beginning, the hydrogen ion enters the right hexagon at the node *a* and hops along it around central point *A* clockwise. Then, upon

reaching node *a*, the hydrogen ion begins to hop along the left hexagon around center point *B* in a counterclockwise manner. Upon reaching node *b*, the hydrogen ion re-enters the right hexagon, and so forth.

Each eightfold path corresponds to two oppositely oriented vorticities $\vec{\omega}$ that change the orientation after the completion of each cycle; see Fig.22(b). This illustration shows the following sequence of changing the vorticity sign. Initially, the hydrogen ion hops along the left hexagon in a clockwise manner. The vorticity $\vec{\omega}$ is represented by the blue arrow. At the transition to the left hexagon at the node *a*, the hydrogen ion begins to hop in the counterclockwise way. The vorticity $\vec{\omega}$ corresponding to this motion gets the opposite orientation (the same blue arrow oriented in the opposite direction). After completing the motion along the left hexagon, the hydrogen ion in node *b* enters again the right hexagon and begins to hop along it. The vorticity orientation remains (red arrow). After completing the motion on the right hexagon, the hydrogen ion, in node *a*, again passes to the left hexagon. The orientation of the vorticity changes sign to the opposite direction (the same red arrow oriented in the opposite direction).

As a result, we have the following pattern: (a) the eightfold path along EZ water molecules consist of oscillating dipoles in time due to the change of vorticity. (b) We note that arrows drawn on tips of the green dotted lines in Fig. 22(b) point to flow of time. (c) The dipoles exchange the orientations in the tract with oscillations that fluctuate in time. (d) If the EZ water contains many such eightfold paths working synchronously, then this EZ water plate can work as a *multi-slot emitter-receiver of the electromagnetic field* (multi-slot interferometer).

For comparison we show, in Fig. 23, the organization of the gravitomagnetic and magnetic fields taken from the book of Ignazio Ciufolini and John Archibald Wheeler entitled "gravitation and inertia" (Ciufolini and Wheeler, 1995).

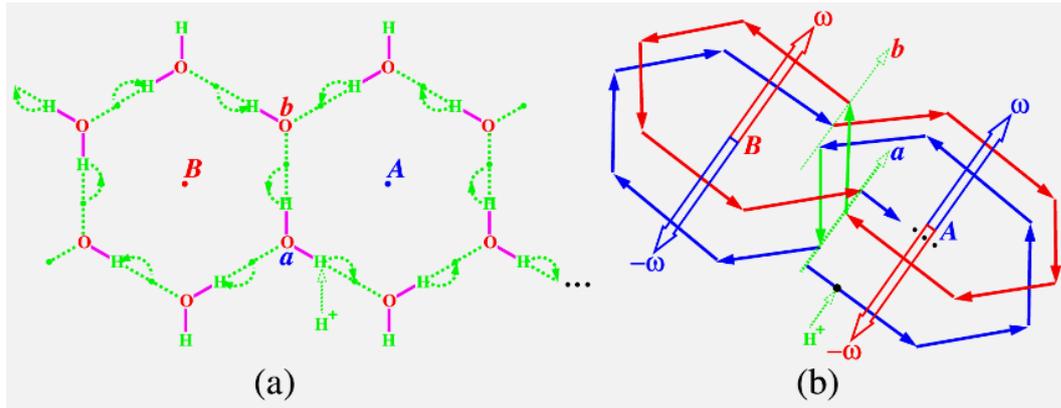


Figure 22: Hydrogen ion hopping along two EZ water hexagonal structures: (a) a general organization of EZ water consisting of two hexagons; (b) dynamics of the hydrogen ion hopping along two hexagons.

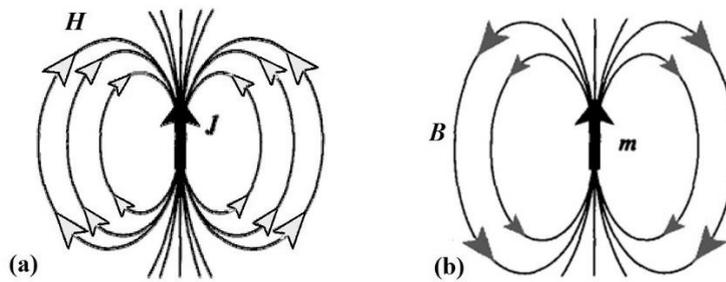


Figure 23: The directionalities of gravito-magnetism and magnetism compared and contrasted [51]: (a) the gravitomagnetic field \vec{H} in the weak field approximation, \vec{J} is the angular momentum of the central body; (b) the magnetic induction \vec{B} in the neighborhood of a magnetic dipole moment \vec{m} .

One can see that these fields have opposite orientations. Thus both fields are represented by almost identical Maxwell equations. It turns that the both fields give equivalent wave equations.

The wave equations for the gravitational-torsion field are shown in (Sbitnev, 2019). In particular, the wave equation for the weak torsion field $\vec{\Omega}$ is as follows:

$$\frac{\partial^2}{c^2 \partial t^2} \vec{\Omega} - \nabla^2 \vec{\Omega} = -\frac{4\pi}{c} [\nabla \times \vec{\mathfrak{S}}]$$

and the wave equation for the weak gravitational field $\vec{\Xi}$ looks as follows

$$\frac{\partial^2}{c^2 \partial t^2} \vec{\Xi} - \nabla^2 \vec{\Xi} = -4\pi \left(\nabla \wp + \frac{\partial}{c^2 \partial t} \vec{\mathfrak{S}} \right).$$

Here \wp and $\vec{\mathfrak{S}} = \vec{v}\wp$ are the density distribution of gradient from all external and internal forces acting on a body as immersed in the superfluid quantum ether and the 3D current density, respectively. The vorticities of hydrogen ions at hopping along the EZ water hexagonal complexes, (Fig.22), give a contribution to the 3D current density $\vec{\mathfrak{S}}$ and, consequently, they are sources of the particular field.

In their motion, there are several ways through which protons can transfer their information or energy. Let us consider some typical Feynman diagrams (i) of elastic scattering of a hydrogen ion on a hole (it is a vacant place for the hydrogen ion) and (ii) tunneling of a hydrogen ion through some obstacle. These processes are shown in Figs. 24 and 25, respectively.

Two processes shown on these figures, illustrate the elastic scattering of a hydrogen ion on a hole and tunneling of a hydrogen ion through an obstacle. The first figures (a) show ideal processes without loss of energy. While the second figures (b) show processes with loss of the energy that is dissipated into heating the

water. Causes of this dissipation can be presence of "mind contaminants" that dissipate phonons generate in the course of these processes. It means that for avoiding the dissipations *we need to have a clear water, which is the case in the EZ-phase.*

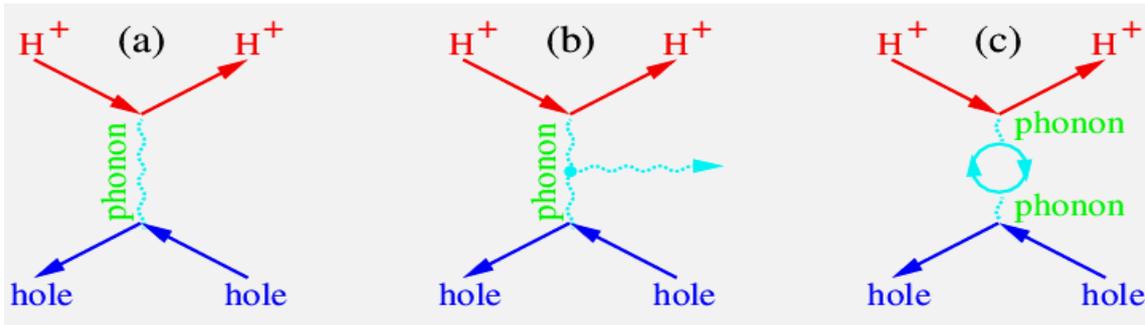


Figure 24. Elastic scattering (a) of a hydrogen ion, H^+ , on a hole; (b) scattering of a hydrogen ion with the energy dissipation because of radiation of a thermal phonon; (c) elastic scattering of a hydrogen ion on a hole accompanied by creation/annihilation of two virtual particles.

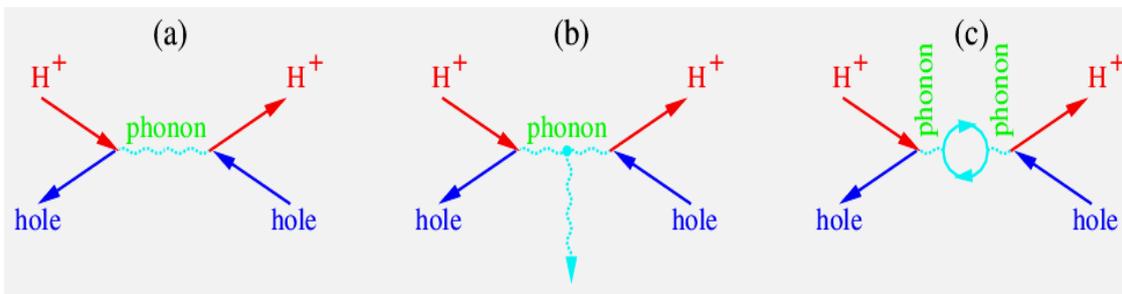


Figure 25: Tunneling: (a) of a hydrogen ion, H^+ , occurs by its annihilation with a hole and radiation of the phonon. This, after a while, generates pair of a hydrogen ion and hole; (b) generation of pair is preceded by scattering of the phonon on a mud with loss of energy; (c) tunneling of a hydrogen ion is accompanied by creation/annihilation of virtual particle-antiparticle pair.

It should be noted that the mobility of the hydrogen ion is highest among many other ions, such as K^+ and Na^+ (Atkins et al., 2009) that are important ions for neuronal communications. These ions have individual ion pumps, while special water wires are prepared each time when a problem regarding the transport of hydrogen ions, protons, arises. One can assume that the aqueous proton transport (Brewer et al 2001) is set each time along most optimal paths, like the Bohmian trajectories of particles in the physical quantum space.

From the above we may conclude that EZ water represents a water space where the

Grotthuss mechanism has a minimal loss of the energy at the hydrogen ion hopping. Observe that the Grotthuss mechanism, along with the relative lightness and small size of the proton, possesses an unusually high diffusion rate of the proton in an electric field, relative to that of other common cations (Atkins et al, 2009).

Therefore, we will assume that along the water wires the water viscosity vanishes (theoretically, we will assume the viscosity inside the water wires in the average is zero). On the other hand, we assume that there is a potential energy due to which a surprising phenomenon is revealed.

Namely, an excess proton charge defect creates its own aqueous transport pathway by shuttling water molecules through it into the hydrophobic nanoconfined space (Peng et al, 2015). Such superconductivity is also found by Sbitnev (2016), where the average viscosity coefficient declines to zero. This also could in part explain ultra-rapid brain response.

7.3 The Path Integral: Gap Junction Channels

There are rigorous mathematical proofs concerning extraction of the Schrödinger equation out of the Feynman path integral (Feynman, 1965; Derbes, 1966), as well as solutions of the Schrodinger equation by applying the same path integral technique (Sbitnev, 2013). Following this statement, the Schrödinger wave equation can be resolved by heuristic writing of a solution by using the Huygens Principle, (Sbitnev, 2012), which mathematically appears as):

$$|\Psi(\vec{r}, t)\rangle = \int K(\vec{r}, \vec{\xi}, t) \Psi(\vec{\xi}, 0) d\vec{\xi}.$$

The propagator $K(\vec{r}, \vec{\xi}, t)$ bears information about the neuron tissue that is contained in the terms covered by curly bracket in the Schrödinger equation (4). Here the integral summarizes all paths leading from a source of radiation to a point of observation (receiving information). Between the source and the end point of receiving information we may place many biological structures such as microtubules, gap junctions, etc. They are represented in the Schrödinger equation by the potential energy term U and, consequently, interfere with the wave function.

The microtubules, for example, can play a role not only as a component of the cellular skeleton in order to provide transportation of biological molecules on long distances, but also may serve as a sort of memory, as it was suggested by Hameroff and Penrose (Hameroff and Penrose, 2014a,b,c), see Fig. 17. As was shown recently by Tuszyński et al., (2019), the microtubules possess memristive properties, what makes them suitable for a long-term storage of memory.

The gap junctions, in turn, are specialized intercellular connections between different cells directly connecting the active state of two cells; see the insert in Fig. 26. The gap junction, electrical synapses, exist in every major area of the central nervous system (Connors and Long, 2004; Söhl et al, 2005; Meijer and Dermietzel, 2006). Gap junctional intercellular communications are formed into ordered arrays showing predominantly hexagonal packing, (Fig. 26), with about 6 to 9 nm center-to-center spacing (Zampighi, 1987; Berg et al, 2002).

Such ordered arrays represent slit gratings for the ion beams passing through them and generate an interference effect behind them. In fact, it represents an ideal interference device for ensuring information processing. A wave function describing the interference pattern from a grating containing N slits and placed in the 2D space is

$$|\Psi(x, z)\rangle = \frac{1}{\sqrt{1+i\frac{z\lambda_{dB}}{2\pi\varpi^2}}} \cdot \sum_{n=0}^{N-1} \exp\left\{-\frac{\left(x-\left(n-\frac{N-1}{2}\right)d\right)^2}{2\varpi^2\left(1+i\frac{z\lambda_{dB}}{2\pi\varpi^2}\right)}\right\} \quad (8)$$

Here ϖ is a width of the slit, d is the distance between slits, and n is the sequence number of the slit. $\lambda_{dB} = h/(c_s \cdot m^*) = 8.2E-34 \text{ J.s}/(1508 \text{ m/s} \cdot 1.83E-27 \text{ kg}) = 0.3 \text{ nm}$. The slits are placed along the x -axis, with equidistant spacing between them, and the z -axis is perpendicular to the grating position. The density distribution of this wave function $p(x, z) = \langle \Psi(x, z) | \Psi(x, z) \rangle$ is shown in Fig. 27.

The gap junctions are observed predominantly in relation to glial cells, which number, in the brain, is considered by some authors to be larger than the number of neurons (see Pereira and Furlan, 2007). They are often strong enough to mediate close synchronization of subthreshold and spiking activity among clusters of neurons (Connors and Long, 2004; Volman et al, 2011).

The gap junctions, therefore, are a ubiquitous, yet underappreciated, feature of neural circuits of the mammalian brain.

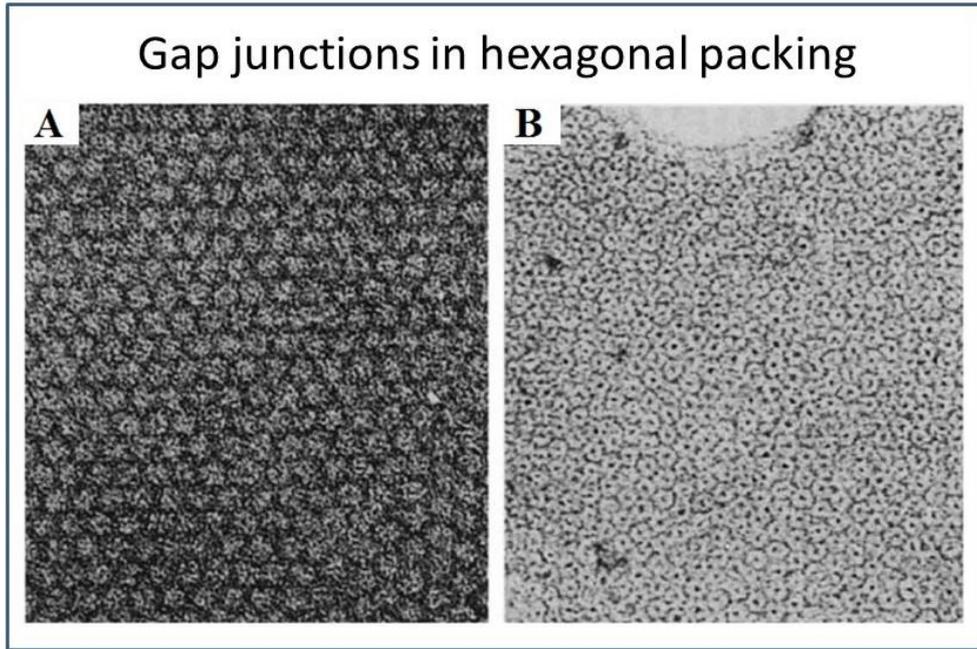


Figure 26: Gap junctions stained with (A) phosphotungstic acid, $\times 580,000$; (B) and uranyl acetate, $\times 470,000$. Well visible is the hexagonal packing. Photos are borrowed from Zampighi (1987).

Consequently, they may contribute to the cognitive processes in both aspects, namely, perception and attention (Nagy et al, 2004). Particularly impressive work in this range is the

article by Richard Maxwell (2009) devoted to connections of a subtle world through chakras with the body organs by means of intercellular gap junction connections.

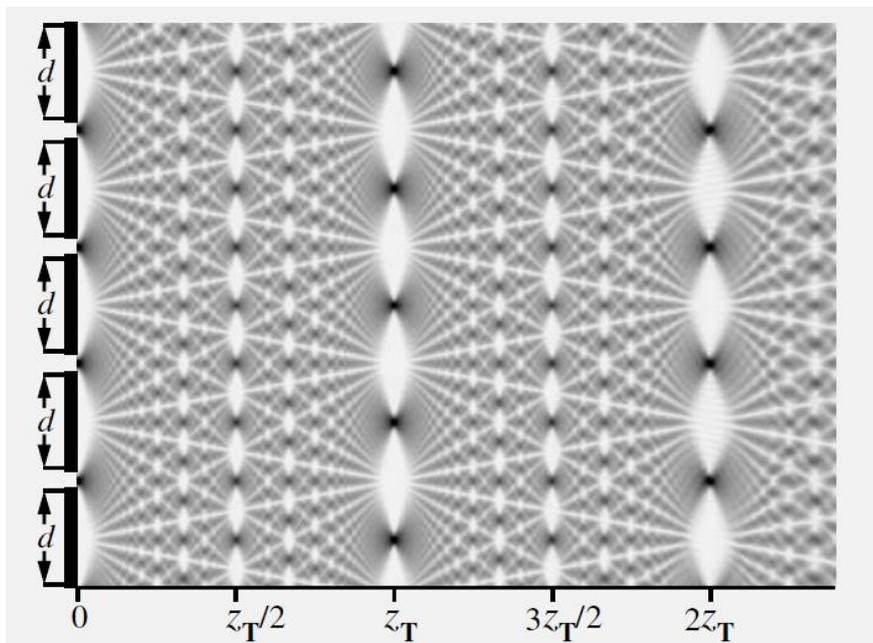


Figure 27: The density distribution of the wave function (8). Here $z_T = d^2/\lambda_{dB}$ is the Talbot length adopted unit of length in the interferometry.

The latter mechanism provides a physiological modality underlying subtle energy systems. Here we emphasize the importance of gap junctions, in connecting a lower level of the brain organization with the higher levels. In addition, we highlight proton transport through intracerebral fluid and the Grotthuss mechanism, picturing the water interface between the brain and the superfluid quantum medium (earlier called the quantum ether).

7.4 The Universe Is Much Wider Than that Given by Baryonic Matter

On a wider scale, three charts demonstrate our relative place in the Universe; see Fig. 28. Curiously, all the baryonic matter of our world composes only about 4% of total, much less than the collective dark matter and energy parts, according to current cosmology. One may say, that a boundless ocean of the dark substance occupies about 95% of total mass-energy content, is not only embedding us, but is distributed everywhere. It was mentioned earlier (Sbitnev, 2019) that the wave equations that describe cosmic microwave background fluctuations contain parts that may reflect the fact that space is filled with dark energy and dark matter as expressed in related force density waves. It should be realized that our whole organism, and thus in our brain, are permanently in contact with such force fields, that likely may influence information processing and storage in its consciousness workspaces.

In turn, in the baryon sector, hydrogen is the most abundant chemical element in the Universe (74% and about 24% of all baryonic matter compose hydrogen and helium, respectively). Hydrogen, together with oxygen, forms water that is considered as the mother of life on the Earth (Geesink and Meijer, 2019b) Amazingly, the mammalian brain contains about 75% of water volume wise and over 90% molecular wise. (Tarlaci, 2013).

One may almost guess, therefore, that *human thought flows due to water and through water*. More mechanistically, we may say that water represents an interface between

the human brain and the Universe (Carniello et al., 2015). Yet, it should be realized that humans even together with his extended mind occupies only a minuscule (invisible) percentage of the entire architecture of the Universe! Nevertheless, humankind can strive to finally understand its place in the Universe (Meijer, 2012; 2015).

To show a place of the human consciousness in the Universe we give a conditional cartoon of the brain in Fig. 29. Two figures show the brain in two states – the awake brain, Fig. 29(A), and the brain in the state of REM dream, Fig. 29(B). In both cases, the brain has a connection with the vacuum zero-point fluctuations due to resonance with protons of water. In the awake brain, however, because of a huge noise conditioned by the operation of receptor-effector mechanism of connecting us with environment, we do not sense tiny zero-point fluctuations. In the second case, the case of REM dream, the nervous tissues regulating the receptor-effector mechanism are in a deep rest and, therefore, there is no huge noise that overpowers the faint stream from the depths of consciousness. In this state, we may really experience vivid dreams. Perhaps, there are people that can have a perception of such tiny fluctuations, coming from deeper layers of the consciousness, and reflecting the harmonic dynamics of the Universe. These people, as a rule, are somehow in a fuzzy state of their consciousness. For that reason, their psyche can be very sensitive to such tiny fluctuations (see section 5.8). These aroused chaotic states of the consciousness likely represent bifurcation conditions, according to a term from brain pathology such as in epilepsy (Jin and Zong, 2011; Nemani and Binder, 2005) and even in schizophrenia (Wang, 2010; Mitterauer, 2014).

Summarizing this section: here we tried to understand what mechanisms may be responsible for the exchange of information between the superconducting quantum spaces. As was noted above, a major mechanism is represented by the Grotthuss process that can be effective when water is in the fourth phase.

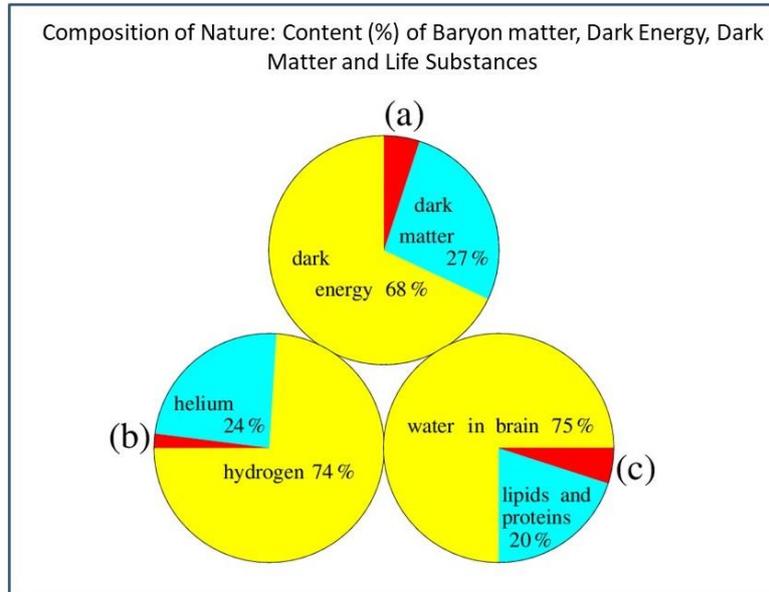


Figure 28. Percent content of different substances in Nature: (a) only 5% of baryon matter represents our visible world. The other are dark matter and dark energy; (b) all heavy atoms represent only 2% of the visible baryon matter. The other are helium and hydrogen; (c) soluble organic matter, inorganic salts, carbohydrate make up only 5% of the brain substance. The other substances are lipids, proteins, and predominantly water.

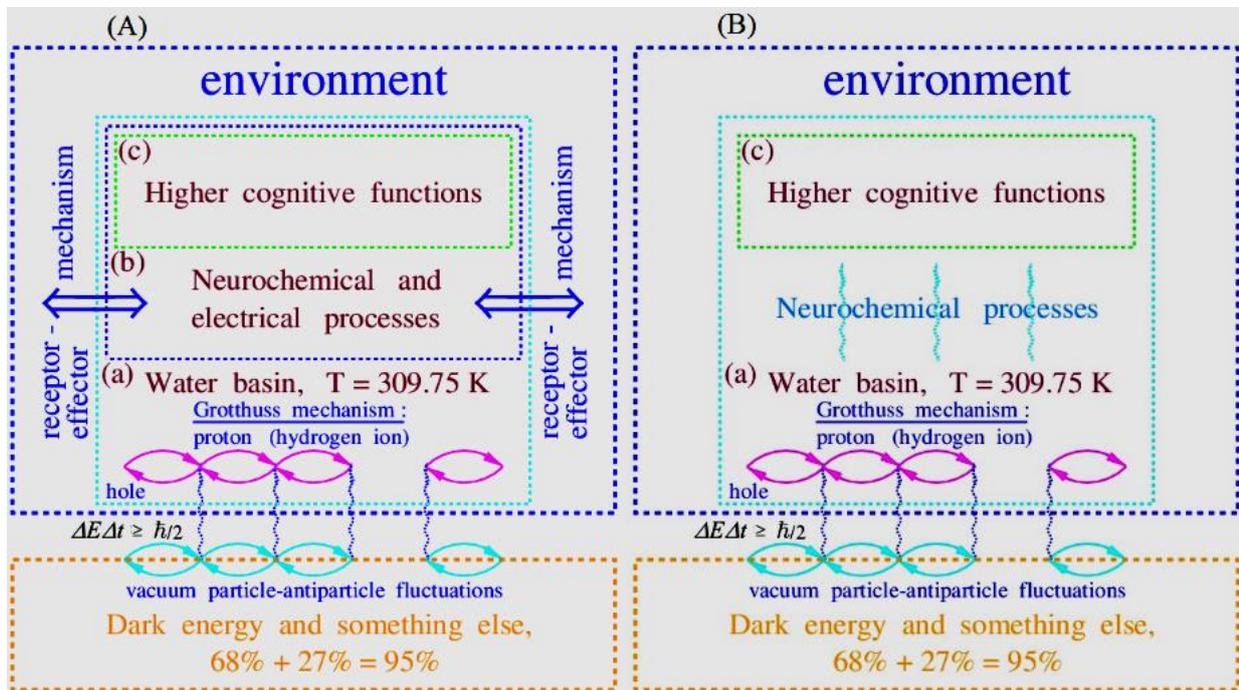


Figure 29. Conditional cartoon of a living being: (A) three-level diagram of brain organization in awake state: (a) a water basin containing all the other levels; (b) nervous tissue and glial cells, supporting electrical activity of the receptor-effector mechanism; and (c) higher cognitive functions creating consciousness as a paradox (Allakhverdov, 2000). All of this is backed by a dark substance – the "superfluid quantum space" (Sbitnev, 2017; Sbitnev, 2019); (B) three-level diagram of brain organization in REM dream state: here the nervous tissues regulating the receptor-effector mechanism are in a deep rest.

This process can be expected to exist near countless subcellular structures, including the cellular membrane of neurons in contact with the complex brain fluid constituents.

Of note, we should realize that the electromagnetic field can, in principle, be shielded by nearest neural tissues, whereas the superfluid field cannot. Yet, the latter is, in general, quite weak and overwhelmed by neural activity and for that reason, one usually does not easily perceive it other than in deep meditative states.

Yet, if wave coherency in the related wave information, combined with that of water structures in the brain exists, it may become manifest. In fact, this picture agrees with the de Broglie's idea about existence of the pilot wave guiding the particle from the initial point $\sim q_a$ to the final one $\sim q_b$ (de Broglie, 1987), implying that the particle and the pilot wave behave as one entity (Fig. 29 A). The interference pattern in this case is defined for all subjects situated in the particular space from which the reflected waves are returned to the particle (Fig. 29 A), as also demonstrated in the elegant hydrodynamic experiments (Bush, 2015).

7.5 The crucial informative role of Ca^{2+} ions

Through the prism of the above description, we may now consider the consciousness evolving in the wet, warm, and noisy brain system. It interacts with a massive volume of memory stored in a deeper, finer-grained scale of a memristive system (Chua, 1971, 2011).

The interaction manifests itself through the destructive and constructive interference effects, resembling the effect of choice. The memristive system by itself is likely based on the cellular organelles involved in the sequestration of calcium ions (networks of the granulated units of Ca^{2+}) (Pereira, 2007) including the calcium-calmodulin-dependent protein kinase II (CaMKII), which is implicated in the strengthening of active neural connections (Craddock et al, 2012).

On the basis of the specific EMF frequency data (Geesink and Meijer, 2018a) and the known sensitivity of Ca^{2+} to EM radiation, we fully support the notion that Ca^{2+} takes a crucial position in the integration of the distributed information within the brain, not only due to its specific atom electronic properties (empty atomic electron shells) and thereby its potential for entanglement and superposition, but also since it affects at least 10 different cellular processes that have been shown to correlate with modalities of conscious perception (Pereira, 2007; Pereira and Furlan, 2009) (Fig. 30). Interaction of general anesthetics with NMDA receptor/channel function have been shown to induce the loss of consciousness (Flohr, 1998), but has also be related to high affinity for tubulin proteins, thereby blocking their Tera-Hertz oscillations in microtubules (Craddock et al., 2017). Earlier it was shown that electromagnetic fields may influence cell function via activation of voltage-gated Ca-channels in the plasma membranes and that this can both lead to beneficial and adverse effects in the exposed cells (Pall, 2013).

In addition, phonon patterns affect trapped Ca^{2+} ions in astrocytes, a process that is instrumental in the formation of quantum information states, that in the proposed astroglial/neuronal "protectorate" may survive decoherence (Pereira, 2007). Interestingly the magneto-sensitivity of Ca^{2+} is well known (Adey, 1993; Liboff, 1985) in the sense that calcium transport and protein/channel binding may be largely affected by magnetic fields with ELF radiofrequency signals. The influence of this signaling of the so-called Ca- ion cyclotron resonance is supposed to be due to the induction of exclusion zones in the structured state of cytoplasm water molecules forming coherent domains. Biological effects are influenced by oscillating magnetic fields (Meijer and Geesink, 2016), depending on their frequency. This special fractal scaled Ca^{2+} behavior supports the premise that astrocytes support functions additional to the normal neuronal mechanisms.

In fact, they may contribute directly to cognitive functions and resultant behavior (Pereira and Furlan, 2009; Bull, 2014). Of note, grafted human astrocytes in mouse brain have a higher rate of Ca^{2+} flux and are much larger and more complex than normal mouse cells and, interestingly, showed enhanced learning, memory and plasticity (Han et al, 2013).

An important aspect of this ‘calcium ion’ hypothesis of mind is that any instantiation of mind could be intimately connected with early stages of memory processes.

The latter is a requirement that is essential to ‘mind’ since it should be capable of dealing with the new incoming information, by establishing new attractors in the “domain” of consciousness and also must be capable of integrating different aspects of incoming information over time. It has been shown that Ca^{2+} ions are also hydrated, and, in principle, their behavior can be described by similar hydrodynamics and path integral approaches, as described in the previous for hydronium ions.

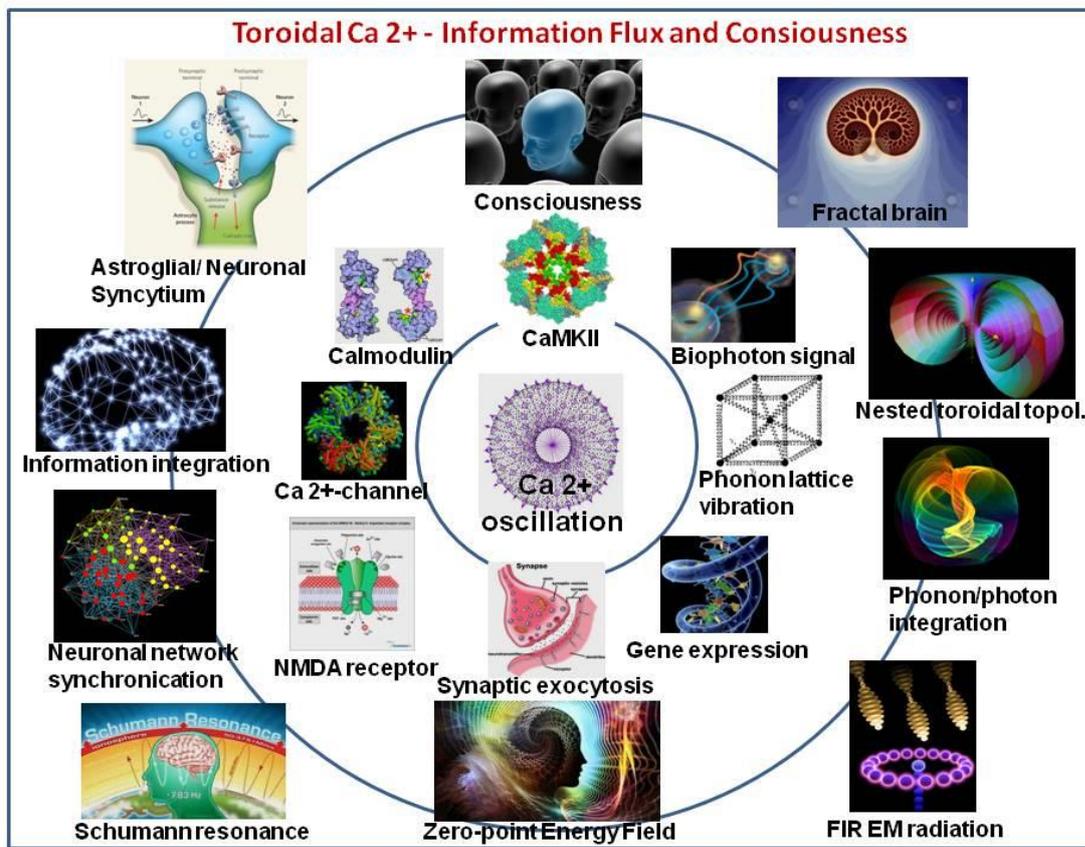


Figure 30. The fractal organization of Ca^{2+} mediated cellular mechanisms related to conscious perception. The pivotal role of Ca^{2+} ions, as the second informational messengers in brain function is indicated at micro- and macro- levels. The inner circle is depicted anti-clockwise: Neuron/astrocyte mediated Ca^{2+} flux leads to activation of Calmodulin associated kinases (CMK11), calmodulin, NMDA-receptor/channel proteins and quantum resonance within Ca-channels that may stimulate synaptic neurotransmitter exocytosis. Outer circle macro -scale: Ca^{2+} flux in syncytia of neurons/astrocytes leads to phonon/photon mediated information storage and integration as well as neuronal assembly and neuronal network synchronization. The Ca^{2+} messenger function may be influenced by Schumann and cyclotron resonances by far infrared (FIR) radiation resonance as well as Zero-point energy (ZPE). The resulting phonon and photon scalar waves in the brain are integrated and protected against decoherence through toroidal processing. Topological integration on the brain macro scale is realized by torus nesting and self-similar fractal representation. This integral process may contribute to the creation of awareness and conscious perception in relation to the external world.

Thus, just as there is a wide variety of intercellular Ca^{2+} waves in different cell types, so is there a corresponding variety in their mechanism of extra-cellular propagation. Nevertheless, two basic mechanisms are predominant: propagation by the diffusion of an extracellular messenger, and propagation by the diffusion of an intracellular messenger through gap junctions. Sometimes both mechanisms operate in combination to drive an intercellular wave. Of note, Ca^{2+} waves can exhibit spiral patterns (Tang and Wang, 2009) and is also influenced by external cyclotron EMF resonances (Meijer and Geesink, 2016), both supporting our concept of toroidal flux mediation in the brain.

Conclusions in relation to Section 7

Consciousness states are, at least partly, received from the superfluid quantum space/zero-point energy field and the information flux is likely bidirectional (back reaction). Consequently, a field-type of cosmic connectivity is attained, necessary for global synchronization in the brain and of the brain with the cosmos.

- The fractal water compartments in the brain function as a superconductive antenna for the ZPE/ superfluid quantum space wave information (Geesink and Meijer, 2019a). This aspect extends to interstitial spaces and non-neuronal cell types, in which spiral Ca^{2+} wave fluxes, that mediate multiple bio-information mechanisms in the brain, play a crucial role.

- For wave-information transfer in brain, one needs two separate mechanisms operating in brain water: the intermolecular jump of hydrated protons (Grotthuss mechanism) for superconductive states as well as a different mechanism of wave/particle diffusion. The latter propagation process in the whole brain is facilitated by quasi-particle formation of solitons (rotating electrons or protons that become dressed with phonons/photons). Hydrated protons have also been shown to be quasi particles with solitonic solutions.

- The latter implicitly introduces the aspect of vortex-like rotation and toroidal geometry of

energy trajectories. Rotatory mediated toroidal flux is likely important for information integration and error correction of various forms of wave energies (Meijer and Geesink, 2016; 2017).

Holographic memory storage and retrieval can be understood from a 4-D situated event horizon workspace that is associated with the brain but not reducible to it (Meijer and Geesink, 2017). The cerebrospinal and interstitial water compartments are equipped with, and sensitive to, external solitonic excitations. In conscious states in brain and the entire cosmos, they can function as the communication conduit between zero-point superfluid space and modalities of life organisms.

- Current observations on relative intelligence of hydrocephalic patients, life panorama aspects of NDE experiences, and precognition PSI phenomena (see sections 5.8 and 5.9) can be better understood through the present superfluid and superconductive model.

8. Comparison of the Present Model with Other Current Models of Consciousness

Definition of our hypothetical model:

Graded states of consciousness in the universe encompassing a) dream-states b) primary awareness c) (sub)-conscious states d) transpersonal experiences and e) universal consciousness, are scale invariant and are guided by a pattern of semi-harmonic quantum waves (meta-language of the GM-scale principle). The latter originates from a superfluid quantum space/zero-point energy field (SFQS/ZPEF), creating pilot wave-induced resonance and cosmic connectivity. The steering of life processes is realized through semi-harmonic tuning of fractally structured water, in a dynamic relation with vibrating macro-molecules, such as hydrated proteins and DNA, in several cell types of the human brain and also in its aqueous compartments. Conscious states arise through solitonic communication with a field-receptive, workspace, that is associated but not reducible

to the brain. It implies a holographic memory workspace (“event horizon”), that supervenes brain function and is organized according to toroidal geometry. Collective pilot waves, including their backreaction lead to a conformal cosmic information field, representing the mental attribute of reality as also expressed in human individuals.

In which aspects does our present model differ from earlier proposed concepts on consciousness and its supposed neural correlates?

Global workspace models

These models are often inspired by “Global workspace theories” of Baars et al (2013), Dehaene, et al (2003, 2017), (see Table 2, left column). The various postulated concepts cannot be treated in detail here and for a short but an adequate review see Seth (2007).

Interestingly, many of these models are also based on an *internal self-model* in the framework of a supposed global workspace. In the latter models the unresolved problem of instantaneous binding of distant brain nuclei, in relation to our *integral* observation and sensing of our world, is approached by assuming multiple “broadcasting” hot spots in the neural networks of the brain. According to the present authors such centers may communicate via resonance of standing waves, phase coupling or even in a spiral (toroidal) mode. Some even consider the integrating activity of this broadcasting of information as the very process of realization of consciousness (Baars et al 2013; Tononi, 2008, 2014, 2016; Dehaene, et al 2003), in which *consciousness is just brain-wide sharing of information*, that is in the global workspace.

However, some aspects remain to be established: a) what is the physical mechanism behind this supposed broadcasting phenomenon (multi-synaptic, electromagnetic, holographic, or (bio)photonic), b) in what form is the particular information sent and c) how is the received information in the cortex integrated to conscious moments with

meaning? In the present work, we propose that such a complex phenomenon requires an information-integrating, workspace, in which the broadcasted information can be put into the context of the entire memory content of the organism. Dehaene (2017) assumes two types of information processing in brain: Firstly, a selection of information for “global broadcasting”, sharing it across modules and holding it over time, in order to make it available for computing and reporting. Secondly, he assumes a self-monitoring of this information in relation to reflexive aspects and error correction as a *sort of meta-cognition*. In this respect, prefrontal cortex neuronal circuits, or even parallel circuits that are operating on the same sensory data are supposed to entertain error correction and differentiation between self-generated versus externally driven representations.

Yet we question, if such synaptic mechanisms are rapid enough for such wide spread processes, or that, *alternatively*, phonon/photon/soliton-mediated communication could represent a more effective mechanism. The latter mechanism could also account for so called extra-sensory information such as NDE, blindsight and inter-personal data sharing is integrated in this concept (section 6.8).

Indeed, it has been argued by Rizvi (2018) and earlier by many others, that synaptic transmission and axonal transfer of nerve impulses are too slow to organize *coordinated* activity in large areas of the central nervous system. The duration of a synaptic transmission is at least 0.5 ms, thus the transmission across thousands of synapses takes about hundreds or even thousands of milliseconds. The transmission speed of action potentials varies between 0.5 m/s and 120 m/s along an axon. More than 50% of the nerve fibers in the corpus callosum are without myelin, thus their speed is reduced to 0.5 m/s. How can these low velocities (i.e. classical neurophysiological signals) explain the fast processing in the nervous system, without a field modality?

A more meta-cognitive form of consciousness, rather will contain a graded modality of hierarchically as well as referential ordered and bodily determined working structure, that is essential for fully coordinated action, and was earlier called “individuated information utilized in action” (Jonkisz, 2015). Interestingly, such a conscious state space (Bekovich-Ohana and Glicksohn, 2014, Brandenburg et al 2016), was modeled by a geometry of two concentric spheres (not unlike our torus model), representing a phenomenological space with three dimensions: time, awareness and emotion.

As mentioned above, we tentatively add to this overall configuration a fourth space-time dimension in relation to self-consciousness.

This enables a continuous contact with an extended consciousness or awareness continuum that is defined by us and many

others as *universal consciousness*, (Meijer, 2019a).

The latter aspect rejects the usual framing of a mental workspace as a dualistic concept, since we envision our proposal of the extended brain as being *derived* from universal consciousness, as the very source of all that exists (Goswami, 1990; Kastrup, 2016; Meijer, 2019a).

In a similar manner, we previously treated life as originated and thereby *extended* from the quantum vacuum from its substance, behavior and laws (Meijer, 2018;2019b).

Multi-dimensional models. Our model is, at least to some extent, related to earlier proposed quantum/spacetime models of Pribram (2004) and Mitschell and Staretz (2011), both on the holonomic brain, as well as to the electromagnetic field brain theories of McFadden (2007) and Pockett (2012).

Current Models of Human Consciousness	
Neuro-correlate models	Quantum/Spacetime models
Global Workspace model- Baars/Dehaene	Wholeness/Implicate order model - Bohm
Multiple Drafts theory- Dennett	Quantum field model- Jibu/Yasue
Dynamic Core/Neural Darwin. model- Edelman	Quantum brain dynamics - Umezawa
Information Integration theory- Tononi/Koch	Dissipative brain model- Vitiello
Thalamic Cortical Rhythms model- Llinas	Holonomic mind model- Pribram
Coalitions of Neurons model- Crick/Koch	Attention quantum zeno effect model- Stapp
Field models- Kinsbourn/McFadden/Pockett	Psychon brain dynamic model- Beck/Eccles
Subcortical models- Penfield/Merker/Ward	Ion-channel coherence model- Bernroider
Internal and World Simulation model- Revonsuo	Orch. Obj. Quant. Reduct.- Hameroff/Penrose
Retinoid model- Trehub/Metzinger	Spin- mediated Consc. Model - Hu/ Wu
Self-model theory- Metzinger/Hesslow/Grush	EM- field models- McFadden/Pockett
Sensimotor Theory model- O'Regan/Noë	Holographic Resonance model- Mitschell
Supramodular Interaction theory- Morsella	Hierarchic model consciousness.- Kaivarainen
Multilevel Feedback model- Haikonen	Dual-time Supercausality model - King
Intermediate Level theory- Jackendorf	Topological Geometro Dyn. Mode I- Pitkänen
Radical Plasticity thesis- Cleeremans	Poised State Quantum model- Kauffman
Collorary Discharge Attention model- Taylor	Photon Med. Consc- Bókkon/Dotta/Persinger
Attention to Memories theory- Izhikevich	Noetic Field theory - Amoroso/DiBiase
Bicameral Mind model- Jaynes	Zero Point Energy model- Keppler/Cagliuiri
Operational Architectonics model- Fingelkurts	Neural Field theory- Robinson
Self Comes to Mind model- Damasio	Infinite Spiral Staircase model- Hardy
Free-energy Unified Brain theory- Friston	Nuclear Spin Neural Qbit model- Fisher
Triple aspect monism model- Pereira	Oscillating Agent Quantum model- Pliukynas

Table 2: Current neurological and neural-correlate models (left) and quantum/spacetime models (right). References to the neuro-correlate models can be found in Seth (2007) and for the Quantum brain models, see Meijer and Raggett (2014) and references in the present paper.

As treated above, it also bears some resemblance to the orchestrated objective quantum reduction model of Hameroff and Penrose (2014), the TGD universe framework of Pitkänen (2016), and also relates to the so-called dissipative information brain model of Vitiello (2001), (see table 3, right column), as previously reviewed by Meijer and Raggett (2014).

Implicitly, a major difference with the abovementioned models is that our concept is not solely related to the known neuronal/astroglial based central neuro-system approach, but that *an additional* modality of an associated mental workspace in a 4-D context is introduced (Beichler, 2012 a, b, c; Carter, 2014).

This workspace mirrors our total of experiences and is sensitive to relevant information derived from various force fields of nature such as geo-magnetism, gravity, Higgs field, as well as zero point and dark energy. We presume, as stated before, that it also comprises an even larger connecting principle in the sense of *universal consciousness*, as it is inferred by some of us (Meijer, 2018a).

In this sense, our model supports that of Hamein (2007;2016), based on a dual toroidal/wormhole geometry in physics and cosmology), as well as the model of Hameroff and Penrose (2014). The latter addressed quantum gravity mediated communication of brain states with information expressed on the Planck scale. The holonomic models mentioned in Table 3, of Pribram (2004), Mitchell and Staretz (2011), and Amoroso and DiBiase (1999), also largely stimulated our present concept.

Reports on the crucial role of consciousness in proper functioning of the brain was recently emphasized by Darnos (2019) and by the unitary relation of brain and cosmos from an energetic point of view by Persinger and St-Pierre (2015), both supporting our ideas on the extended brain in relation to the whole universe. Of particular interest are the studies of Atasoy (2015, 2016, 2017) that revealed a distinct presence of harmonic brain waves as related to the brain connectome. The

researchers used data from two imaging techniques: magnetic resonance imaging (MRI) and diffusion tensor imaging (DTI), to create three-dimensional maps of the structure of the brains of a group of individuals. The MRI- data yielded the structure of the cortex and the DTI yielded an anatomical map of the underlying connections of the white matter in the brain.

The team then analyzed these brain maps using the mathematical framework of Laplace Eigenmodes, or harmonic waves, which describe natural vibrations of a system where all parts move together at the same frequency. See for this aspect also the adequate paper of Joye (2016). Thereby, they could ask the crucial question: how do these harmonic patterns, or *connectome harmonics*, actually *make up* the fMRI data. The collective data indicate that a new language emerged to describe both the spatial and temporal elements of neural activity. Namely, the patterns tell which regions should be synchronized with each other at a particular frequency, and allow to characterize the fMRI data as a combination of these patterns. These authors, interestingly, suggest a *musical analogy*, since the patterns can be compared to musical notes composing a complex musical piece, very much in line with the present paper (Section 3.4), where we stated that functional networks of the human brain are probably predicted by semi-harmonic patterns, ubiquitous throughout nature.

Therefore, the model of Atasoy about human brain networks, may have a direct relation with the proposed GM-scale: both models make use of eigenfrequencies, coherent behavior, connected harmonic patterns. This in addition to aspects as the overlap between different states of networks, harmonics corresponding to different frequencies (wavenumbers) and based upon a general physical principle of self-organization. Atasoy et al. (2015) in this respect refer to the classical Chladni vibration patterns that were recalculated earlier by us (Geesink and Meijer, 2016), showing a perfect fit with the frequencies of the GM-scale. The introduced framework of harmonic brain modes, therefore, not only

establishes a relation between the spatial structure of correlation patterns and temporal oscillations (linking space and time in brain dynamics), but also enables a new dimension of tools for understanding fundamental principles underlying brain dynamics in different states of consciousness. Atasoy et al., (2018) (Fig.31), more recently examined the minds of 12 people treated with placebo or on LSD, while listening to music. They recorded their brain activity through the lens of the brain's underlying connectome-harmonics.

What they found was that under the influence of LSD, more of these harmonics were contributing to brain activity and their strength of activation was also increased. The brain was

essentially activating more of its harmonics simultaneously, and in new combinations. Apart from combinations of harmonic EMF frequencies also the aspect of *wave amplitudes* should be taken into consideration.

Kraikivski, 2019, recently, postulated the importance of the amplitude of coupled oscillators for the creation of conscious percepts. Interestingly, the author postulates the functionality of an “operational map, isomorphic to a distance matrix with space-like properties that would serve as a timeless linking (integrating) unit that allows a rapid selection of a repertoire of functional states, encoded in amplitude patterns of oscillatory processes”.

Table 3: Literature compatible with and/or supporting the present brain model concept

Scientific subject	Author(s)	Congruent aspect with our theory
Global workspace model	Baars/Dehaene	Long dist. broadcasting commun. brain
Information-integration theory	Tononi/ Koch	Information core concept
Orchestrated Objective Reduct	Hameroff/Penrose	Q-coherent oscillat. tubular proteins
Projective mind Hypothesis	Williford et al	Virtual projective integrate brain
Toroidal brain hypothesis	Tozzi and Peters	4D- Toroidal brain information domain
Human connectome/brain modes	Atasoy et al	Harmonic frequency modes in brain
Glutamate-induced biophotonics	Tang et al	Physics of biophotonic brain comm.
Biophotonics redshift brain activity	Wang et al	Biophotons higher brain functions
Fractal Inform. geometric music.	Bandyopadhyay et al	Fractal musical brain language
Operational Architectonics theory	Fingelkurts et al	Operation of a mental brain domain
Consciousness Cosmol. Framework	Pereira et al	Universal field of Energy
Intuition as a holographic phenom.	Bradley	Intuition from holographic memory
Spin-mediated consciousness	Hu and Wu	Spin as mind-pixel in consciousness
Water as conduit in cosmic entangle.	Carniello et al	Univ. role of H ₂ O in cosmol. order
Qualia: interaction proto-conscious.	Tressoldi et al	Proto-consciousness domain
The Pribram-Bohm Holoflux Theory	Joye S R	Holofield theory and implicate Order
Brain and neg-entropic entanglement	Poznanski	Consc. guiding encoded in ZPE field
Genomic consciousness in neurons	Cacha/Poznanski	Solitonic interactions with DNA
Physical bases to consciousness	Persinger/St-Pierre	Unified,non-local cosm. brain energy
Quantum gravity, role of consciousness.	Darmos	Role of consciousness in physics
Two-brain hypothesis	Goodman et al	Electro-ionic/ Electromagnetic brain
Non-synaptic model long-term memory	Cacha et al	Engrams as waves in interfacial water
Quantum physics synaptic transmission	Georgiev et al	Q. tunneling in neurotransm. release
Oscillators as conscious percepts	Kraikivski	Distant space-time matrix as operat. map
Holo-informational mod. of conscious.	Di Biase	Superimplicate order in organizing mind
Nature of mind and consciousness	Greyson	Is consc. only produced by the brain?
Integral relativity of awareness	Neal	Role of photon/phonon symphonic resonan.
DNA resonance code as neural code	Savelyev e al	Proton oscillations in DNA morphgen. field

This, very much, resembles the concept of a guiding/supervening holographic memory workspace as envisioned in the present study.

The latter is also true for the Fractal-like Information Integration Theory of

Bandyopadhyay et al., as discussed in section 3.4.

Yet, we prefer the use of nested toroidal geometry for describing self-referential information flow and also added the aspect of an extra 4-D spatial dimension to arrive at a cosmic mental workspace concept by which we integrated mind/matter aspects in the consciousness framework.

It is striking indeed that many related and recent studies on consciousness contain the suggestion that a supervening memory workspace. The latter is required to understand an integral operation of the brain on the brink of chaos, as a sort of quality controlling and updating system. Such ideas take quite different forms but, at least partly, support our present concept (Table 3). This is certainly true for the very elegant consciousness model of Fingelkurtz et al (2010, 2014), called *nested operational architectonics* of the brain. In this model it was postulated that an electromagnetic brain field connects a mind-subjective space-time to a distant physical space-time. For a fractal representation see Kida et al (2016). Meta-

cognitive aspects of consciousness on the basis of current physics and cosmology were also proposed by Pereira et al., (2018), postulating a matrix of reality, being an N-dimensional combinatorial state space of eternal self-organizing elementary energy forms. This is seen as the ground of reality as a universal field, potentially encompassing all possible manifestations, either material or mental, connected via a transitional zone to a manifest world with its informational and qualia endowed aspects. Poznanski et al. (2018, 2019) presented a related theory in which brain consciousness is guided by hidden dynamics of dipole associated electrons, modeled by ZPE field/de Broglie/Bohm-type of active information of oscillating waves, as also touched upon in our studies. The same group emphasized the importance of biophotonic and electromagnetic information transfer (Cacha et al, 2014, 2017) and in relation to this suggested the concept of a “Two-brain hypothesis”: one brain with an electro-ionic character and a simultaneously acting electromagnetic brain (see also Goodman et al, 2015).

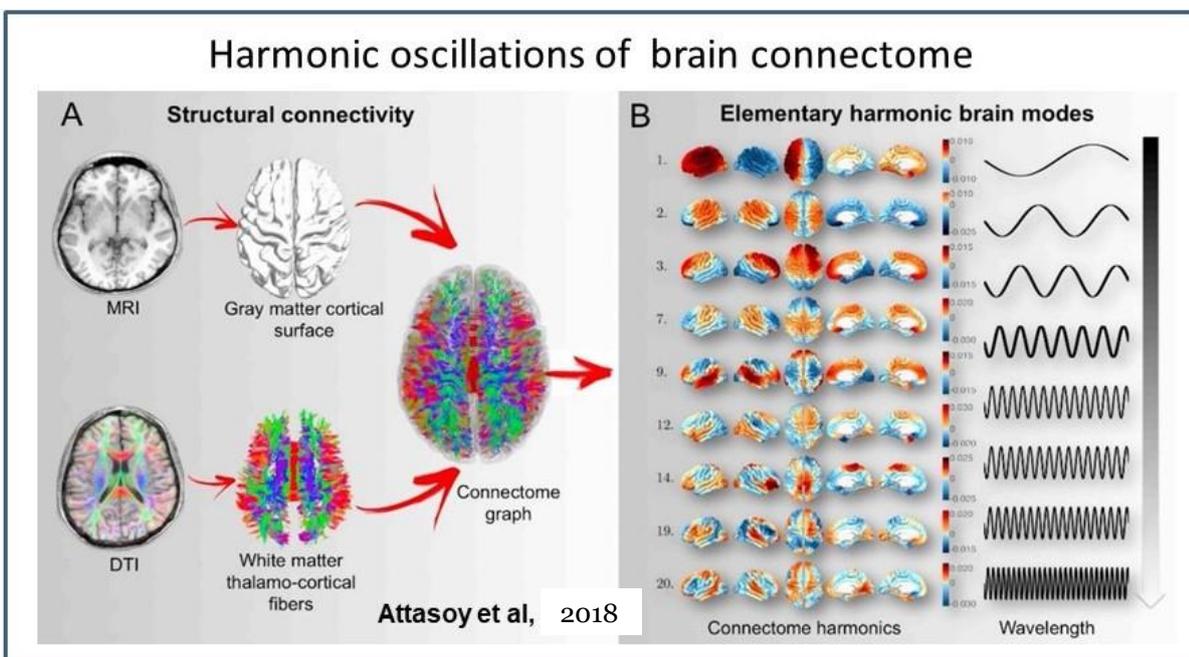


Figure 31. (A) Structural connectivity of the human brain defined as the combination of local cortical, gray matter connections. (B) Elementary harmonic brain modes defined as fully synchronous patterns of neural activity are estimated as the harmonic modes of structural connectivity; i.e. connectome harmonics (Atasoy et al, 2018).

The latter aspects of the theory are in striking agreement with the present model. Both the aspects of macro-quantum equation and error correction, on the basis of negentropic entanglement are mentioned, but lack the toroidal geometry and the essential photon/ phonon/soliton coupling of electrons as an optical guiding mechanism.

We hold that a total acoustic semi-harmonic scaling of frequency patterns should be included, describing a balance of *coherent* but also *decoherent* modes, in order to construct the long-range order of phase synchrony in the consciousness code.

Further congruence with our model is noted from the studies of Tressoldi et al. (2016), who conceive consciousness as an emergence of qualia through an interaction with a *supposed non-local proto-consciousness or proto-mind*, acting as an interpreter and decision maker, constantly re-describing its own activity enriched with the emotional value.

In addition, a *projective consciousness model* was hypothesized by Williford et al. (2018), that combines a projective geometrical model of a perspectival phenomenological structure of the field of consciousness with a free energy minimization model of interference. This was supposed to act as a *4-D projective transformation*, that is instrumental in integration of perception, emotion and memory as well as in reasoning and imagination, in order to control behavior as well as to optimize resilience and preference satisfaction. The particular projective space proposed is virtual and outside our 3-D space as an extra parametric dimension active in creating a world model for the sake of selfhood, as a viewer or transcendental ego (our double or daemon unveiled) that provides a global availability and multi-modal information integration.

This resembles the cosmological approach of Pletcher (2019), that pictures consciousness as an interactive process of polarizing an observed source of a *higher dimensional (4+1) space* on to a cognitively modeled collapsed (3+1) space.

All this supports our concept of the requirement of a reflexive 4-D workspace in a superfluid quantum space with rotatory geometry. Of note, Libet rightfully stated earlier that the ultimate scientific challenge lies to produce experimental evidence for the two-way interaction between a conscious mind field (also called the stored mental map in a cognitive space) and the physical brain, as attempted in the present study and abovementioned studies.

Aspects of quantum holographic theory were also applied by Bradley (2006) and DiBiase (2013), in relation to intuitive perception of the future, based on interaction with non-local information through unfolding and harmonic resonance. This phenomenon, according to the authors, is not restricted solely to the brain but works also via information input in the cardiac system in the form of quanta of energy. These may arise from zero-point energy guiding that can overlap with the future (most probable potentials in the implicate order domain) and can lead to intuition, synchronicity, clairvoyance and telepathy (section 5.7).

The importance of a new scientific framework for the (re)-union of science and spirituality, was treated by the physicist Faggin (2014), the designer of Intel's first microprocessor, arguing that death is not final but rather necessary to dissolve the identification of consciousness with the body, thereby freeing it to recognize its own true nature. The latter aspect was also treated in a very recent paper of the first author (Meijer, 2019 b).

Conclusion:

(Self)-Consciousness is generally considered to arise from the brain thalamo-cortical recurrent neuronal activity. Yet, we hold that consciousness is at least partly *received* from a qualia space (superfluid quantum space/ZPE information field), linked to a sub-Planckian space-less and time-less dimension, bearing geometric patterns with mathematical relations (Penrose and Hameroff, 2011). Communication from these fields may

take place with photons/phonons/solitons through a “holo-flux” of active information as described by Bohm and Peat (2008). This guiding process, in brain is, among other factors, mediated through its water compartments (cerebrospinal, interstitial, and intracellular spaces) in the form of freely moving protons, creating a superconducting medium. Hydrated protons are converted to and serve as antennas for electrons covered with phonons (phonon dressed electrons or solitons) that exercise shaping effects on proteins and organelles (Meijer and Geesink, 2018b). This can occur with the help of structured water, in which the information from the aforementioned fields is mirrored in fractal frequency wave patterns. This life “information” is not only stored by interaction with proteins and DNA but also, holographically, in a memory sphere (event horizon) around each cell that can be physically imagined in the vicinity of the plasma membrane with its complex array of intrinsic proteins and aqueous layers (Meijer and Geesink, 2018a). All this takes place in a fractal-like manner in the cell at the micro level (down to the level of elementary particles), as well as at the macro level. This also implies entangled conditions in the whole brain and in the entire organism with its various organs and connective systems.

This concept is in line with the holo-fractal and semi-harmonic vibrations proposed by us that, as earlier mentioned, have been demonstrated in the brain by Atasoy et al., (2015, 2016, 2018), with scanning techniques, and also showed by Tozzi et al., (2016, 2017) as a holographic domain that operates from a 4th spatial dimension, projecting into our 3D world. Both the *semi-harmonic* character of the EMF frequency pattern and the here proposed superfluid state, indicate vortex dynamics and toroidal geometry. Ca²⁺ ions and their transmembrane gradients, as quantum information carriers, are envisioned by us as playing a crucial role in the cells and the integration of neuronal activity in various parts of the brain. Their quantum state is protected

against the environment (decoherence) by being partially being enclosed in water gels or confinement within shielded Ca-channel proteins. Ca²⁺ ions influence a spectrum of biochemical and biophysical processes in the brain (Fig. 30) and, partly, by astro-glia fluxes promote cerebral binding and synchronicity of brain activity, (Pereira and Furlan, 2012). These, have been related to EEG signals with typical alpha-, beta-, gamma- and delta-frequency ranges. Therefore, water is seen as very central as a superconducting and phonon-antenna containing matrix that drives the balance of coherence/ decoherence of wave information to the left.

The present consciousness theory was confirmed by brain scanning in the abovementioned studies and is supported by the fact that certain hydrocephalic patients and other conditions with greatly reduced neuronal brain tissue may have an unexpected level of consciousness and intelligence (Greyson, 2015) (sections 5.7 and 5.8). We therefore present the concept of a *non-material, field-receptive, resonant, mental workspace* that is part of a *universal* mechanism of rotational information flow.

Testability: The present GM- EMF frequency scale concept is experimentally based, since it evolved from meta-analyses of more than 750, mostly peer-reviewed, articles, consistently showing the particular frequency-band pattern in a variety of disciplines such as biomedical/biophysical studies: a) quantum entanglement studies, b) energy distribution of elementary particles, c) superconductor studies, d) clay material EMF properties and e) water absorption frequencies (see table 1).

It follows that our consciousness hypothesis can further be experimentally tested by exposing various types of brain tissues *in vitro* or *in vivo* to externally applied combinations of discrete EMF frequencies and/or selective shielding of such external EMF radiation modalities. This, through the use of advanced radiation technologies and/or specific EMF frequency modulating materials as well as probing of responses of electric activity or

performing scanning of tissue slices or whole brain with various high-tech methods. The more transcendental aspects could be tested in further detailed analyses of a spectrum of known subjective experiences under the influence of discrete musical frequency bands and their combinations.

9. The Construction of Reality: An Integral Model

In this final section, the authors attempt to capture the various informational aspects, mentioned above, as well as their perception of the fabric of reality, in a comprehensive scheme. This scheme is based on the central concept of universal consciousness in the form of a quantum wave knowledge field that is penetrating the whole of reality, as earlier proposed by various quantum physicists (Bohm, 1987; King, 2008; Primas, 2003, 2009) and system biologists (László, 2005 and 2007)

as recently reviewed by one of us (Meijer, 2019a).

The Construction of Reality, depicted in the diagram of Fig. 32, is presented as the unfolding of basic information, which, initially, was present in a quantum-information field (black), which consisted of quantum energy, exhibiting an implicate and symmetric order. This field can also be seen as Universal consciousness, containing highly compressed information about all the available data from the present and the future (4-dimensional information from all time). In the integral scheme in Fig. 32, the unfolding of this information is expressed in a "dual" process consisting of:

- the processing of wave information in a transcendental superfluid quantum space (left column);
- the unfolding of information in the 3-D organization of a material world (right column).

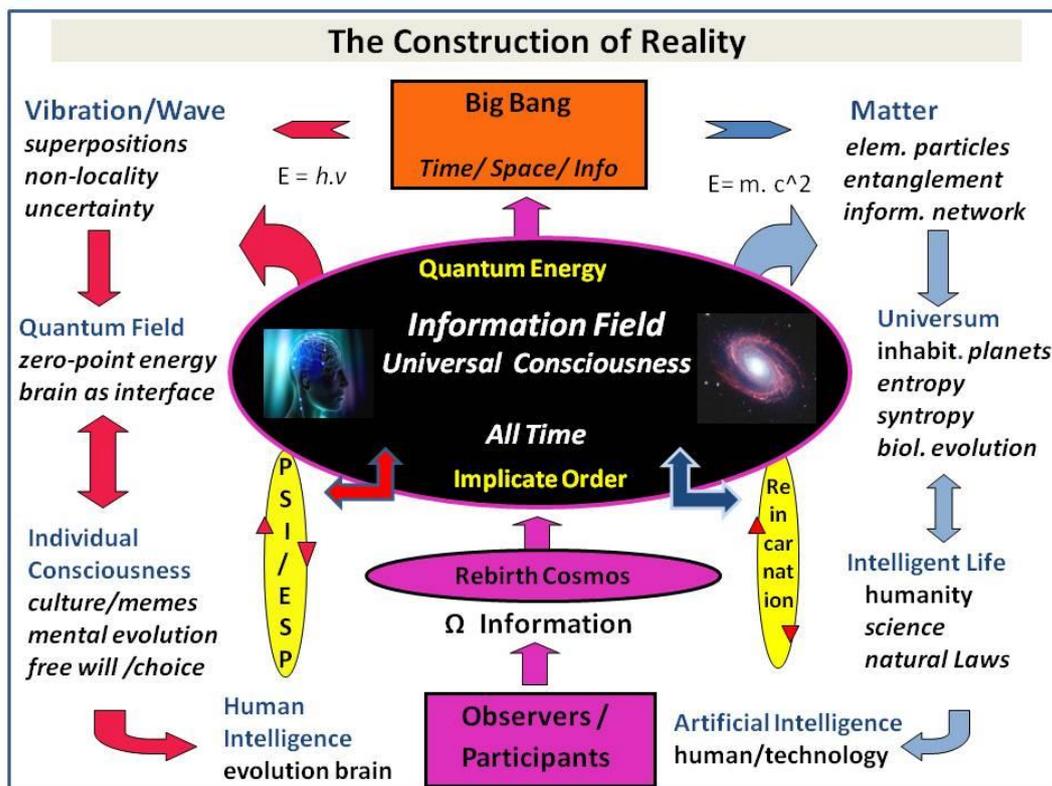


Figure 32. An integrated scheme depicting the Construction of Reality, with its material (right part of the figure) and mental (left), aspects. This concept assumes a central quantum information field, that provides the very basis for creation of our universe and dynamically evolves further through cyclic feed-back processes from the present reality, in which natural (among others human) and artificial intelligence play crucial roles in observation and participation (see text for further explanation).

These separated processes do not imply the introduction of a kind of "Cartesian dualism", because they are strictly correlated, assuming that any form of matter also contains "mental/informational information, as exemplified in the wave/particle principle, as a crucial basis for the description of nature. More classically, this duality of substance was conceived as panpsychism, (Edwards, 1967; Griffin, 1997; Skrbina, 2005; de Quincey, 2010; Strawson, 2009). Yet, in our view, Universal consciousness rather implies a dynamic field of information, with a continuous and bidirectional flow of generated information that originates from the entire universe, including our own world (Meijer, 2012, 2019a).

Extra-sensory communication (ESP) in telepathy and premonition as well as in PSI-type of experiences, (clairvoyance, and near-death experience (NDE) phenomena, see yellow ellipse on the left in the figure above), can be seen as an interfacing of our brain with the universal information field. The latter cyclic process implies that death, that is often seen as a passage into another domain, is rather a continuation of an existing state, since individual (mental) information is, at any moment, already expressed in this universal knowledge field (Wolf, 1996, Meijer, 2019b).

By means of the gathering and compression of all of the past and present information, the potential for the start of a new universe is produced (Meijer, 2015). The final stage of this process was previously indicated as the Omega Point (Ω Information, (Fig. 32), as put forward by Teilhard de Chardin, (King, 1996), and more recently described by Barrow and Tipler (1986) and Tipler (1995). This process of storing universal information also includes the processing, and internet-like distribution, of knowledge, as well as the compression of this information in the form of future (re)-formulation of the laws of nature. It also implies an ongoing communication and circular causality between the individual and its exo-world). The latter should therefore include the universal information field as proposed here.

The underlying implicate order, as an essential part of the universal consciousness, is viewed upon as containing the primordial recipe for the development of life and is the basis for the unfolding of the initially compressed information (Fig. 32, information field in the center).

The entangled flow of mental and material information, pictured in the scheme, obtains a circular character through a final integration of the two knowledge domains at the Omega Point, ultimately resulting in a final state of our present universe and (attentively) the birth of a subsequent version of it. The resulting (highly compressed information) is seen as a vision of an ultimate "theory of everything" which is then used as initial information for the next cycle. An ultimate "theory of everything" is defined here as a final statement of self-contained, internally self-consistent and compressed information that can be used as the input for a more refined version of the previous one (see bottom center of Fig. 32).

Taking these different aspects into account, the *Universe can thus be seen as an intelligent living organism*, since it is self-observing, stores information, is therefore self-learning in a process of regeneration and reproduction, see also Melkikh (2020) treated in part 2. Human evolution is, in this view, an intrinsic part of cosmology in which intelligence plays a role in the birth and rebirth of the universe (called the rebound universe). This is often pictured as a circular process in which in each new "cycle" identical information is extracted and transferred. However, such a model could, instead of conceived as a circular process, rather be better described by a mathematical well defined, *(double)-spiral or toroidal process* in which in each cycle novel information is gained and added to the already accomplished one, similar to the process of science itself (Meijer, 2018).

Finally, at least one important question remains: if our Universe restarts itself through recurrent symmetry breaking, seemingly producing a division of mind and matter, what

would be the potential role of information in this astounding process? It stands to reason that only the perspective for the evolution of intelligence afforded the *potential for the Universe to observe itself* in greater detail in a self-learning mode, (Meijer, 2012). Only bio-friendly information, coupled to a universal memory, provided a recipe for creation of life and finally for intelligent and participating observers. Due to its entangled state with the material world, the universal source- and knowledge field assumed by us, fulfills the necessary condition to function permanently as a bridge between the mental and material domains.

In this manner it can also be instrumental in the ultimate reconciliation of this catastrophic separation of mind and matter. Of note, it was the gnostic prophet Mani (216-276 AD), who projected that reconciliation of mind and matter is the very aim of the Universe and will be brought about through the saturation of matter with light.... In the current scientific endeavor, information should therefore be positioned as the most fundamental aspect of the architecture of reality.

From the abovementioned phenomena it is obvious that a “final theory” in physics in the future, should describe *both* the *material* and *mental* aspects of reality and consequently must integrate a testable model of consciousness and self-consciousness. Such a comprehensive model of the whole should also be based on a solid mathematical and geometric framework and be compatible with *a completed theory of quantum mechanics*. It should thus, implicitly, include an integral description of the cosmos at the micro- and macro scale. The hypothesis that gravitational integration and compression leads to a universal memory space of which individual human self-consciousness is a discrete part, should be further investigated, (see for more information on this aspect Carr (2017) and Haramein et al. (2016)).

The present hypothesis on brain function, may for some readers imply that a part of our memory is *localized externally from our organism* (non-neuronal and even non-

material). However, it should be realized that the present authors situate this mental workspace in an extra (fourth) spatial dimension, which is not visible to humans, so that differentiation between extra- and intra-neuronal is trivial, while the supposed mental modality is in fact quantum physically defined.

In addition, in the present work we emphasize that aqueous compartments inside and surrounding the brain neuronal tissues may play a much more central role in the creation of (self)-consciousness than traditionally thought. We hold that these cerebrospinal and interstitial water compartments can function as an important part of dedicated antenna domains for receiving external and internally produced EMF signals. We stipulate here that the information dissipating brain, as earlier conceived (Vitiello, 2001), may create our integral and universal memory, coined by the latter author as “*our double unveiled*”.

Consequently, as mentioned above, we consider our concept to be compatible not only with present neurological concepts, but also with trans-personal observations such as the unexpected brain to brain connections as recently experimentally demonstrated by Hasson *et al.*, (2013); Wackerman *et al.*, (2003); Radin, (2004); Richards *et al.*, (2005); Standish *et al.*, (2004); as well as Pizzi *et al.*, (2004). In a similar vein, we should take into account the many cases of reported personal life panorama’s pictured in stunning detail by the many registered near- death cases, (for a critical discussion on the latter item see Lichfield (2015).

In such NDE visions, astounding transpersonal information states of consciousness states are experienced in the absence of neuronal processing and fluxes of information in brain cortex (Greyson, 2013, Meijer, 2019b).

Also, in the light of the superb treatment by McGilchrist (2009) of the very different features of and crosstalk between right and left-brain hemispheres, as well as its socio-psychological implications, one should ask how this very crosstalk is organized, and what

determines its outcome, memory storage and retrieval. A personal supervening and integrating memory workspace, that, among others, is mirrored in the water compartments inside and surrounding the brain, as postulated in the present paper, could be envisioned as a “third hemisphere” in a 4D context, that earlier was framed as our “Double”, and interestingly, long ago by Greek philosophers as our “Daemon”.

It is shown in the present paper that the consciousness aspect of “bottom up” pansychism can be reconciled with the “top-down” aspect of a retro-causally driven guiding field of thoughts and qualia, (see a stimulating discussion on that in Kastrup (2017, 2018)). We submit that such interlinked processes occur due to their physical relation, being a two-way recurrent information flux that can be modeled by the self-referential toroidal geometry, in which consciousness returns to itself in an everlasting dynamic mode.

Nature thus seems to unfold itself through the operation of natural laws within a matrix of semi-harmonic relations, as guided by a *musical master code*, creating an overwhelming symphony that we experience as a vivid dream of a concealed reality. Humans, in this respect, are not only observers but also active participants in this cosmic endeavor: the evolution of conscious entities have been woven into the cosmic code from the beginning. We hold that *the ZPE/SFQS domain is instrumental in these events and that we may, for the first time, have identified, at least a part, of its EMF frequencies*. These resonance patterns may also represent a pilot wave aspect of the “hidden” implicate order as proposed long ago by Bohm and De Broglie. Finally, in this sense we clearly touched upon, what is called, the “*Hard problem*” of consciousness studies of Chalmers (1995), since our model, apart from the aspects of Chalmer’s (relatively) “*Easy problem*” of neurological/behavior correlations, the present study also treats his

conceived “Hard problem” aspect through its considerations on mind/matter relations and the potential origin of qualia. The present model also highlights the basic notions of top-down causation and potential retro-causal quantum influences on life processes.

Here our journey into deeper levels of the fabric of reality ends, at least for now. Yet we will remember the wide vistas and beautiful horizons exposed to our exploring eyes: will we ever oversee the splendid integral landscape so secretly hidden from us by nature?

The late John Wheeler, in 2015 revisited by the first author, (Meijer, 2015), expressed all this with his famous prophesy of hope:

"Someday we'll understand the whole thing as one single marvelous vision, that will seem so overwhelmingly simple and beautiful that we may say to each other: 'Oh, how could we have been so stupid for so long? How could it have been otherwise!'"

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