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Review Article

Reflections about a "Membrane" between Mind and Brain

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Abstract

This review presents biophysical and quantum physical aspects of informational processes coming from the early evolution till the human brain. Here, the sophistication in the layered cortex architecture as well as the functional orientation of its areas has built nearly "free" zones for associations and connections. With our self-consciousness, a further horizon is reached which represents a "membrane" or portal to other space dimensions - leading out of the narrow cage of the brain.

This notion renders the brain cortex into a kind of "antenna". Some possible ways of this linkage to these "outer space dimensions" are discussed, also looking to psychological aspects like "extended mind", terminal lucidity" etc.

Introduction

This article is about the relationship between the subjective experience, the "realm of the mind", a world that is internally recognizable through introspection, and the parallel (epiphenomenal) informational processes in living systems and finally, our brain. This "hard problem" is one of the biggest mysteries and one can only approach it in all modesty, and it would be naïve to try to solve it [1]. Many interpretations are to be found in the literature from materialistic theories, e.g. mind-brain identity theory to dualism to panpsychist and monistic views, where a universal spirit is behind everything. Here, Kuhn [2] has offered a recent and ample overview.

These theories and especially the quantum theories can only give a kind of mediation in the relation between the mind and brain. However, no real solution has been found, yet for this hard problem, "the problem of finding a naturalistic explanation for the qualia, namely these immaterial connotations of our experiences" [3].

In approaching this riddle, many articles looked first at the basic principles of how matter became "active matter" and later "living matter" in a kind of self-organization [4-8]. Here, a focus was laid on processes that increasingly get an informational - means negentropic - grip on the building blocks of matter [9].

Thus, matter is leveraged to higher and higher complexity, showing at least the typical signs of life. Furthermore, if this uplifting spiral is working with quicker media like electromagnetic fields or quantum processes, then informational processes can easily take place in living organisms. By this, we encounter the so-called minimal units of consciousness (MUC) - well described in recent papers [10-14]. The upgrading development of informational processing starts with the smallest feedback loops between a stimulus and a reaction already in protocells and archaebacteria [15]. These are the smallest building blocks of a goal-oriented, teleonomic way of working in the sense of minimal physicism [11,16,17], turning even the smallest living beings into responsive entities.

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As a result, e.g., bacteria can react to environmental changes, move to the food source, or avoid toxins. Of course, all this also applies to higher organisms, such as single-celled organisms [18-20]. Here we already have even higher abilities, such as a memory that reaches into the past [11]. In such organisms, their free energy [21] is only enough to go back to the past to remember particularly damaging events, less so also to remember positive ones such as food sources, etc. because reflecting on possible future events would cost too much energy. At this point, nature not only has a goal-oriented (teleonomic) component but above all an economy-oriented component (minimal free energy principle) [11].

This is also the origin of the use of quantum processes – already found from the elementary waves/particles to atomic orbitals etc. – for information processes [22-25]. Finally, in eukaryotic cells, the actual processing of information takes place at the cell membrane or in internal membranes/compartments. Here, the principle of Markov blankets applies [12,26]. This means that information processing happens behind a blanket in a protected space that is isolated from disturbing influences of the surroundings. Thus, molecules can interact with each other via their charges/related fields and via quantum processes (see below). A read-out of the internal calculations gathers the information on the surface of this "protective ceiling" via mediators like EMF [27,28]. For the readout, corresponding frequencies can range from IR to terahertz and to lower frequencies and corresponding beats [29]. Ultimately, this can be converted into chemical information via electron or proton shifts into the activity of enzymes and in conformations, so to speak, which then couple into classical cell biological signaling pathways [30].

So even in the smallest organisms such as protists, bacteria protozoa, etc., we have this principle of MUC [13,31-33] as a gradual breakdown of information from quantum calculations to electromagnetic information and finally to chemical and mechanical responses of the cell. Also in communities, bacteria can display community-level oscillatory dynamics [34,35]. During the higher development of living beings, such minimal units of consciousness can cluster more and more strongly and thus produce ever-larger "thinking apparatuses" [36]. These are collections of minimal units, but nothing has been said about the extreme increase in performance in the further development of the brains of invertebrates to vertebrates, mammalians, and humans [37-41]. At the end of this evolutionary line, self-awareness of the human mind appears, and the human brain has reached an overall sophistication that integrates all the above-mentioned tools of biophysics, biochemistry, etc. gathered during evolution [13,42].

However, if we look at human consciousness: which mechanisms are behind the seemingly disparate nature of the subjective self-consciousness and the epiphenomena that are going on concomitantly with the movements of our mind. For example, there is a "disparity between the rapid succession of mental processes and their electrophysiological correlates, such as those measured by EEG. This discrepancy raises fundamental questions about the nature and speed of thought relative to their physical manifestations in the brain" [14]. In the end we have to admit that "the evolution of human consciousness is utterly inexplicable from the principles of classical physics" and "In quantum physics, consciousness is causally effective and capable of making genuine choices for control of observed behavior. The transition from classical to quantum thinking in biological sciences could be enabled by appreciating the quantum nature of physical systems as a useful physical resource that allows them to achieve tasks that are impossible for classical systems" [43].

In the human brain, we see that the fugitive world of quantum calculations is transferred to the processing layers below via electromagnetic fields by ephaptic coupling [44] with direct and local transfer via gap junctions [45-49]. By this, thresholds for action potential firing are changed. This in turn leads to, e.g., long-term potentiation and chemical/ionic facilitation on synapses which are the templates for morphological changes within the brain. Finally, morphological changes are represented by outgrowing and re-ordering of dendritic spines or changes in the quantity of axonal myelination [50,51]. Thus, we see with our instruments of today only skid marks of the informational processes within the brain and of the sceneries which are subjectively accessible, and which are going on with the speed of faster processes like quantum calculations [14].

In any case, during the evolution of information processing, the human cortex has fully reached a border, mediating the "real" outer world with a realm that possibly lies in "higher dimensions". This mediation might be done with the quantum world of the brain. This appears like a "membrane" in the quantum world or in analogy to a comment of Roger Penrose: "Or is the goal of our quest beyond quantum physics?" [52].

This quest should be also a topic of the present article. The expression Akashic Chronic (A-Field after E. Laszlo [53]) for a memory beyond our 3D space and time was already used in a previous related article [13], the present manuscript goes even further from reality - at first glance. However, more and more scientific papers come onto the scene on this topic [54, 55], some of which were dismissed as voodoo only decades ago. But with the latest data from physics and many other disciplines, things can be increasingly confirmed that were previously considered completely absurd. Furthermore, due to modern information techniques, big data mining, etc., so many compelling proofs exist that the mind is in no way restricted to the narrow cage of our head: phenomena like lucid dreams, near-death reports, xenoglossy, terminal lucidity, out-of-body sensations [54,56-59] are mind baffling. So, questions remain: with which eyes does the person "out of the body" see the sceneries that are reported, and which are in most cases proofed as real? Why could people sense events without "real" senses which then proofed that they really happened? In many cases, our established science performs contortions to answer these questions and takes refuge in complicated linguistic expressions as well as offering pseudo-rationale explanations, like mass hypnosis or random coincidences, etc. – in order not to let any further questions arise here.

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Regarding extrasensory perceptions, the first cautious approach to leaving the narrow brain-cage is the concept of an "extended mind" [60]. Here, objects within the environment function as a part of the mind and are a "coupled system" - a complete cognitive system of its own. In this manner, the mind is extended into the physical world, to man-made machines or social groups.

The present manuscript adds arguments from various schools of philosophy and humanities to the topics mentioned above. Corresponding results are often hard to proof or disproof scientifically, however, in the last years we have experienced a rapid increase of canonical scientific literature that tries to reconcile such different poles [54]. In this line, the following topics were analyzed:

1) At the highest-level within the brain, information processing is via quantum physics or beyond quantum physics.

2) Phenomena of time in quantum processes and our brain

3) For the process of self-recognizing by our mind the system of self-representation must possess at least one "dimension of possibilities" more.

4) Where is the interface, the "membrane" through which the 2 realms (our brain in a 3D world and a "higher" space dimensions) can interact?

5) So where could the "membrane" be located and what could it look like?

Results and discussion

At the highest-level within the brain, information processing is via quantum physics or beyond quantum physics

We have to seize again the notion that the brain is working at the highest level with quantum information processes and that our subjective experience tells us that sceneries come very fast and can be shifted without delay.

Quantum processes have developed in evolution over billions of years [6,8,61] – beginning with the basic elementary physics, to quantum orbitals of atoms, to molecular reactions with tunneling in enzymes, then information conduction processes in larger biomolecules like in microtubule, etc. In the words of Zhi and Xiu [62]: "Life and consciousness are based on structure, order, connection, correlation, and coherence. Neural systems, membranes, microtubules, DNA, and the structures of living systems have greater similarity with crystals, semiconductor materials, superconductors, lasers, and superfluids. In classical mechanics, the existence of such phenomena is impossible; they need to be studied with quantum physics." Furthermore, quantum phenomena are hierarchically ordered with feedback loops reaching up and down, with classical macro levels providing the context for quantum events [25]. Nevertheless, quantum processes always emit photons, and they can theoretically bridge further distances in the brain.

As mentioned above, biology always works with approximations in the direction of optimization and not with a (digital) formulation of ideal solutions, which are then immediately realized [63]. In this respect, this procedure is very similar to quantum calculations, because here possibilities are explored, namely with photons. Again and again, photons are exchanged in the connection of the molecules working with each other [64] to approximate the optimal result. The high complexity of all thousands of reactions that take place simultaneously in a mammalian cell [65], also renders the statement of Görnitz [66] understandable, who writes about the quantum relationships of molecules: "It is only through the entanglement of photons that it becomes explainable that information structures arise whose complexity cannot be captured with single photons or even with ideas of electromagnetic waves." Photons form anew in every new quantum calculation and entanglement period, always at the starting point of the factual (materialized) starting points, and are fluid and exchangeable as long as a fact has not been formed. Nevertheless, the complex interplay of the entangled photons then forms a new information structure, which finally forms a new fact when the state vector collapses [13].

Overall, however, the exchange of information initially via the quantum level costs much less energy [12] than if substrates are immediately realized as reaction products, then degraded again, and then realized again. The same applies in information processing, here not everything is "printed" out in the same way in the calculation, read, and rewritten, i.e. the hardware of the brain – the connections of the neurons – is changed in the same way. As with computers, it first goes from the subtle quantum level into the photons, i.e. electrical level, then in the direction of "firmware" (in machine language) with computers i.e. the chemical synapses and the physicochemical action potentials, before it really changes the hardware, namely in e.g. the outgrowth of dendritic spines on pyramidal cells or other relatively solid compounds [14].

It is true, that in the brain a large computing capacity is possible, especially if one applies the holographic model (2.5 Pbyte instead of 30 TB – conventional neuroscience) [67]. It was calculated that the brain can perform about 10^{13} to 10^{16} analog calculations per second and requires about 15 to 20 watts of chemical power. A supercomputer (IBM's BlueGene/L) can do up to $3.6 \cdot 10^{14}$ double-precision floating-point operations per second, however, this requires about 3.2 megawatts [IBM 2004, 2024]. Thus, the brain would cook itself up, if it would only operate in classical ways [63]. This also applies to other molecular processes in the cells, and one would generally have to consume many more calories in order to cope with the enormous metabolic rates - a person builds up (and breaks down) the same amount of ATP every day, which corresponds to his entire body weight! Here, again, an economy of free energy has prevailed (see introduction), which can be found throughout biology.

These arguments make it very clear, that quantum principles were already exploited for information transfer in primitive protocells [15,68] and finally in eukaryotes. For

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example, unicellular organisms like amoebae can react very variable compared to larger organisms with a nervous system. Of course, a single-celled organism has no nerve cells or nerve system. Nevertheless, it avoids an obstacle in a coordinated manner and uses the beat of its cilia in a highly "concerted" manner. That is why Hameroff and Penrose [19] blame the microtubules of the cytoskeleton for this function, and also for the necessary quantum calculations via hexagonal benzene-phenyl rings of the microtubules that share three delocalized pi orbital electrons, forming "pi resonance clouds". Thus, quantum coupling is possible between these clouds [69,70]. However, other mechanisms via membrane channels and ions or spin - spin correlations are proposed for cellular quantum computing and information transfer [71-73]. In any case, brain information processes are search processes [74] and these work perfectly with quantum mechanics [66]. Most processes below the level of quantum calculations we can resolve with functional MRI as well as the extremely complicated neuronal wiring [75] and their functional gradients [76]. Magnetic recordings already record electric (ephaptic) couplings of multilayered neuronal arrays [77]. Thus, we begin to understand the functional interplay of "semblions" [78], of the mental states, perceived objects as well as feelings. We must admit that these classical electric and electrochemical phenomena are working very fast [79], however, many "higher" cortical functions than the processing of visual stimuli must use quantum calculations [80].

But back to the general quantum relationships in the brain: in fact, recent proposals suggest that unknown systems can mediate entanglement between two known quantum systems, if the mediator itself is non-classical. For the human brain and by NMR detection via zero quantum coherence, Kerskens and Perez [81] have found that entanglement mediated by consciousness-related brain functions must be non-classical. In this respect, it was shown that fluoranes which are used for general anesthesia interact exclusively with quantum-entangled (!) photons and not with individual photons [82]. This suggests that, at least at a fundamental level, there could be a mediation via photonic information directed towards nerve cells. It also indicates a potential causal relationship between consciousness and brain function at the photonic level.

Thus, at this level brain functions should operate non-classically, which would mean quantum, or "beyond-quantum" based. This also shows that in the brain such phenomena exist not only in the nm and µm range but also macroscopically [75]. For such quantum phenomena, Nishiyama, et al. [67] proposed a holographic brain theory by super-radiance. They posed the question "where is the image of the outside world formed inside the brain? Ruppert Sheldrake hypothesized that we actually send waves outside our body to probe the space around us. On the other hand, Karl Pribram proposed a holographic image formation within our brains [67]. Which of these ideas is closer to the truth? We argue that the holographic brain hypothesis has merits that have not yet been fully explored. One of the possible benefits would be simultaneous integration and synchronization of sensory inputs into a coherent whole."

Holographic representation could be ideal for memory storage, too, because memory is robust against brain damage, as holographic images are robust against smaller damages, and holography can yield a much greater storage capacity than via classical ways [83]. However, this should only be true for special parts of the brain like the frontal lobe and parietal lobes, in other parts like, e.g., grid cells for localization of the organism in the environment, and for other centers, it should be locally confined in the brain [66].

In their "Quantum Theory of Consciousness," Zhi and Xiu [62] find another stringent connection between mind and body: "Life and consciousness are based on structure, order, connection, correlation, and coherence. Neural systems, membranes, microtubules, DNA, and the structures of living systems have greater similarity with crystals, semiconductor materials, superconductors, lasers, and superfluids. In classical mechanics, the existence of such phenomena is impossible; they need to be studied with quantum physics." And for mediation of the related quantum processes, Leong [84] argues: "... that photons, through their dual nature, act as pivotal conduits facilitating the intricate processes of resonance and perception. They bridge the observer and the observed, functioning as carriers of information, and weave a tapestry that is both minutely detailed (via their particle nature) and expansively interconnected (via their wave nature). This simultaneous embodiment of specificity and potentiality within photons is foundational in shaping human consciousness and our engagement with external reality. The concept of resonance, underlined by photon interactions, echoes prominently within the theoretical constructs of Quantum Holography".

Phenomena of time in quantum processes and our brain

But back to the difference in the speed of our subjective experience in humans and the suggested rapid processes via quantum calculations and the objectively measured nerve conduction velocities. Why can we still find our way around in time and not constantly stumble over obstacles or are knocked over? Here you must clearly separate the processing processes in the cerebral cortex from the other more reflective processes in the nervous system [85]. We have a "reflex person" in us who reacts relatively quickly - at least in hundredths to tenths of a second - to predictable stimuli through learned reactions. For example, a protective reflex, defensive reflex, balance reflex, etc. are given as a response to sudden changes in the environment. A specially created pre-dating mechanism guarantees that the reflex person does not come into conflict with the consciously thinking person [86].

Measured with the most modern methods the transmission of a tactile process from the finger to the brain, for example, takes about 10 milliseconds. In addition, if the brain "expects" a second tactile process at the same frequency, i.e. in the same rhythm, then you can even foist other stimuli on the brain, such as a clicking sound, and then this is only subjectively processed "shifted" because otherwise this obviously overwhelms the processing rhythm – or the turning of our attention. On the other hand, there is already a "readiness attitude/potential"

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for similar stimuli that are clocked at this frequency in the brain. These then act as an "over-fast" reaction to similar stimuli, although it is not a reaction triggered directly from the outside, one was in the correspondingly "preset" readiness attitude. This means that the brain always tries to adjust a little in advance to possible situations that will come our way. When looking directly at the brain processes with functional magnetic resonance tomography, a rhythmic activity that jumps back and forth between different brain regions is noticeable [87-89].

But quantum information does not transmit the information as such but must be brought into the real world via complicated readout processes. This is why quantum information is often used in the wrong context. The transmission speed of direct information only goes up to the speed of light. This is why Penrose introduced the term "quanglement" [90], as it is about entanglement or coherence, i.e. modified information. "Furthermore, if information as such could go backwards in classical times, then the paradox would arise, for example, that if you went backwards into the past and killed one of your ancestors there, you would suddenly cease to exist. Therefore, such an effect is excluded and will never be measurable. In the brain, however, an unconscious backward movement of quantum information cannot violate this law of causality, because it remains unconsciously in the brain and has no external effects" [14,91]. This could actually explain the temporal appearances of consciousness, the almost immediate perceptual experience, and also the immediate formation of the will.

On deep reflection on the phenomenon of "sense of time", it appears as Eddington described it: "there are entities, events, processes, etc. - they take place, and we pass them by ("temporally" - author's commentary)" [92] (Figure 1). Here too, we must introduce at least one more dimension of possibilities, 4+D. We as individuals move in 3D space in time and every now and then we can catch a "tip" of the processes that take place in 4+D from a different "perspective". Even if one assumes this hyperspace in another picture, e.g., as stacked or nested 3D spaces, then one always needs something active as a "driver" in order to go forward or backward in time - just 4+D plus "time".

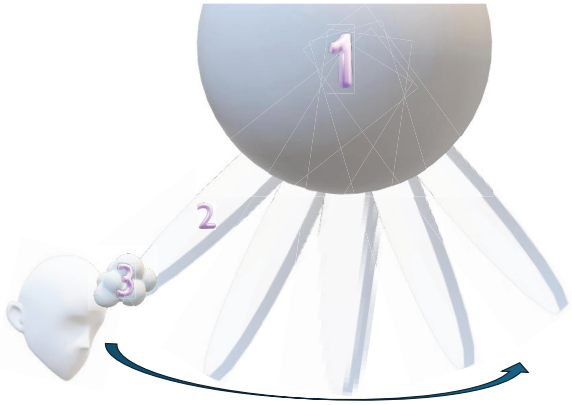

Figure 1: Pouring out of the realm of possibilities (1): events, entities, processes etc. (2) - they take place, and we pass them by (chronologically). We can capture the appearances only at the right time (Kairos) (3) -modified after Eddington [92].

Regarding quantum-mediated phenomena in the microscopic range of microtubuli, Roger Penrose [93] proposed that the brain sends unconscious quantum information backwards through time during information processing. In the quantum world, time is going in two directions, both forwards and backwards. Thus, time itself does not exist as such in the quantum world - see also King's "transactional interpretation of non-locality" [94] have demonstrated quantum entanglement between two photons that are not coexisting. Here, one photon is measured even before the other is created, however, full quantum correlations were found demonstrating that the non-locality of quantum mechanics applies not only to space but also to time.

Only if quantum "calculations" come back via decoherence into our 3D world, do the classical succession of events and causal relationships create the arrow of time. Long ago P. Jordan coined the sentence: "The collapse of the wave function works as an amplification mechanism acting as a bridge between the quantum and the classical world" [95].

Let us again consider the subjective perception of time and how it should be in evolution. In the case of the minimal units of consciousness, we have seen that for reasons of the economy of free energy, it is sufficient to store only past experiences. With the higher development of metazoa up to humans, more and more goal-oriented behavior occurs, which suggests that certain planning for the future is also taking place. This means that the living being can now extend the vector of subjective time toward the future. At higher levels of experience and thinking ability in humans, it is also possible to look at complicated networks of relationships and causal links between people or certain systems. This can be seen like a plane and also extrapolated two-dimensionally into the future as a time level (networked thinking).

For the process of self-recognizing by our mind the system of self-representation must possess at least one "dimension of possibilities" more

In the situation of contemplation over an object, as a viewer in 4+D, one is internalized and in relation to the objects of observation – "For what is inside, that is outside" (Goethe, poems). In this way, I can grasp both sides of the "coin" in the sense of the "quantum observer" (see below), while in 3D (only spatial dimensions!) I separate myself from the object and thus objectively "determine" it - ego and object are thus separated (typical dualistic view since Descartes [2]).

On the other hand, quantum phenomena seem to come from a higher dimension that has "fallen" into our 3D space + time – from a world of at least 4D + time (see Introduction). Thus, the electron orbitals of atoms have both a wave and a particle nature. And, if you look at the bizarre orbital shapes, e.g. dumbbell shape or even more absurd shapes like it is seen in the so-called "rosette-shaped" d- and f- orbitals - in 3D space, one element would never circle around another in this way.

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The tunneling of electrons, i.e. the passage through an energy barrier that would be insurmountable according to classical physics, is also such a paradox [96]. The quantum relationship of "entangled" photons is also temporally permanent and spatially completely independent. The relationship is such that a change in the state of one photon entails an immediate ("instantaneous") corresponding change in the state of the other photon, regardless of whether the distance is µm or kilometers!

With the paradoxes of the double-slit experiment, we enter another additional "space", namely the realm of the relationships of the observer (and his brain) and an external system! These questions lead us back to the world of philosophy. Werner Heisenberg wrote in 1956 [97] "... we must remember that what we observe is not nature itself, but nature that is exposed to our way of questioning."

However, this also shows that one cannot separate the observer (e.g. via his brain) and the observed in such quantum experiments! For example, Heiblum and his group have shown the so-called quantum xenon effect [98]. This means that the more often a system is observed, the more its processes slow down, and they also become more coherent because of this action (depending on the strength of the intervention). They also observed that the more often an observation of a quantum system is made, the more the observers can influence the result that is to come out of this experiment [99,100].

May be some observations like that of the "quantum eraser" may be mis- or overinterpreted [101], but the following statement remains: "The qualitative distinction of traits such as observer-dependent/independent, whether in the epistemic or in the ontological sense, carries a mudskipper. Even if human creations, albeit observer-relative, might not be so by themselves, there is always the Gödelian enigma, i.e., that the decision to claim an entity to be observer-independent must depend on an observer" [102].

Thus, we ourselves (or at least the "determination system" we have devised) are forced to believe that we a part of the strange (4+D) quantum physics that we have just observed! Thought forms, which are sent as quantum resonance from a defined structure from the brain into the 4+D world, should therefore influence the experiment. However, where do the "creative" and the "new" come into the world, regardless of whether it is computer-generated or not – as Brändas [102] addresses it in the so-called NATI hypothesis (Nature is all that it is). So, he has no solution for this problem either. He postulates negentropic pockets in open dynamical systems of self-organization where creative aspects can arise in evolution. However, in the end, he remits it to the very long-time courses of evolution, and we never can experience it in such time courses.

And finally, when introducing other dimensions, one could argue that the "hard problem" is only shifted to other worlds, to other "drawers" and dimensions. However, the problem of creativity, mental connections of new entities, etc., remains.

But again, where is the pilot of consciousness here [103]? As already stated, one needs one dimension more to grasp three spatial dimensions. Already during the vision process, two images of the left and right eye are generated and then sent to the association or representation areas within the brain. In the primary visual center, there are the side-specific cortical columns of representation sending the information to other centers in order to calculate the 3-D impression [104]. In general, for the target process, which is complete and virtually online. Without much delay, many different centers in the brain are responsible for vision tasks – it can involve more than 50% of the cortex [105]! So, if you want to see a so-called tilting image - such as the Necker cube or the fixation staircase - first in one direction and then in the other, then an image changes to the other possibility with a response of 0.5 seconds or more [106]. On the other hand, during the physiological process, of vision, everything is immediately captured by our perception, the three-dimensional situation, color, movement, etc., and the information of the picture is distributed over many areas within our brain.

So, where is the ego, the mind pilot looking at the picture, and where comes the contents of our thinking? Do they come from the subconscious, which represents much more than the consciousness - which is only "a little ship on the sea of the unconscious" [107] or from wherever? Here we can only stick to the inspirations and research results of the humanities scholars (see below).

Where is the interface, the "membrane" through which the 2 worlds (our brain in a 3D world and a "higher" world) can interact?

From the previous argumentation about the speed of information processing and from the many individual data of recent publications, it becomes increasingly clear that the highest level of information processing in the brain must take place via quantum physical processes (see above). Probably, our brain could dive into the quantum world with resonance via such "antennas". And if the quantum world is to be one dimension higher, where should be a portal or a membrane? Is this macroscopically via a direct passage or does the information have to pass through a microscopic "portal" at the Planck level? What properties enable the human brain to act as a quantum antenna?

During evolution up to the human brain, more and more neurons have formed that are not assigned to a direct function, such as vision, hearing, motor skills, etc. [108,109]. In addition, more and more interneurons are created that provide associations between individual brain areas and thus functionally serve to further process the brain's inputs and outputs [110]. And increasingly there is a focus on the links between them and their rapid attachment, dismantling, and conversion - depending on the learning processes. Metabolically, all neurons in the cortex are protected (blood – brain barrier) and are otherwise "mothered" by the glial cells. This allows these neurons, which are mainly located in the frontal lobe, and their connections in layer I of the cortex to concentrate fully on "quasi-neutral" information processing

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[27]. Together with the apical dendrites of the pyramidal cells, they are then, "the antennae" that "listen" into the quantum processes. On the other hand, according to the common view, at some point in the evolutionary line towards humans, a critical limit of complexity, density, and quantity of neurons and their connections was reached, which then led to the emergence of a new quality [111]. This new quality should then be consciousness and later self-confidence. But from where does something e-merge? From which space of possibilities does something suddenly appear?

Of course, we have to learn from birth to deal with our environment. We have to learn what the things around us mean. In the visual process, in coordination in combination with sensorimotor skills, we then slowly "understand" and "know" our environment. At the same time, corresponding "resonance groups" of neurons are connected, which then virtually map the outside world in our brain [38,40,76]. At the same time, our behavior is constantly corrected by positive and negative feedback from the outside world, and thus internal circuits are also readjusted. For example, we also have to learn to rein in or control our emotions. In this way, a "censor" sits on the more primitive basic patterns that normally control our emotions. And so, it goes on and on, until a moment appears in the individual development in which the first self-confidence shines through. And in such a way that we can evaluate and observe ourselves relatively neutrally - as if from the outside - in the most elaborate case – without getting too entangled in emotional relationships again – put ourselves in other people's shoes [85]. A "higher dimension" of perception that interacts with the rest of the brain. But if a more neutral neuronal matrix (e.g. in the frontal lobe) is formed, shouldn't that also be a mirror, an antenna, or better many antennas with many radio receivers, with which we can adjust to increasingly complex levels or "station programs"? When certain "ideas" come to us from outside, it often happens, as a complete thought picture, and one experiences here everything immediately. What about "evidence experiences" - when we have the sentient that what we feel as an inner experience corresponds to what we observe outside? This could be because our inner resonance fields coincide with what comes to us from the outside. Therefore, the receiving station for subtle quantum thought processes and inspirations should easily be in resonance, e.g., via quantum and electric processes (see above).

So where could the "membrane" be located and what could it look like?

Couldn't the passage between the worlds also be on the lowest level, at the Zero Point Fluctuation (ZPF) and Quantum Kinetics? Then we are no longer dealing with the antennas quietly set to reception, but we look at the level of zero-point fluctuation. There is a wild gear here, but this level is smaller by orders of magnitude than the level of elementary particles, atoms, and molecules (10^{-13} m). This means that this swirling quantum foam fits billions of times between the elementary particles. Here, virtual particles come and go even at zero degrees Kelvin in what is known as the ZPF. This happens near the so-called Planck length of 1.616×10^{-35} m and at extremely short-term intervals up to the Planck time of 5.391×10^{-44} s [112,113]. This ZPF could therefore be the common denominator between the quantum field and the membrane.

Keppler [114,115] suggests a resonant amplification of zero-point modes of our mind processes within the brain as a kind of projection into the ZPF and a resonance by phase locking of similar attractors [116]. In this respect, Poznanski [117] proposes "that the fundamental process of consciousness originates from raw fluctuations at the molecular level (~ 0.2 nm to 1nm), where thermal molecular agitation is a source of molecular-embedded raw fluctuations." Here, "thermo-qubits are supposed to be the noncontextually raw syntax at the source of syntactical structures. However, he argues in a recent paper [118] that information quantization should be seen as a macroscopic quantum effect with structuration in time by resonance, synchrony, or coherence.

In any case, active work with the "ideas" as a whole, or the relationships of the thoughts, must take place through the working memory and through the whole brain, whereby the active structural or intentional process is particularly decisive [118]. But where do the ideas from the unconscious come from? Where does the unconscious, the body consciousness, get its information from?

In any case, with the elementary particles, atoms, and molecules of our whole body, we are completely embedded in the ZPF level. In this way, the body could also receive similar information! Such questions remain unanswered, and we can only rely on the reports of the humanities scholars. But if we receive from the noise [118] what we project into it, in the sense of a "reflexive monism" [119,120], then the question remains, where does the "new", the creative combination of what has already existed, the impulses or the complete reorientation come from? Do we draw this from the unconscious, from the "body consciousness" or from other "hidden" deposits in other parts of the brain or the autonomic nervous system [121, 122]? Is it possible that the 4+ dimensions are placed around us and in us (we as 3D humans can hardly visualize this) and we then get it from our body up into the brain? This 4+D penetration is it also between atoms and elementary particles? And if the "parts" of our thought content are regrouped in the "other space", in the 4+D – who or what helps with this? Are these the subtle "auras" of the "transition zones" on the membrane (that are still to be discussed) that "color" the contents of feelings and thoughts individually according to our traditions, language, socializations, country specifics, etc.? Or is it again what is stored in the brain (wherever) as "memory" from the earliest imprint before and after birth?

The fact is that we cannot completely get out of our imprints of continent, country, language, culture, religion, etc. [123, 124] - partly through extremely disciplined training and preparation. This also applies to our perception of sensory stimuli, which is mixed with immediate interpretation – we are already shaped by evolution in such a way that in our memory and therefore in perception and behavior, the dangerous and negative for our survival are interpreted more strongly – i.e. fear and avoidance patterns – as recklessness or excessive daring. This has already

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shaped the basic connections in the brain pathways. And so, it goes on with what we have already been given in the course of life. Ultimately, it is also a reflexive monism or a "supradual construct" [120]. Supradual means that behind the dualistic image between the "world of things" and the "world of the mind" there is another world – in another "space" dimension, so to speak. That's why Rapaport explains this with the image of the Möbius strip or small bottle, which is expanded into the HyperKlein bottle. Overall, these constructs then become similar to protyposis, or the "subquantum background" - a background geometry that we find in the theories of spacetime [63,125-128].

What does Protyposis mean, or with background geometry in the physics of space? And where do we have to imagine the passage level, the "membrane"? The term "Protyposis" was coined by Görnitz [63,66] it is a reason why everything that exists can be represented in a three-dimensional space as a consequence of protyposis [63]: "For reasons of group theory, it is the space of representations of protyposis, the space of its "appearances"... Thus, the movement of the Earth and the Moon is recorded with six spatial coordinates and six-speed coordinates – i.e. in a twelve-dimensional space – even though all this happens in three-dimensional space. The prototype anticipates possibilities - if they manifest themselves in our 3D world, they are then channeled into certain paths by this fixation." According to Görnitz, this is also called "dynamic layer structure" because step by step (always first protyposis and then manifestation) in our world then result from the possibilities getting more concrete realities. The more is concretized in this way, the narrower the paths or the levels or spaces of possibility that remain for fingering out the potentialities become. This is reminiscent of evolution (mentioned above), which also explores almost all possibilities of biological manifestations over very long periods (deep time) and possibly brings them into our world. For the protyposis, there are three manifestations in our world that can be converted back into each other: information, energy, and particles – and "simple things can be extended and complex things can be small" [63].

Regarding the information processes of the brain, this means an interplay between software and hardware according to protyposis as the unified framework of quantum physics, matter, and information. This intimate relation between soft- and hardware as a dynamic layer structure is expressed in the notion of "uniware" [63].

Discussion and future directions

You can see that you do not necessarily have to go over the "quantum foam" to explain some quantum phenomena because such a connection is already possible in larger up to really macroscopic systems. However, the common denominator remains the "connectedness" and the "instantaneous" (without delay) exchange of information.

Expanding to brain processes Pribram [74] states "My claim is that the basis function from which both matter and mind are "formed" is the potential reality, the flux or holo-flux, [129]. And for the decoherence of the neuronal quantum processes Pribram cites Stapp: "Brain process is essentially a search process - the brain searches for a satisfactory response - and then dissipates [increases the entropy of] its energy in the initiation of the action that it represents".

In this respect, David Bohm [130,131] pointed out many striking similarities between the behavior of our thought processes and that of some quantum processes. For example, while entertaining a vague train of thought, the act of concentrating on one, to bring it into better focus, changes the original sequence. Like electrons governed by Heisenberg's uncertainty principle, which are never the same again once they have been looked at or measured, a thought that has been highlighted through attention is different from the vague musing that preceded it. The focused thought has "position" like the particle aspect of an electron's two-sided nature, whereas the vague musing has "momentum" like the electron's wave aspect. We can never experience both simultaneously. This is a characteristic feature of a quantum entity. However, Bancal, et al. [132] suggest in their paper "Quantum non-locality based on finite-speed causal influences leads to superluminal signalling" that quantum correlations somehow arise from outside spacetime, in the sense that no story in space and time can describe how they occur..."

Regarding ZPF De la Pena, et al. [133] present a quantum formalism where both matter and radiation field are shown to emerge because of the permanent interaction of matter with the ZPF. They argue that quantum mechanics alone represents a handy, but incomplete description of the statistical behavior in configuration (or momentum) space of the mechanical part in the particle–field system. With their elaboration of nonrelativistic quantum electrodynamics, they suggest crossing the doorway go beyond quantum mechanics.

Possibly, we project our mental activities into the "white noise" of the ZPF and here they enter the "other world" formed as "Geistgestalten" (shapes of our mind) and then they come back to our brain with some modifications, creative impulses and in the case of viewing or contemplation as evidence experiences. But what is this "outside spacetime"?

This view of the ZPF regards it like a hyperspace [125], an aspect which was also mentioned by Volkamer [126] who depicts in his theory of 3 parallel worlds, two worlds of subtle matter (as a kind of background geometry with 12+ dimensions) and our world as structurally identical gross material "crust" of the two others and this is comparable to Plato's "shadow world" and Bohm's "explicit order". Bohm formulated an interpretation of the quantum mechanics of hidden (ethereal) variables), which spans an invisible but actually existing (ethereal) world ("implicit order"). This world superimposes and conditions our visible gross material world with the "explicit order" in a higher dimensional way – including the processes of natural law [130,131]. Also, recent cosmological models propose that we live in a "multiverse" or even in a black hole with our three space dimensions inside more other dimensions and time [134] or with an anti-parallel universe, too [135].

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In the end, if we look at such influences of such parallel worlds and their influence on the highest developed areas of our brain, then our brain cortex is actually "degraded" to an antenna or a receiver. In part, this is because, of course, the rest of the brain has to amplify these signals, reduce them to what can be processed, store them, and prepare them for further purposes. After all, it should also be made available to our "reflex person" who lives in the "now" of classical physics and works with classical nerve conduction, for example.

The following phenomena that cannot be explained in any other way, such as sudden ingenious abilities after brain trauma, anesthesia, or other drastic events, also speak in favor of an antenna function of the brain projecting through the mentioned membrane and projecting into other dimensions. For example, there is a case who, after a severe traumatic brain injury, suddenly had the ability to recognize mathematical and geometric formulas in all the structures he saw. This allowed this person to see fractals (see above) and geometric derivatives in the shapes immediately and intuitively – although he had never shone with mathematical or geometric skills before [136,137]. You can also mentally familiarize yourself with an area of knowledge through intensive practice and constant "sticking to it". In the process, however, the new connections in the brain also change, which makes it more "receptive" (!) to corresponding intuitions again. It is possible that the corresponding new connections and newly developed sensitivities in the brain are then also newly formed antennae for newly built "homes" in a spiritual realm - in a "hyperspace" of whatever kind [125].

Indeed, H. Wahbeh, et al. [57] argue: "If consciousness were non-local, one might be able to perceive information from underivable future events. Experiments testing this idea have shown that human physiology responds to randomly selected future events [138], including electrodermal (skin resistance) [139], electrocortical (EEG) activity [140-142], and heart rate [143,144]. These laboratory studies apparently show that the body can react to randomly selected stimuli about 1–10 seconds in the future. Erotic and negative images produce more robust reactions than emotionally neutral images. Pre-reactions generally manifest in the same direction that the body would normally react after being exposed to a stimulus. This has also been shown by meta-analyses (summary evaluations) of these studies [145-149]."

In addition, this recent work by Wahbeh, et al. [57] has cited several phenomena, all of which suggest that consciousness is not an emergent property of the brain. In this way, information from distant places is perceived unconsciously or consciously. Furthermore, information can be absorbed by other people without them being able to communicate in any way in the classic way. Then, as mentioned above, that up to some seconds into the future can be foreseen, as "feeling the future" [150,151]. This would also fit King's "transactional interpretation of non-locality" (see above). Interestingly, in probands, an avoidance of masked negative stimuli takes place about 500 milliseconds before stimulus onset [152].

It is also reported that people suddenly develop skills that are beyond their experiential knowledge, for example, xenoglossia, i.e. never heard of or spoken foreign languages they have learned before. Furthermore, cognitive abilities can suddenly be regained when the brain is seriously damaged in its function, such as the terminal lucidity of previously severely neurodegenerative damaged people (Alzheimer's and similar diseases) [153,154]. In other cases, people with a rather low level of education have developed mathematical formulas and derivatives in "looked" pictures (e.g. Srinivasa Ramanujan in the last century) that had caused the great mathematicians of the time to be downright enthusiastic and amazed! Of course, the same applies to "born" geniuses, who – as already mentioned – often report that the new and ingenious "fell" to them – almost intuitively. Interestingly, the "ingenious" mathematics of Srinivasa Ramanujan helped to perform calculations for the aforementioned string theory 80 years later.

But here we can only speculate from the point of view of the humanities. What remains is a background that subtly affects our world, which allows for all possibilities, relationships, and processes, but nevertheless represents a connection of the whole from the origin of matter to our consciousness and leads to the phenomena discussed, in whatever way.

So, the "Membrane" for the communication with the brain as well as with the organism could be both within the subatomic even within the "subquantum level" [127] and as well in the macroscopical level, "protypical" and holistic as "Geistgestalten" (figures of our mind). We are all involved in the multidimensional Cosmic Mind [155], in this respect, this is both monistic, panpsychic [62,156] or multiple- or supra-dual (matter, mind as a dual construct) [120] (Figure 2). And of course, with our brain and the experiences we have stored in it (see above) [157], we filter out all influences from higher dimensions. If, however, in moments of meditation and other extraordinary circumstances (see above), we have little or no "filtering" influence here, then W. Blake's words apply [158]:

„If the doors of perception were cleansed everything would appear to man as it is, infinite..."

Figure 2: Horizon of all possibilities (1) imbibing all objects (2) and the perceiving subject (3) in a supradual manner. This "horizon" (1) can be seen as background geometry ("further dimension") serving as mediating "space" for conscious perceptions.

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Conclusion

In the present review, it is hypothesized that man is able to receive and transfer information from another space dimension with a kind of super-extended mind. For these purposes, our body and brain can function as antennae and transmitters reaching through a portal and "membrane" into a horizon of all possibilities that imbibe all objects, memories, and the perceiving subject. Philosophically, this represents a kind of supradual interpretation encompassing both a monistic and panpsychic view. Regarding the portal or membrane to another space dimension, quantum processes as well as sub-quantum processes at the ZPF level are in discussion.

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