

# The body-mind problem as a play between coherence and decoherence.

By Ulla Mattfolk, MSc

## Abstract.

Living matter result from mixed states of quantum: classical physics; the mind and the body. Life depends on a digital state function, and the Schrödinger cat is 'dead and alive' at the same time. There is no total wave collapse, only partial with interference/superposition. In contrast to non-living systems, they don't appear to optimize anything, but is intermediate, and reactive.

Life uses noise or dissipation as a tool to create stability and coherence, through formation of decoherence and negentropic states. Life is indeed quantal entanglement, resonance and superposition, with also noise in perceptions from the surroundings, to keep up the quantal states. To be a living matter made of ordinary atoms and molecules the decoherence is needed, and thence we have two different selves, one that we might call the decoherent singular I, and one that we can call 'the wise man', or 'the magnetic body' in TGD; that is one classic and one quantal self. The longstanding problems of stress, homeostasis and sleep would also get a reasonable understanding.

Perceptions are both classic, through bodily sensations and senses, including thinking, and quantal in form of cognition, awareness, intention, qualia, and also OBE and paranormal events belonging to experiences of our quantal self, the magnetic body. Paranormal events would partly be explained in a simple way.

## 1. Introduction.

The body-mind problem is mostly thought of as illusory (reductional, singular) and the mind emergent from chemistry and complexity. The atomistic view of [assembling little pieces together](#) has been prevailing in the search of the microscopic dynamical laws ruling their cooperative behavior so that the mesoscopic and macroscopic functioning of the system could emerge. Cancer treatment progress *in total* has almost completely been absent of this reason, claims [Paul Davies](#) in [Rethinking cancer](#), although medicine use many holistic physical means in diagnosis (MRI) and treatment (cancer). Biology is not only chemistry and genetics, living cells should be considered as material objects that can be [controlled using physical forces](#). The important role of [mechanical and physical cues/forces in determining cell behavior](#) is increasingly recognized. [Cell mechanics](#) and [biological soft matter](#) has become common labels. Protein conformation can respond to local, small-scale mechanical signals, as [a kind of 'sense', integrated with cytoskeletal mechanics](#), that would make the problem dualistic. Already chemistry is dualistic, depending on quantum physics in the zero point. How is life different from chemistry then? Complexity alone?

Cells' ability to [sense and generate forces appropriate to correct tissue context](#) gives tissue morphology and function, perception and action. Force effects on cells have long been studied, but the understanding is still low of how they propagate through and act on different cell substructures as dynamic deformation in response to a time-varying force, resulting in models for cell motility, deformability, and sensing, rooted at the molecular/atomic/particle/wave/string level.

## 2. Sensing and perceptions.

### 2.1. Perceptions uncertain and probalistic.

["We learn by asking"](#) the right questions, by sorting and selection of knowledge, sensed

through [perceptions](#) (innate as intuition), and experienced as [a fuzzy, probalistic, uncertain knowledge](#), requiring 'sensing' or interaction, as a 'sampling'. Underlying much of the information processing is the need to fuse information ([clustering](#) and [granulation](#)); especially in attempts to get awareness or 'intelligent' operations, characterized by a degree of global ordering in the data. The [self organising-map](#) guide as a topology-preserving architecture, '[Using Maximum Entropy to Estimate Missing Information](#)', as instance. This sorting we have forgotten in the discussion. The lowest energy state is the preferred one, (the 'vacuum' at/near zero) which is the theta-waves, containing most information. Disturbing waves, as the 40 Hz waves, are there only as long until we have sorted them out. The synchronous firing is the disturbance, the work, the modulation, not the result, but dissipation coming from outside (through [p-adic windows](#)?) . [The inner dynamics \(the low frequencies\) set the order of the system](#), and hence the different waves form a hierarchy, and subsystems through symmetry breaking from (squeezed) algebra of coherent states (as superpositions). This is dualism too. Pitkänen use the analog '[the Big Book](#)'.

Perceptions are linked to actions + memory and intentions. Fractality is deterministic, coherent (topology) and a model for holistic self. The question if self is motoric or sensoric was vivid some years ago. The motoric concept resulting from modulations has some favor. This would mean a changing self (accommodation).

## 2.2. Time and consciousness.

There are two ultimate questions: 1.) ["What is reality without human observation"](#)? *"Is the moon there when nobody looks"*, as Einstein put it, or the measurement-problem. Is consciousness there without human mind, linking consciousness to measurement? This tells us nothing of the source of consciousness, which may be coherent information out of body. Vitiello's model of the perception and measurement happening through a zero energy point, with creation of a negative and a positive energy/time cone; [The Double](#), giving a mapping/mirror by deformed Hopf algebra. Pitkänen use [Zero Energy Ontology](#) . Time is in this sense created as a personal experience, a subjective time, linked to perceptions. [Kauffman](#) came to the same solution. Presens is the zero. Living tissue is most heterogen in time-aspect. Different tissues experience different times/distances (live at different spacetime sheets of the Book).

What is 'innate knowledge' and where comes it from? Is it a gift from 'God'? What is God? Mathematics has some of the attributes of God: to exist outside time, pointing to the importance of perturbations (breakdown of symmetry) for creation of the consciousness. What is understanding? It needs an observer, a 'Self' forming a meaning, and not only a mechanical accumulation of facts. It is the 2.) [hard problem of consciousness, qualias](#) (the question how, quality, experience as in [Chalmers](#) dual 'zombie' world). The understanding is [a reflection from Nature](#), as realized from the fact that mental pictures, patterns, imaginations etc. are the (mathematical?) keys to understanding, as a principle of *coherence* between *consciousness* and *awareness*. Recall, awareness refer to various *resulting* functional phenomena and processes of cognitive art, associated only with the more primitive consciousness.

Information has at least a double aspect of qualias and logic. Humans are compared to [Mistake Making Machines](#) considering errors and mistakes related to inadequate usage or functioning of physical or logical devices. This gives the learning capacity.

### 2.3. The trinity.

The triplet body, mind and soul, are also important. The 'magic' number three is found in so many places, and it can be linked to the primes and the cosmic aspect. *"[The separation of total correlations](#) in a given quantum state into entanglement, dissonance, and classical correlations using the concept of relative entropy as a distance measure of correlations"*. Entanglement and dissonance, jointly belong to what is known as quantum discord. Another symbol is the music metaphor. Reality may be a trinity.

### 3. Physical reality and living systems.

Physical experiments are optimized for fundamental, pure states as quantum statistics, delocalization, and entanglement, and ordinary matter quantum phenomena need isolation from environment to avoid influence of decoherence and dephasing. *"[How will life sciences fit into the picture](#) with objects from subatomic particle/string/waves and molecules up to elephants, mammoth trees, or the human brain? Can genuine quantum phenomena be realized with biomolecules? Zeilinger-group showed it could ([wave-interference](#) with strong bonds). This can also be [the DNA waves](#). "New tools are required to define and quantify entanglement in macroscopic framework."*

[Living systems use](#) mixed states giving the quantum coherence in 'channels'/networks or 'antennas'/clusters? Are thus non-trivial, non-linear, quantum phenomena relevant for life? Non-trivial = long-ranged, long-lived, or multiparticle quantum coherences, the explicit use of quantum entanglement, the relevance of single photons/phonons, or single spins triggering macroscopic phenomena. Life would be 'saved quantal (innate) information', and living matter a play between non-trivial and trivial physics, quantum and classic physics, where the surroundings play an important role through sensing and polarization?

Noise or dissipation can induce 1.) [large-scale ecological patterns](#), beyond expectations from traditional non-stochastic approaches. [Massless particles/solitons create higher energy states and long-range correlation \(larger scales\)](#) 2.) [The fine-tuning process](#) can be generated/enhanced as interplay between quantum coherence and correlated fluctuations as a room-temperature transfer process (high  $T_c$ ?) with a marked dependence on the degree of symmetry and *delocalization* of the initial exciton state. Electrons can be [dipole holograms](#) ('quasiparticles'), [loose mass](#) in graphene, or mass change (compression-extension), [are dephased](#) from electron-phonon inelastic scattering, or fractionalized ( $e^2/h$ ) in electron-electron scattering giving composite fermions (quasiparticles, [massless](#) Dirac fermions). [Photons/phonons](#) (and [electrons](#) in doped copper superconductors) can induce decoherence, but also 3.) transmit the non-dissipative state. The stochastic dephasing of destructive quantum interference is responsible for [the fast energy transport](#) in the photosynthetic complex? Information is transferred in the same way in nerves. Life is a quantum play with dissipative structures, [a little as](#) Prigogine once said?

### 4. Life is dualistic.

The open, mixed states in biology and [evolution](#) cannot be ignored in physics. They are real, existing solutions that can tell us much about the physical theory. They have a phase of interference between external (exogenous and endogenous) and internal network (microtubuli, fibrils, genomes, nerves etc.) states. In a way it can be seen as a [\(superfluidy\) energy gap](#), [Zero Energy Ontology](#) with a light-like CD-diamond cone, or [a Dipole two-mode SU\(1,1\) squeezed state](#) of thermo field dynamics, with the generation of time, [the problem of quantization](#) or discreteness, the hierarchyproblem, and the emerging of a life-time (for each momentum  $k$ -mode subsystems). *"[The emerging picture of the canonical quantization](#) is a*

unified view of many features of time evolution in expanding geometry, incl. coherence, two-mode squeezing, entropy and vacuum thermal properties. The doubling of the degrees of freedom is actually introduced by considering the modes of momentum  $k$  and  $-k$  as the couple of modes of total zero momentum in terms of squeezed vacuum: the  $k$  and  $-k$  modes introduces a partition in the  $k$  space and leaves out the zero momentum modes which are present in the quantized field  $\phi$  and in its canonical momentum  $\pi$ .

Two representations of  $u(t)$  in terms of two distinct basis,  $\xi(\eta)$  and  $\chi(\eta)$ , with  $\eta$  playing the role of time coordinate. In this way the doubling of the degrees of freedom is introduced. The 'negative' kinetic term in our Lagrangians also appear in 2D gravity models. In case no negative norm states appear, its canonical structure is similar to the one of non-unitary time evolution. Gives a realization of the  $SU(1, 1)$  structure in terms of a system of [damped-amplified oscillators](#). " [Amplified oscillations have a dominating effect..](#)

[Zero Energy Ontology](#) contains also the asymmetry. Large  $\hbar$  for flux tubes increases the time during which negentropic entanglement prevails: basic structure is causal diamond, chronon, or event. The larger the  $\hbar$  the longer the duration, the bigger the hierarchy.

" For general quantum correlations and their classical counterparts, under the action of decoherence, three general types of dynamics that include a peculiar sudden change in their decay rates are seen. [Under suitable conditions, the classical correlation is unaffected by decoherence. Such dynamic behavior suggests an operational measure of both classical and quantum correlations.](#)" Macroscopic systems cannot be explained without entanglement.

Living systems must be studied as a whole - as complex, topological and hierarchial, entangled beings? The [sign of life](#) is HCONSP and interferences (H-O as water, N, S, P as expansion agents) and carbon containing molecules of different size ([flexibility](#), complexity). That is seen as instance in the COOH- and N-ends of biomolecules, forming a [network of carbon-molecules](#). Redox-reactions are important for entropy/negentropy-creation.

## 5. Superorganisms, -genomes.

This is a most profound realization of the quantum wave-concept giving synchrony and coherence at population level. Population behaves as a self (the 'fish-stim' effect). [Sulfur networks are more simple](#) compared to [carbon networks](#). [Sulfur metabolic bacterial genotypes](#) with the same phenotype form large connected genome networks that extend far through space. How far is a linear function of the number of reactions in all networks with the same *phenotype*, not to the number of reactions in metabolic genomes. Different neighborhoods of any genome network harbor very different novel phenotypes, and metabolic innovations that can sustain life on novel sulfur sources. This means interconnection through other mechanisms than individual, forming supergenomes/organisms? This can be done through long-range tuning 'antennas' or clusters?

## 6. Life and Death are graded.

Is it possible to be partly alive or [partly dead](#)? Can quantumness survive in biological environments in different degrees, as in [a wave oscillation](#) or Gaussian distribution? "The kinetic argument, phase averaging, and decoherence are all consistent with the unitary evolution of quantum physics – not including a qualitative transition between quantum and classical phenomena - [only a gradual reduction of the observable quantum effects.](#)" [Complex complexity](#) versus simple complexity, as instance?

Is it possible to [build living organisms](#) from scratch, as [the Venter Institute](#) claim. But they use already existing organisms, nothing is built from scratch (first they need to know the real meaning of the genome). This is as difficult to answer as the question about emergent structures of space. From what is spacetime emergent? Which bricks are used? What are the bricks of life? Can they be created? Energy cannot be created nor destroyed? Can [information](#) be destroyed (?), see [information as energy](#).

No, said [Presman](#) long ago. He studied em-effects of radiation, a most brilliant study. He showed the nervous system has two purposes, and the far most important one is to inhibit transfer (perifer more decoherent; central more coherent). [Brain is a quantal structure](#), say [Hu & Wu](#); no, decoherent (from surroundings), says [Tegmark](#), [Vitiello and Freeman](#). The same statement; decoherence is inhibition/dampedness from outside. Maybe different bodyparts are decoherent in different degrees? Is ['consciousness' a measure of that degree](#), as seen in electro-measurements especially in the [DC-potential](#) (about 10 mV). This [reflect Nature](#).

[Our brain uses too little energy, compared to a computer](#), what would mean dissipationless functions, as superconduction, thus a double ['state within a state' with quantum dissipationless physics](#). [Brain activity cannot fully be explained by electric field, magnetic field, nor by chemical diffusion together](#). That point to ev. remote metabolism from 'decay' of (dark) matter from the zero point?

[Vitiello and Freeman](#) compare EEG pattern formation in neocortex in terms of phase transitions in classical physics and spontaneous breaking of symmetry in quantum physics. A picture emerges, unifying brain studies and condensed matter physics (at [synapses](#)?). [We can test if anesthetics block quantum coherence in post synaptic receptors](#).

That longer wavelengths have longer coherent potential is also seen in the 7 Hz/40 Hz problem of consciousness, as in the importance of small molecules (as superorganism?) in signaling; the smaller the more important. Methyl is one important example, complex carbon compounds are at the other end. ["The theory of carbon interference is to conceptualize entropy through mass change as a function of space."](#) - degradation, smallness of molecules, entropy shift by solitons (heat) triggers activity (decoherence) that gives off energy... so, in fact we need to brace our metabolism. Eating and drinking = water, lipids, proteins in our membranes...Brain needs a constant cooling by diverse fluids. So synapses are actually also about bracings and inhibition? As the food-demand? A very odd way to look at our biology.

[Rakovic](#) said illness is too much of quantum world. We need decoherence and perceptions, which are both superpositions and decoherence. Too much decoherence gives pain, necroses, cancers, too much superpositions gives psychic illness, functional failures etc. The [absence of contact inhibition](#) in cancercell population growth may be a result of insufficient decreasing of intercellular water activity because of specific cell-cell contact destruction, but also providing good dense contacts between cells with limited amount of water in the intercellular space (forming a tumour/subsystem).

## **7. Subsystems, hierarchies, selves.**

In entanglement, two or more subsystems are needed, as are appropriate degrees of freedom that might be entangled. [The subsystems are known as modes, and the possibly entangled degrees of freedom are observables](#). Entanglement is *the degree of correlation* between observables pertaining to different modes that exceed any correlation allowed by the laws of classical physics. Systems can be entangled in their *external* degrees of freedom (positions



and momenta) as in the EPR-paradox. This kind of entanglement has been shown many times at 'impossible' large distances. Mainly non-locality (GHZ), Bose–Einstein condensates and superconduction (W), resonating valence bond (RVB) and cluster-formation are used in living systems. The type of entanglement also gives [the implementation of various gates](#), interpreted as hierarchies, cut-offs or [boundaries](#). [Lasers and B–E condensates](#) are [macroscopic effects of boson statistics](#), and requires highly [specialized environments](#) (as in [membranes](#), [nerves](#), see [Heimburg](#)). Carbon, protons, photons can be composite bosons, and electrons as composite fermions give the essential bricks of life.

[Topological](#) invariants, [insulators](#) and [defects](#) are made during non-equilibrium symmetry breaking phase transitions [when a region, surrounded by ordered domains](#), remains trapped in the "normal" or symmetric state. Topological defects are a "diagnostic tool", observed as macroscopic objects with classical behavior, e.g. vortices in superconductors and superfluids, magnetic domain walls in ferromagnets, dislocations, grain boundaries, point defects in crystals, cosmic strings. The EPR-paradox may be even interpreted as an 'outer memory' or 'imprint' and trapped memories as inner memories?

The same concept is used in forming [memory](#)? Our brain hasn't room for all memories, so they must be also outside brain, as instance in the body, seen in many [therapies](#). Even life itself can be seen as such a creation, islands of coherent invariants and defects, with self-organization.

[Wikipedia](#): *quantum decoherence (QD) is the way quantum systems interact with their environments to exhibit probabilistically additive behavior. QD gives the appearance of [wave function collapse](#) and justifies the framework and intuition of [classical physics](#) as an approximation: by QD the [classical limit](#) emerges out of a quantum starting point and it determines the location of the quantum-classical boundary. QD occurs when a system interacts with its environment in a [thermodynamically irreversible](#) way. This prevents different elements in the [quantum superposition](#) of the system+environment's [wavefunction](#) from [interfering](#) with each other.*

So decoherence keep up the superposition of the wavefunction? It isn't devastating for life, but a prerequisite? It is a perceptual tool. It gives the collapse, or maybe rather, the interference. Without decoherence there would be no life as we know it. In fact, decoherence is the interference pattern arising when different waves meet. This can be seen in the double-slit experiment too. In fact, I claim that life has difficulties keeping up the decoherence which will always vanish. There are different kinds of stabilities, the classic matter, and the perceptions, sensations, emotions, motions, with many, many time scales, because the protons are said to be of equal age as the Universe, maybe the leptons too. Protons and electrons have the biggest (entangled?) subsystem of all (subsystem of 'God') together with the photons? Living bodies are hierarchial (and fractal) time structures and entropy-creators, and evolution an [open-ended growth of complexity](#)?

This complexity-ladder is seen in the hierarchies of carbon-, and oxygen-compounds in oxygenation, as in the reduction by water, which assimilate the relaxing energy and creates the phase-shift? Could this complexity be treated as black boxes, or qubits, qutrits etc., as topological and fractal hierarchial structures, so we don't need all degrees of freedom, but can use 'holism' or 'boxes', or [the entropy concept](#)?

## 8. Living systems are holistic conscious systems.

Real numbers describe things like water pressure, velocity, temperature, would be vital, and their mathematics could be sophisticated in fluid mechanics but ignorant of number theory. Is there a relation between rationals and real numbers giving life? The dissipation, trigger or stimulus in the external field (real numbers) is responsible of the “phase transition” from the normal (zero magnetization) phase to the magnetic phase. The mathematical structure must allow physically distinct phases (called unitarily inequivalent representations of the quantum algebra) and Hopf etc. algebras are often used to describe this in the inner field. In quantum mechanics (QM), on the contrary, all the state representations are physically equivalent (unitarily equivalent) and therefore QM is not useful to describe phase transitions.

*Close relationship between a quantum harmonic oscillator and the classical particle moving along a circle was discussed by t'Hooft. Dissipation of information would occur at a Planck scale in a regime of completely deterministic dynamics and would play a role in the quantum world. Algebraic structures underlying t'Hooft's relation of classical systems with the quantum harmonic oscillator, is discussed by Blasone et co.*

*The possibility to define entropy differently for rational/algebraic entanglement (conscious intention) and the fact that number theoretic entanglement entropy can be negative (in Shannon entropy) gives the idea that living matter resides in the intersection of real (entropy) and p-adic worlds (size, windows, hierarchies), somewhat like rational numbers live in the intersection of real (topology) and p-adic number fields, maybe as kinetic and potential energies and their relations and fractions? One such interpretation is the Yang-Mills gap, forming an energy gap. Life is negentropic, coherent islands in the entropic Sea, like topological invariant islands of negentropic information (memory)? This intersection is discrete set containing both rational points and algebraic points common to reals and algebraic extension of p-adics involved.*

Personality and ego are stable, long-time entanglements that help in sorting out noise, organizing the information and choosing (free will?) entanglements. Ego is good for keeping the self entangled and to avoid illness? The self is both more decoherent (left brain) and more quantal (right brain). We have two selves? Pitkänen has a view "how magnetic body (with one self) *controls and receives information from the biological body.*" This is the opposite to above, where the body at least receives information from the magnetic body of coherence. Maybe both views are right and we have two types of perceptions, going either directions? Both 'bodies' can perceive? Quantum entanglement and non-local quantum correlations may play a role. 'Res Potentia and Res Extensa' are linked by quantum measurement. Kauffman wants to NOT deduce measurement (perception) from within quantum mechanics, wave collapse is not a process in time. Experience/qualia are non-spatial. Unconscious mind or dreamless sleep may well be related to potentials/quantum state. But conscious experience itself is associated only with measurement. Measurement isn't a substance nor a process in time; we cannot 'pick up' experience. It resides in the zero point, or presens, that shifts all the time. The same say Pitkänen.

So we need decoherence, and a well-developed self and ego. Differentiation/self is the factor governing complexity, and the 'difference that make a difference'. In that way the rational/algebraic mathematics can be condensed and distilled in intelligent life, out of pure 'consciousness' seen as coherence and information, in the entropic Sea?

In sleep the hierarchy grows. Dreamless sleep or unconscious mental activity are *unmeasured* open quantum behavior? Why we need sleep is unknown. Maybe to keep up [our perceptions](#) that otherwise vanish, and for memory and homeostasis. Also the gender line (locked in by junctions) and [stemcells](#) are taken 'out of time', prolonged by starvation.

### **9. Networks as entanglements.**

Highly controlled cells with entanglement develop [networks](#). Neurons hardly ever get cancerous; connective tissue/epitels do. These are cells that must be flexible to relax stress-energy (in water) that by necessity are created by living, reactive, decoherent systems. The decoherence creates stress, and hence also too much energy on 'wrong' places, as cancers (very electronegative), forming a '[floppy](#)' subsystem? So we need fast, dissipationless energy transport to maintain our health.

With too much of quantum state we cannot create the decoherent state properly, and the perceptions fail. We get hallucinations, feel no hunger, thirst, pain etc. We [look into 'the open window'](#) of Jung. We feel free and happy (the flow), are spiritual, artists, musicians, creative people. This may go too far and we get a psychosis. This also happens [in euphoria before death](#), anorexia, etc.? Sleep is also to connect to this 'window' of '(sub)consciousness', even outside body? Sleep was once the awake state.

There must always be a balance. I suggest this balance is what we call [homeostasis](#), the amplified/damped states, creating the intermediate matter. There is no explanation found to this phenomenon, as far as I know. It regulates metabolism and is stressed by practically every change of states. And sometimes [creates more stress](#) to handle a problem. Even illness and [addiction](#) can be seen as such a disturbance, acting to create a new stability point of states. The operators would be interference between classic-quantum physics, and homeostasis would be primarily quantal.

Living matter is intermediate matter, a 'new' way to organize dissipation, not by raising temperature but maybe relaxing energy using protons, mainly from water, and/or to transfer away dissipation. The superconducting matter handle and transfers the energy resulting from accommodation to the surroundings. This would explain the energy problem. Protons and temperature are strongly regulated in biology and invokes on consciousness giving anesthesia.

### **Conclusions.**

Function precedes structure, and energy precedes information. The ground energy state is as near zero as possible, giving the interpretation that synchronized brainwaves are dito disturbances from the ground state. The relaxing of these waves gives awareness and intelligence, that is, high intelligence is a high sorting efficiency of consciousness, seen as measurements or perceptions. This explains the behavior of perceptive signals, sleep demand, and homeostasis eventually.

The second big insight is the energy demand, too low in living systems. The energytransfer along networks need especially little energy, and is almost dissipationless. This can be interpreted in no other way but the nature of living matter is dualistic with both quantum and classical physics involved. In fact, there are hints that the quantal physics is stronger, and the classic decoherence in negentropy cannot last, but will vanish and get disordered with time. Coherence is the reason for decoherence and decoherence an effect of coherence.



Interference precedes decoherence, seen also in the double slit experiment, interpreted as perceptions, negentropic network creation and energy relaxing of flexible structures, scaling and creation of memories. Living matter is a dual play between coherence and decoherence.

## References.

1. Paul Davies (2010). Rethinking cancer, <http://cancer-insights.asu.edu/wp-content/uploads/2010/01/Physics-World-June-20101.pdf>
2. B. D. Hoffman, G. Massiera, K.M. Van Citters and J. C. Crocker (2006) The consensus mechanics of cultured mammalian cells., <http://www.pnas.org/content/103/27/10259.full>
3. T. J. Newman (2005). MODELING MULTICELLULAR SYSTEMS USING SUBCELLULAR ELEMENTS MATHEMATICAL BIOSCIENCES AND ENGINEERING, Vol 2, (3), 611 – 622, <http://biodyn.physics.asu.edu/papers/Newman-2005.pdf>
4. Brenton D. Hoffman and John C. Crocker (2009). Cell Mechanics: Dissecting the Physical Responses of Cells to Force. Annual Review of Biomedical Engineering, Vol. 11: 259-288. DOI: 10.1146/annurev.bioeng.10.061807.160511.
5. Lofti A. Zadeh (2010). Computing with Words—Why? and How? WorldComp <http://www.cs.berkeley.edu/~zadeh/presentations.html>
6. Lofti A. Zadeh (1988). Fuzzy Logic. IEEE Computer Vol 1, 83 - 93. <http://www.geocities.ws/hhvillav/00000053.pdf>
7. Giuseppe Vitiello (2009). Coherent states, fractals and brain waves, [http://arxiv.org/PS\\_cache/arxiv/pdf/0906/0906.0564v1.pdf](http://arxiv.org/PS_cache/arxiv/pdf/0906/0906.0564v1.pdf)
8. B. Bouchon-Meunier, R. R. Yager, and L. A. Zadeh, Eds., *Uncertainty in Intelligent and Information Systems*, Advances in Fuzzy Systems - Applications and Theory, Vol. 20, Singapore: World Scientific Publishing Co. Pte. Ltd., 2000.
9. Matti Pitkänen (2010). Dark Matter Hierarchy and Hierarchy of EEGs, [http://tgd.wippiesspace.com/public\\_html/pdfpool/eeddark.pdf](http://tgd.wippiesspace.com/public_html/pdfpool/eeddark.pdf)
10. M. Atiyah (2008). Mind, Matter and Mathematics. The Royal Society of Edinburgh Presidential Address, [http://www.rse.org.uk/events/reports/2007-2008/presidential\\_address.pdf](http://www.rse.org.uk/events/reports/2007-2008/presidential_address.pdf)
11. Matti Pitkänen (2010). ). Negentropy Maximization Principle, [http://tgd.wippiesspace.com/public\\_html/pdfpool/nmpc.pdf](http://tgd.wippiesspace.com/public_html/pdfpool/nmpc.pdf)
12. Stuart Kauffman (2011). What is consciousness? A hypothesis. NPR-blog 29.1.
13. Anon.(1995). Journal of Consciousness Studies: Expl. Consciousness: The "Hard Problem" <http://www.imprint.co.uk/hardprob.html>
14. David J.Chalmers (1995). Facing Up to the Problem of Consciousness, J. Consc. Stud. 2(3):200-19. <http://consc.net/papers/facing.html>
15. G. Minati and G. Vitiello (2006). Mistake Making Machines. Systemics of Emergence: Res. and Developm. 1, 67-78 DOI: 10.1007/0-387-28898-8\_4
16. K. Modi, T. Paterek, W. Son, V. Vedral, M. Williamson (2010) Unified View of Quantum and Classical Correlations. <http://arxiv.org/abs/0911.5417>
17. Markus Arndt, Thomas Juffmann and Vlatko Vedral (2009). Quantum physics meets biology, HFSP Journal, DOI: 10.2976/1.3244985
18. Lucia Hackermueller, Stefan Uthenthaler, Klaus Hornberger, Elisabeth Reiger, Bjoern Brezger, Anton Zeilinger, Markus Arndt (2003). The wave nature of biomolecules and fluorofullerenes. DOI: 10.1103/PhysRevLett.91.090408 <http://arxiv.org/abs/quant-ph/0309016>
19. L. Montagnier, J. Aissa, E. Del Giudice, C. Lavalley, A. Tedeschi, G. Vitiello (2010). DNA waves and water. <http://arxiv.org/abs/1012.5166>
20. Thomas Butler, Nigel Goldenfeld (2009). Robust ecological pattern formation induced by demographic noise. <http://arxiv.org/abs/0906.5535>
21. Francesca Fassioli, Ahsan Nazir and Alexandra Olaya-Castro (2010). Quantum State Tuning of Energy Transfer in a Correlated Environment. J. Phys. Chem. Lett., 2010, 1 (14), pp 2139–2143 <http://pubs.acs.org/doi/full/10.1021/jz100717d>
22. Y. Huisman, et al. (2010 ).Time-Resolved Holography with Photoelectrons. Science Express. DOI:10.1126/science.1198450, after <http://www.physorg.com/news/2011-01-scientists-holograms-atoms-electrons.html> (2011)
23. Belle Dumé (2005). Electrons lose their mass in carbon sheets. IOP Physics World 9.11. <http://physicsworld.com/cws/article/news/23538>
24. M.Pitkänen (2010). Massless States and Particle Massivation [http://tgd.wippiesspace.com/public\\_html/pdfpool/mless.pdf](http://tgd.wippiesspace.com/public_html/pdfpool/mless.pdf)
25. Libby Heaney, Adan Cabello, Marcelo F. Santos, Vlatko Vedral (2010). Extreme nonlocality with one photon. <http://arxiv.org/abs/0911.0770>
26. Patrick Rebentrost, Masoud Mohseni and Aln Aspuru-Guzik (2009). Role of Quantum Coherence and Environmental Fluctuations in Chromophoric Energy Transport. J. Phys. Chem. B, 2009, 113 (29), pp 9942–9947 DOI: 10.1021/jp901724d
27. Filippo Caruso, Alex W. Chin, Animesh Datta, Susana F. Huelga, Martin B. Plenio (2009). Highly efficient energy excitation transfer in light-harvesting complexes: The fundamental role of noise-assisted transport. <http://arxiv.org/abs/0901.4454>
28. W. J. Freeman and G. Vitiello (2007). Brain Networks Dynamics. pdf, video [http://www.archive.org/details/Brain\\_Network\\_Dynamics\\_2007-31-Giuseppe\\_Vitiello](http://www.archive.org/details/Brain_Network_Dynamics_2007-31-Giuseppe_Vitiello)
29. Nigel Goldenfeld, Carl Woese (2010).Life is physics. <http://arxiv.org/abs/1011.4125>
30. Alex Kaivarainen (2007). Unified Theory of Bivacuum, Particles Duality, Fields & Time. <http://arxiv.org/ftp/physics/papers/0003/0003001.pdf>
31. E. Alfinito, R. Manka and G. Vitiello (1999). Vacuum structure for expanding geometry, [http://arxiv.org/PS\\_cache/gr-qc/pdf/9904/9904027v1.pdf](http://arxiv.org/PS_cache/gr-qc/pdf/9904/9904027v1.pdf)
32. M. Blasone, E. Celeghini, P. Jizba and G. Vitiello (2002). Quantization, group contraction and zero point energy, [http://arxiv.org/PS\\_cache/quant-ph/pdf/0208/0208012v1.pdf](http://arxiv.org/PS_cache/quant-ph/pdf/0208/0208012v1.pdf)
33. A. J. McKane, J. D. Nagy, T. J. Newman and M. O. Stefanini (2007). Amplified Biochemical Oscillations in Cellular Systems. *Journal of Statistical Physics*, Vol. 128, Nos. 1/2, DOI: 10.1007/s10955-006-9221-9
34. J. Maziero, L. C. C'eleri, R. M. Serra and V. Vedral (2009). Classical and quantum correlations under decoherence. [http://arxiv.org/PS\\_cache/arxiv/pdf/0905/0905.3396v3.pdf](http://arxiv.org/PS_cache/arxiv/pdf/0905/0905.3396v3.pdf)
35. João F. Matias Rodrigues, Andreas Wagner (2010). Genotype networks, innovation, and robustness in sulfur metabolism. <http://arxiv.org/abs/1010.0934v1>
36. Timothy Newman (2011). Cancer is Complex...But Is It Simple? NCI Perspective: Tackling Cancer's Complexity vol. 1, 11-12.
37. Edwin Cartledge (2010). Information converted to energy. IOP PhysicsWorld 19.11. doi:10.1038/nphys1821
38. A.S.Presman (1970) Electromagnetic fields and life. [http://www.filefreak.com/files/749572\\_qkuqo/Electromagnetic\\_Fields\\_and\\_Life\\_A\\_Presman.djvu](http://www.filefreak.com/files/749572_qkuqo/Electromagnetic_Fields_and_Life_A_Presman.djvu)
39. Huping Hu and Maoxin Wu (2006). Evidence of non-local physical, chemical and biological effects supports quantum brain. Preprint 11/25/2006 <http://www.quantumbrian.org/NonlocalIII.pdf>
40. Max Tegmark (1999). The importance of quantum decoherence in brain processes. <http://arxiv.org/abs/quantph/9907009> DOI:10.1103/PhysRevE.61.4194
41. Walter J. Freeman and Giuseppe Vitiello (2005) NONLINEAR BRAIN DYNAMICS AND MANY-BODY FIELD DYNAMICS, [http://arxiv.org/PS\\_cache/q-bio/pdf/0507/0507014v1.pdf](http://arxiv.org/PS_cache/q-bio/pdf/0507/0507014v1.pdf)
42. Robert Becker (1984) The Body Electric. <http://free-pdf-ebook.com/2008/10/09/the-body-electric-dr-becker/>
43. Thomas Heimburg (2010). The Physics of Nerves, <http://arxiv.org/abs/1008.4279>
44. Radoslav Bozov (2010). Carbon interference theory, <http://radobozovhealth.com/?p=121>
45. Dejan Rakovic (2009). Quantum medicine: Phenomenology and quantum-holographic implications", Med Data Rev, Vol. 1, No. 2, pp. 71-73. <http://www.dejanrakovicfound.org/papers/2009-MED-DATA-REV.pdf>
46. Vlatko Vedral (2008). Quantifying entanglement in macroscopic systems, NATURE Vol 453, 19 June 2008, doi:10.1038/nature07124, <http://www.vlatkovedral.org/nature07124.pdf>
47. Giuseppe Vitiello (2008). Topological defects, fractals and the structure of quantum field theory. <http://arxiv.org/abs/0807.2164>
48. M. Pitkänen (2010). Quantum Model for Bio-Superconductivity, <http://tgd.wippiesspace.com/biosupercond.pdf>
49. Thomas Heimburg (2009). Themed issue: membrane biophysics, DOI: 10.1039/b912987c.
50. Walter J. Freeman, Giuseppe Vitiello (2008). Vortices in brain waves. <http://arxiv.org/abs/0802.3854>
51. E. Dennis, A. Kitaev, A. Landahl, J. Preskill (2001). Topological quantum memory. <http://arxiv.org/abs/quant-ph/0110143v1>
52. Decoherence. [Decoherence, the measurement problem, and interpretations of quantum mechanics](http://en.wikipedia.org/wiki/Quantum_decoherence) [http://en.wikipedia.org/wiki/Quantum\\_decoherence](http://en.wikipedia.org/wiki/Quantum_decoherence)
53. M. Pitkänen (2010) TGD Inspired Quantum Model of Living Matter, [http://tgd.wippiesspace.com/public\\_html/articles/quantumbio.pdf](http://tgd.wippiesspace.com/public_html/articles/quantumbio.pdf)
54. Michal Horodecki, Jonathan Oppenheim and Andreas Winter (2005) Quantum information can be negative. Nature <http://www.physorg.com/news5621.html>
55. Jill Bolte Taylor (2008). My stroke of insight. [http://www.ted.com/talks/jill\\_bolte\\_taylor\\_s\\_powerful\\_stroke\\_of\\_insight.html](http://www.ted.com/talks/jill_bolte_taylor_s_powerful_stroke_of_insight.html)
56. Todd Murphy (1999). How the Brain Creates the Experience of God. <http://www.shaktitechnology.com/god.htm> ,
57. Sleep paralysis. Neurological disorders net. <http://neurology.health-cares.net/sleep-paralysis.php>
58. Giana Angelo and Marc R. Van Gilst (2009). Starvation Protects Germline Stem Cells and Extends Reproductive Longevity in *C. elegans*. Science: Vol. 326 no. 5955 pp. 954-958 DOI: 10.1126/science.1178343
59. Stuart Lindsay (2010). The epigenetic control of cancer, video. <http://vimeo.com/17609797>