A General Introduction about Quantum Entanglement in Biophysics

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What is Quantum Biophysics and Why is Quantum Biophysics

One of the great concerns arising from the development of genetics in modern science is that new organisms are being created when very little is known about the functioning of biological systems at the molecular level. [1] Making synthetic alterations to a complex natural system whose basic organizational patterns are not understood is considered by many to be the equivalent to leaving the development of new computer software to technicians who know next to nothing about computer programming.

Despite this level of ignorance, at the molecular level, there is growing evidence of influences on gene expression and function emanating from an even deeper level of bio-physical existence, that is, the influences which emanate from the subatomic or 'quantum' levels of life. [2] The potential role of such influences open up new possibilities for a more sophisticated understanding of organism management from the most fundamental level of biological structure. The biotechnology community currently understands even less in this level than the aspects of gene control and regulation operating from the molecular level.

This level is so important, because until this deeper level of functioning is recognized and accommodated it is highly unlikely that the long-term consequences of randomly introducing extraneous molecular sequences into organisms through genetic engineering can be adequately predicted. But the fact is, few people be aware of this now.[2] Quantum bio-effects are likely to operate through channels whose existence is currently barely even conceived of by most genetic engineers. The primary focus of the genetic engineer continues almost exclusively at the molecular level of biological functioning, and essential interdisciplinary

communication with the physics community remains extremely limited. This area is completely 'off the radar' for all except only a few biotechnologists.

Not only the genetics part, but also many other fields of the biology need to be understood in the quantum scale. Many important biological processes taking place in cells are driven and controlled by events that involve electronic degrees of freedom and, therefore, require a quantum mechanical description. For example, in enzymatically catalyzed and cellular biochemical reactions, bond breaking and bond formation events are intimately tied to changes in the electronic degrees of freedom. Another important field is key events during photosynthesis in plants and energy metabolism in eukaryotes also warrant a quantum mechanical description - from the absorption of light in the form of photons by the photosynthetic apparatus, to electron transfer processes sustaining the electrochemical membrane potential. Because of the importance of sensing light to both plants (for regulating vital functions) and animals (for vision), the interaction between light and biological photoreceptors is widespread in nature, and also requires a quantum mechanical description.[3] A prime example is the protein rhodopsin, which is present in the retina of the human eye and plays a key role in vision.

As in any other academic field, Quantum Biophysics also has many branches, with different interested areas and methods. Here I can only introduce some of them, which I think are interesting and comparatively easy to be understood.

Self-Organization and Quantum Entanglement

Self-Organization, or Self-Assembly is defined as the spontaneous organization of individual components into an ordered system-structure. “Self-Organization” dynamics is working in a number of “Quantum Bio-Physics” structural changes, acting without any interference of external agents. Quanrum biophysics would demonstrate a reasonable strategy to interpret Self-organization in “nano-biology”, taking in consideration the synchronic effect of parallel processing between “local and no-local” co-evolutional information energy exchanges among DNA/RNA/and

Protein.

Protein synthesis is a sophisticated energy-consuming process, where any risk of "mis-folding" needs to be corrected without delay, because the functional mutation of proteins in the cell is very dangerous. It must avoid metabolic diseases in every living cell. The correct self-folding of proteins is normally assisted by cofactors named "Chaperons", the last works as complemented structures of "Ribosomes", to regulate through the "Endoplasmatic Membrane" (ER) the performance of the process of protein's folding, in order to fold the polypeptide chains of amino-acids, and assemble correctly functional groups of proteins to yield active mature protein's structures. In the case of "mis-folding", other enzymes called "chaperonins complexes" help to destroy immediately the mutant-proteins to avoid serious diseases. The problem that remains to understand is the organization of signal communication in a way that "Ribosome/ER/ Chaperons ", can work in a field of synchronic signal information, forming a highly organized pathway of bio-transformations.[2] Certainly we can observe that such synergy of co-organization, for getting a correct in vivo-folding of the proteins, cannot work as a statistical search of probable conformations. This is because it would take an astronomical amount of time, and large amounts of energy will be dissipated if the properly functional conformation is choose by a trial and error method, while in vivo, the protein's folding works at a rapid rate, sometime on the range of nanosecond scale. Current studies of ribosomal interactions with Endoplasmic Reticulum (ER), demonstrate the importance of the nano-organization of ER as "super lattice network" of adjacent nano- tubules, vesicles and sacs and cavities, contained in the inner membranes with a granular length of nanoscale dimensions. Today, in the Post Genomic Era (8), the understanding of the "Ribosome/ER/ Chaperons " self assisted assembly, can be seen in Quantum Bio-Physics as a simultaneity of communication in an Information in Energy field, working in a nanoscale space-time region.[2]

Now there is a research result to claim that the unique properties of bio-nanostructures (as the Endoplasmatic Reticulum, ER) permit the realization of "quantum entanglement" effect in vivo through a confinement in the energy cavitations (i.e. nanotubes, or other nano matrices). This quantum-entanglement produces an energy conversion of heat signals in a field and thus able to generate a simultaneity of information to support a synchronic coherent activity among "Ribosome/ER/ Chaperons ", in a way to get the best correct folding of proteins.

Above is for the synthesis of protein. In another kind of synthesis, the same phenomenon occurs, that is the photosynthesis procedure of the flowering. Biologists indentified that a plant gene T, produce a protein FT, works as a molecular switch and as a key-mediator of signals for inducing the flowering time-development pathway.[4] But actually how this kind of protein regulates the plant's flourishing? The current model is that the molecular switch activate an energy field, and this energy trigger various events during the flowering plants. This triggering is synchronic coordinated, and the processes of self-organization triggered are associated with photosynthesis and photoperiodicity. Current studies suggests that nano-tubules and nano-filamentous elements play a fundamental role as functional pathway in an every greater variety of sub-cellular structures growth and living functions. Such micro structures synchronize the spatial and temporal regulation of morphogenetic events in plants to control various factors of plant cell's division and differentiation, there fore leaves and plant stems cooperate for generation flowers developmental synchronicity are depending by the activity of some nanostructure interfaces.

These nanostructures act through quantum-entanglement, and thus process the quantum information. Go back to the energy field produced by the FT. This energy field is created through the cavities of micro-tubes through an strong interference, caused by the enrichment of the limit of the quantum waves "shock compression", in a way to transform the quantum information carried by the interaction, into mixed entangled states of phonons. So that via the process of entanglement, a component

of space is annulled, on the basis of a coherent negative interference of quantum waves in nano-tubules. Therefore throughout the entanglement occurs a significant alteration of the structure of wave-fronts; so that a component of the three-dimensional space is erased for destructive interferences of quantum waves. The above imposing interactive distortion permits to duplicate the time in a new dimension of retroactive timing amplification of mutual pulses, normally functioning around pico and femto second timescales. In that way it become possible that protein (FT), works as a molecular switch on//off, activating entanglement//disentanglement effect, so as to utilize the simultaneity of communication of active information energy and to get the function of triggering FT as a key-mediator, for inducing the Flowering time- developmental response.[4] In this contest of flowering activity, everywhere in different plants, the information energy field operates as a no local field, as a mean to favour a distributed shared information, available for common reference, to any cooperative agent, with the purpose of modulate in a coherent synchronism for each self –organization process, based on internal and extra-cellular signals cooperation, that would be mediated by a molecular switch on/off devices.

Based on the above facts, we can subdivide information communication into two subsets: A) the first is the traditional transmission of encoded energy (information is considered as a kind of encoded energy, or can be embodied in the form of matter), within the limit of the speed of light between two different space locations; B) the second, a long distance simultaneity of communication of dense coding energy which is generated by the entangled effect, producing a parametric down-conversion of information energy (The reason why down-conversion of energy is because, under some circumstances, as the coherent-resonance in a cavity, an ultraviolet photon can spontaneously splits into two lower-energy infrared photons ;[5] for instance it is known the case of blue photons that undergoes though 'down-conversion' inside a crystal to form two lower-energy red photons that are entangled together. Besides confinement of quantum energy in a nano-cavity, it also lowers the degrees of freedom, and works as resonator generating the

superposition of quantum waves associated to the quantum particles; therefore the entanglement effect produces a dense-coding information based on a no-local field of super-dense information.) The crucial difference between the two subsets is that in the first case, information as recognizable form of codified energy, can be transferred like signal exchange, after a previous interaction through a direct local contact, between energy and matter, while in the second case the information energy represents an extraordinary probability of exchanging energy at large distance, simultaneously through an quantum entanglement effect, without a need of having a previous direct contact or mechanical collisions.[6]

In conclusion, the idea is that all life have two forms of information exchanging, one is the super dense encoded simultaneity of non-local exchange of information energy (the information energy represents an extraordinary probability of exchanging energy at large distance simultaneously through a quantum entanglement effect, without the need of having a previous contact or mechanical collision of materials.); another one is the embodied information in DNA, as genetic material, transmitted through the regular process of biological inheritance-conservation (information as recognizable form of codified energy, can be transferred like signal exchange, after a previous interaction through a direct local contact , between energy and matter.)

Some History and Experiments of Quantum Entanglement

The question of faster-than-light "communication" really began to be explored when Einstein questioned the fundamental principles of quantum theory in the 1930s. He believed that the quantum theory developed by Bohr and others, now the accepted way of viewing quantum theory, was incomplete and would be improved upon in the future. Along with Boris Podolsky and Nathan Rosen, in 1935 Einstein proposed a thought experiment that became known as the EPR paradox. It caught the attention of many scientists, who attempted to prove that "action at a distance" (non-locality) was either possible or not.

In 1982 a remarkable experiment (Bell Test Experiment) was performed in Paris by a research team led by physicist Alain Aspect. This ingenious experiment, based on the EPR paradox and an inequality principle derived by John Bell, verified the principle of quantum entanglement and nonlocal interactions. The results of Aspect's experiment clearly showed that subatomic particles once coupled and then separated are still connected at some fundamental level. A correlation between their wave functions remained, as they were once part of the same wave function that was not disturbed before one of the child particles was measured.

Researchers in Austria, led by Marcus Aspelmeyer, as reported in the June 2003 edition of New Scientist, carried out a more recent experiment into quantum entanglement. They successfully sent entangled photons to opposite sides of the Danube River without the use of optical fibers by using satellites to beam entangled photons to Earth.[7]

Every year more scientific evidence appears supporting the theory of the quantum interconnectedness of the universe.

Reference List:

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[2] Paolo Manzelli, *Quantum Biophysics-the emergence of self-organization phenomena in nano-scale dimension*, the General Science Journal

[3] UIUC Quantum Biology page, http://www.ks.uiuc.edu/Research/Categories/Quantum/

[4] Paolo Manzelli, *Self-Organization in Nature-Case Study,* the General Science Journal

[5] Paolo Manzelli, *Self-Organization and Energy Conversion,* the General Science Journal

[6] Dejan Raković, Miroljub Dugić, Milan M. Ćirković, *MACROSCOPIC QUANTUM EFFECTS IN BIOPHYSICS AND CONSCIOUSNESS*, NeuroQuantology, September 2004, Vol. 2, Issue 4, pp. 237-262.

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