

Exploration

Are Lithium, Phosphate & Posner Molecule Fundamental for Quantum Biology?

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Abstract

In this article I compare the work of Fisher proposing that phosphate ion and calcium phosphate known as Posner molecule are fundamental for quantum neuroscience. Phosphate ion show nuclear spin could serve as qubit able to get enzymatically entangled and make possible a transfer of qubits. Posner molecule would serve as unit of quantum memory. I describe first what might be called Lithium mystery, which served as a motivation of Fisher and summarize also the TGD view about the role of Lithium. The model of Fisher for how phosphate ion and Posner molecule could play a central role quantum neural processing is described. I also summarize the TGD view about the situation suggesting that Posner molecule might indeed have deep role. What puts bells ringing is that ELF radiation at frequencies equal to multiples of 15 Hz cyclotron frequency for Calcium ion in endogenous magnetic field $B_{end} = .2$ Gauss was found by Blackman and others to have effects on vertebrate brain. Furthermore, the cyclotron frequency of phosphate ion in endogenous magnetic field B_{end} corresponds to the 10 Hz alpha resonance frequency defining a fundamental biorhythm.

1 Introduction

I encountered a very interesting Facebook link (see <http://tinyurl.com/zyy3b41>) to the work of Mathew Fisher [2] (see <http://tinyurl.com/hd3t6sr>) related to quantum biology.

I attach below the abstract of the article of Fisher.

The possibility that quantum processing with nuclear spins might be operative in the brain is proposed and then explored. Phosphorus is identified as the unique biological element with a nuclear spin that can serve as a qubit for such putative quantum processing - a neural qubit - while the phosphate ion is the only possible qubit-transporter. We identify the "Posner molecule", $\text{Ca}_9(\text{PO}_4)^6$, as the unique molecule that can protect the neural qubits on very long times and thereby serve as a (working) quantum-memory.

A central requirement for quantum-processing is quantum entanglement. It is argued that the enzyme catalyzed chemical reaction which breaks a pyrophosphate ion into two phosphate ions can quantum entangle pairs of qubits. Posner molecules, formed by binding such phosphate pairs with extracellular calcium ions, will inherit the nuclear spin entanglement. A mechanism for transporting Posner molecules into presynaptic neurons during a "kiss and run" exocytosis, which releases neurotransmitters into the synaptic cleft, is proposed. Quantum measurements can occur when a pair of Posner molecules chemically bind and subsequently melt, releasing a shower of intra-cellular calcium ions that can trigger further neurotransmitter release and enhance the probability of post-synaptic neuron firing. Multiple entangled Posner molecules, triggering non-local quantum correlations of neuron firing rates, would provide the key mechanism for neural quantum processing. Implications, both in vitro and in vivo, are briefly mentioned.

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In the sequel I describe the Lithium mystery which served as a motivation of Fisher and also TGD view about the role of Lithium. The model of Fisher for how phosphate ion and calcium phosphate known as Posner molecule could play a central role quantum neural processing is described. I also present TGD view about the situation suggesting that Posner molecule might indeed have deep role. ELF radiation at frequencies equal to multiples of 15 Hz cyclotron frequency for Calcium in endogenous magnetic field $B_{end} = .2$ Gauss was found by Blackman and others to have effects on vertebrate brain. Furthermore, the cyclotron frequency of phosphate ion in endogenous magnetic field B_{end} corresponds to the 10 Hz alpha resonance frequency defining a fundamental biorhythm.

2 Lithium mystery

The starting point of Fisher was a very interesting finding challenging the hypothesis about life as mere bio-chemistry. Already in 1986, scientists at Cornell University examined the effects of the two isotopes of Lithium on the behavior of rats. Pregnant rats were separated into three groups. One group was given Li^7 , one group was given the isotope Li^6 , and the third served as the control group. Once the pups were born, the mother rats that received Li^6 showed much stronger maternal behaviors, such as grooming, nursing and nest-building, than the rats in either the Li^7 or control groups.

Li^6 therefore has a positive effect on maternal behaviour unlike Li^7 . The chemistry is exactly the same. According to the popular article, Fisher believes that the higher nuclear spin of Li^6 could give it special role.: in the article he talks about nuclear spin $J = 1/2$ which cannot be true since the spin must be even. As a matter of fact, according to my Nuclear Physics by Howard Li^7 has nuclear spin of $J = 3/2$ units whereas Li^6 has nuclear spin $J = 1$ so that neither of the above claims is correct. Could the bosonic character of Li^6 nucleus provide an alternative explanation? In any case, the finding strongly suggests that magnetic fields are involved.

Lithium - presumably Li^6 - has also other positive effects. If the positive effects are indeed due to Li^6 isotope, the dose of Lithium could be reduced by using only Li^6 isotope. I attach here the abstract of the article that I wrote as a reaction to discussions with my friend Samppa who told about Lithium [6] (see <http://tinyurl.com/j44epwp>).

Lithium has been used for more than 50 years as a mood stabilizer in manic depression. During last years Lithium has been studied intensively and found that it can be used also in treatment of schizophrenia and many other brain disorders. The effectiveness of Lithium is however difficult to understand in the standard framework of biology. In TGD framework organism-environment pair of standard biology is replaced with the triplet magnetic body - organism - environment. Magnetic body uses biological body as sensory receptor and motor instrument. This suggests that the re-establishment of communications of brain with some level of the magnetic body is how lithium causes its positive effects. Magnetic body does not receive information about brain and cannot control it since dark Lithium ions and corresponding cyclotron radiation are not present. The disorders caused by the lack of Lithium and other biologically important ions would therefore be something totally new from the perspective of standard neuroscience.

TGD explanation for the effects of Lithium relies on the notions of magnetic body and dark large $h_{eff} = n \times h$ photons, electrons, and ions and relies on cyclotron frequencies as frequencies assignable to the dark photons responsible for the communications between magnetic body and biological body. In this picture the charge of the ion and its total magnetic moment would be relevant rather than only nuclear magnetic moment characterizing also neutral atoms (which could also contribute to the magnetic moment of ion). Cyclotron frequencies would replace Larmor frequencies.

1. For Li^6 the cyclotron frequency is about 50.0 Hz in the endogenous magnetic field $B_{end} = .2$ Gauss explaining the quantal effects of em fields at ELF frequencies on vertebrate brain reported by the

pioneers of bio-electromagnetism such as Blackman [1] to occur at multiples of cyclotron frequency in this magnetic field for Calcium ion and also for other biologically important ions. For Ca^{+2} ion the cyclotron frequency is 15 Hz. Thanks to the large value of $h_{eff} = n \times h$ dark photons would have energies above thermal threshold. An attractive hypothesis is that the energies are in the range of bio-photon energies (visible and UV).

2. In the case of Li^6 the dark photons would make possible communication to and control by the magnetic body relevant for maternal behaviors. Magnetic fields oscillating at 50 Hz frequency are known to have biological effects [5]. The size of the corresponding magnetic body part would be obtained from the wavelength $\lambda = 2\pi R$ (R denotes the radius of Earth) of the lowest Schumann frequency 7.8 Hz as $L = (7.8/50) \times R = .98 \times R$. This suggests that dark magnetic flux tubes assignable with Earth are involved: not however that the field strength is $2B_E/5$.
3. For Li^7 the dark photons would have cyclotron frequency about 42.9 Hz, which brings in mind the thalamocortical resonance with frequency around 40 Hz assigned to consciousness at the time when the use of the word "consciousness" ceased to be pseudo-science. The more abundant Li^7 (92.5 per cent) should be also important but could be associated with other kinds of biological functions.

3 Phosphate, Posner molecule, and cognition

Fisher as also other quantum biologists tries to understand quantum biology as an improvement of biochemistry. One assumes that standard quantum theory brings in small effects allowing to optimize biological functions. In the case of the avian navigation and also in many other situations the problem is that Earth's magnetic field is only 2 per cent of the minimum magnetic field at which the proposed radical-pair mechanism is found to work [7] (see <http://tinyurl.com/jnxvdmf>). To my opinion much more radical approach challenging the basics of quantum theory itself is necessary.

Fisher wants to identify the quantum mechanism behind neural activity assumed to rely on nuclear spins. This is quite a demanding challenge. One should understand long coherence time for nuclear spins representing the qubits, discover a mechanism transporting the qubit through the brain to neurons, identify a molecular scale quantum mechanism entangling qubits, identify a chemical reaction inducing quantum measurement of the qubits dictating the subsequent neuron firing, and understand what happens in nerve pulse transmission from pre- to post-synaptic neuron at quantum level.

1. Fisher assigns fundamental qubit and the ability to develop long lasting quantum entanglement with phosphate ion (see <http://tinyurl.com/zgbgtwy>). Phosphate ion would be qubit transporter. The transfer of phosphate ion from APT to a molecule is fundamental part of metabolism and the TGD proposal is that a transfer of negentropic entanglement (purely TGD based notion involving p-adic physics as correlate for cognition) is in question.
2. Enzyme catalyzed qubit entanglement would emerge in the reaction $\text{ATP} \rightarrow \text{AMP} + \text{PPi}$. PPi is diphosphate ion with entangled phosphate and the reaction $\text{PPi} \rightarrow \text{Pi} + \text{Pi}$ would create two entangled phosphates. The reaction rate is proposed to depend on whether the 2Pi state is spin single or spin triplet.
3. Quantum memory is assigned with so called Posner molecule $[(\text{PO}_4)^{-3}]_6\text{Ca}_9^{+2}$ made of 6 phosphate ions and 9 calcium ions would be the key player. Posner molecule belongs to a family of calcium phosphates having as building bricks PO_4^{-3} and Ca^{+2} ions (see <http://tinyurl.com/jftjmr0>). Calcium phosphate is the principal form of calcium found in bovine milk and blood. 70 percent of bone consists of hydroxyapatite, a calcium phosphate mineral known as bone mineral. Tooth enamel is composed of almost ninety percent hydroxyapatite.

Posner molecule is neutral since the charges of 9 Ca ions and 6 phosphate ions cancel each other: $9 \times 2 - 6 \times 3 = 0$. Geometrically Posner molecule can be described as a cube with Calcium ions

at corners and center and phosphate ions at the centers of faces. The nuclear spin of the Posner molecule assignable to phosphates is 0, 1, 2, or 3. Posner molecule has also reduced rotational degrees of freedom characterized by group Z_3 giving rise to pseudospin. Posner molecule would be a carrier of phosphate qubits giving rise to (working) quantum-memory realized in terms of entangled Posner molecules.

4. Fisher proposes the notion of quantum entangled chemical reactions. This notion does not make sense if one identifies chemical reactions as processes involving state function reduction as assumed in chemical kinetics. The notion could make sense if chemical reactions are identified as unitary time evolutions for entangled systems such as Posner molecules. In TGD framework the notion of entangled time evolutions could make sense in zero energy ontology (ZEO).
5. Nerve pulse transmission from pre- to postsynaptic membrane would entangle neurons by entangling Posner molecules. Biochemistry is complex but to my opinion the proposed model is too complex to be feasible. My view is that the enormous complexity of the description based on biochemical reaction pathways reflects the failure to realize the presence of control level - magnetic body. Situation would be like trying to understand the functioning of computer program regarding it as mere physical phenomenon without any idea about its purpose.

4 TGD view

In TGD framework both nuclear spins and angular moment of dark nuclei in the magnetic fields assignable to dark magnetic flux tubes would be important: Larmor frequencies would be replaced with the sums of Larmor - and cyclotron frequencies assignable to (usually) charged particles. It is interesting to look whether the cyclotron frequencies of phosphate and Posner molecule could teach something about their possible role.

1. Phosphate PO_4^{-3} with mass number $31+4\times 16 = 95$ has cyclotron frequency 9.5 Hz in the endogenous magnetic field $B_{end} = .2$ Gauss assumed in TGD model: this is 10 Hz in the accuracy with which B_{end} is known. This frequency is in alpha band! For smaller charges -2 and -1 one has frequencies 6.26 Hz and 3.13 Hz. In TGD framework the transfer of phosphate from ATP to the acceptor biomolecule could be at the fundamental level transfer of negentropic entanglement from metabolites [3, 4]. This could reduce to the transfer the ends of the associated flux tubes between the molecules.
2. Posner molecule is neutral since the charges of 9 Ca ions and 6 phosphate ions cancel each other: $9 \times 2 - 6 \times 3 = 0$. Being neutral Posner molecule as a whole does not couple to the magnetic field except through its total magnetic moment. TGD proposal that ions form Bose-Einstein condensates encourages however to consider the possibility that the building bricks of Posner molecule form separate Bose-Einstein condensates. One can ask whether this is possible also more complex calcium phosphates: could bones be much more than just passive building bricks?

The simplest possibility is that 3 Cooper pairs of fermionic PO_4^{-3} molecules (as is easy to check by noticing that phosphorus and oxygen atoms are bosons and there are surplus 3 electrons: note that phosphorus nucleus is fermion and oxygen nucleus a boson) form a Bose-Einstein condensate a their own circular portion of flux tube. 9 bosonic Ca^{+2} ions would form similar Bose Einstein condensate at their own flux tube portion. The value of h_{eff} proportional to the mass of the ion by $h_{eff} = h_{gr}$ hypothesis. The formation of Cooper pairs of phosphate ions would conform with the conjecture of Fisher that two phosphate ions can entangle.

The cyclotron frequencies of these Bose-Einstein condensates would be 9.5 Hz *resp.* 15 Hz in $B_{end} = .2$ Gauss. This model could allow to improve the understanding about why the radiation at harmonics of 15 Hz has effects on vertebrate brain and also about the realization of alpha rhythm as a control signal from magnetic body. Fisher proposes that in nerve pulse transition two Posner

molecules fuse temporarily and produce a spray of Ca^{+2} ions. This could make sense also in TGD framework.

These observations put the bells ringing - with a frequencies of 10 Hz and 15 Hz, one might say. Unfortunately this frequency is not directly audible, so that I cannot hope that colleagues would hear the ringing! There are however some hopes: also 10 Hz and 15 Hz can be made audible as difference of frequencies fed to right and left ear! Maybe some experimentalist could get interested!

References

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