Concerning Spin as Mind-pixel: How Mind Interacts with Brain through Electric Spin Effects

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Abstract: Electric spin effects are effects of electric fields on the dynamics/motions of nuclear/electron spins and related phenomena. Since classical brain activities are largely electric, we explore here a model of mind-brain interaction within the framework of spin-mediated consciousness theory in which these effects in the varying high-voltage electric fields inside neural membranes and proteins mediate mind-brain input and output processes. In particulars, we suggest that the input processes in said electric fields are possibly mediated by Dirac-Hestenes electric dipoles and/or spin transverse forces both of which are associated with the nuclear/electronic spin processes. We then suggest that the output processes (proactive spin processes) in said electric fields possibly also involve Dirac-Hestenes electric dipole interactions in said electric fields and Dirac negative energy extraction processes, shown by Solomon, of nuclei/electrons besides non-local processes driven by quantum information. We propose that these output processes modulate the action potentials, thus influencing the brain, by affecting the cross-membrane electric voltages and currents directly and/or indirectly through changing the capacitance, conductance and/or battery in the Hudgkin-Huxley model. These propositions are based on our own experimental findings, further theoretical considerations, and studies reported by others in the fields of spintronics, high-energy physics and alternative energy research.

Key Words: spin; mind-pixel; electric spin effect; spin transverse force; Dirac-Hestenes electric dipole; electric field; proactive spin

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1. Introduction

Within the framework of spin-mediated consciousness theory, the nuclear/electronic spins are proposed to be the mind-pixels which interact with the brain through quantum effects, modulating and being modulated by various classical brain activities such as the action potentials (Hu & Wu, 2002 & 2004a-d). Since classical brain activities are largely electric and, in comparison, magnetic fields insides the brain are only microscopically strong but fluctuating, we have previously discussed how action potentials modulate the dynamics of nuclear/electron spin networks inside the brain through J-coupling, dipolar coupling and chemical shielding tensors, thus, feeding information into mind in the dualistic approach (Hu & Wu, 2004 c & 2004d). Further, based on our own experimental findings and work done by others, we have also discussed on how mind might influence brain through proactive spin processes enabled by the varying high-voltage electric fields inside the brain (Hu & Wu, 2006a-d & 2007a-c).

What we have not explored in details so far are the electric spin effects which are the direct effects of electric fields on the dynamics/motions of nuclear and/or electronic spins and related phenomena, and their possible roles in mind-brain interactions.

Therefore, we explore here a more specific model of mind-brain interaction within aforesaid framework in which the said electric spin effects in the varying high-voltage electric fields inside neural membranes and proteins mediate mind-brain input and output processes. We first suggest that the input processes in said electric fields are possibly mediated by Dirac-Hestenes electric dipoles and/or spin transverse forces both of which are associated with the nuclei/electron spin processes. We then suggest that the output processes (proactive spin processes) in said electric fields possibly involve Dirac-Hestenes electric dipole interactions with in said electric fields also and Dirac negative energy extraction processes, as shown by Solomon (2006 &2007), of nuclei and/or electrons besides non-local processes driven by quantum information shown by us. We suggest that these output processes modulate the action potentials, thus influencing the brain, by affecting the cross-membrane electric voltages and currents directly and/or indirectly through changing the capacitance, conductance and/or battery in the Hudgkin -Huxley model. These propositions are based on our own experimental findings, further theoretical considerations within the framework of spin-mediated consciousness theory, and studies reported by others in the fields of spintronics, high-energy physics and alternative energy research.

2. Dirac-Hestenes Electric Dipole

It has been long known that in an external electric field, the Dirac particle such as an electron or nuclear sub-entity acts as if it has an imaginary electric moment $|\mathbf{d}|=ieh/4\pi mc$. Dirac was aware this in 1928 and wrote that "[t]he electric moment, being a pure imaginary … should not…appear in the model [and it] is doubtful whether the electric moment has any physical meaning ..." (Dirac, 1928). Later, Dirac stated that "these extra terms involve some new physical effects, but since they are not real they do not lend themselves very directly to physical interpretation" (Dirac, 1983).

It was Hestenes who showed that Dirac magnetic and electric dipole moments have

same origin associated with spin and magnetization (For a review, see, Hestenes, 2003). In Hestenes' formulism, magnetic moment density is not directly proportional to the spin but "dually proportional." The duality factor $e^{i\beta}$ has the effect of generating an effective electric dipole moment for the Dirac particle. Hestenes commented that "this seems to conflict with experimental evidence that the electron has no detectable electric moment, but the issue is subtle" (*Id*). Other researchers have also shown recently that the magnetic and electric dipole moments of a fermion are closely related because they determine the real and imaginary part of the same physical quantity (Feng *et al*, 2001; Graesser & Thomas, 2002).

Indeed, Silenko has recently shown in the Foldy-Wouthuysen representation that although the influence of the electric dipole moment on the Dirac particle motion is negligibly small in an external electric field, it influences significantly the spin motion of the said particle (Silenko, 2006).

In addition, in the classical models of the Dirac particle, fast oscillating electric dipole moments also appear (Rivas, 2005; Gauthier 2006). These findings coincide with earlier finding that a moving magnetic dipole induces an electric dipole $\mathbf{d}=(\mathbf{v}/c^2)\times\mathbf{m}$, where $\mathbf{m}$ and $\mathbf{v}$ are respectively the magnetic moment and the velocity of the moving spin, as a relativistic effect (Rosser, 1964). Rivas (2005) believes that what is lacking in the typical quantum mechanical wave equation is this oscillating electric dipole. He states that "in general, the average value of this term in an electric field of smooth variation is zero, [but] in high intensity fields or in intergranular areas in which the effective potentials are low, but their gradients could be very high, this average value should not be negligible." Rivas further showed that the electric moment of the classical Dirac electron could lead to interesting physical effects (*Id*).

Here we specifically propose (Proposition I) that in the dualistic mind-brain approach of spin-mediated consciousness theory the interactions between the Dirac-Hestenes electric dipoles of nuclei and/or electrons with the varying high-voltage electric fields inside the neural membranes and proteins directly feed information carried by the neural spike trains into mind through the varying high-voltage action potentials.

Do we have any other justifications for Proposition I besides the points already discussed above? The answer, indeed, is "Yes." First, even if the Dirac electric dipole is purely imaginary with no known physical consequence, we argue that in the dualistic mind-brain approach, it may serve as an information receiver in the non-local domain where mind resides for the simple reason that such non-local domain is likely amicable to a description by the imaginary numbers (See, e.g., Rauscher & Targ, 2001).

Second, following Hestenes (see, *e.g.*, 2003) and possibly others, we strongly believe that the origin of the electric dipole is intrinsically associated with a Dirac particle actually being a composite entity with the un-manifested antiparticle inseparably accompanying the regular particle. Since the antiparticle sometimes shows up in our spacetime as real, we have reason to believe that the same in its un-manifested form is an active participant in the primordial self-referential spin processes driving quantum mechanics,

spacetime dynamics and consciousness as will be discussed elsewhere in due time (Also see, Hu & Wu, 2003 & 2004b).

3. Spin Transverse Force

Recent studies in spintronics have shown that an electric field will exert a transverse torque/force on a moving spin (see, *e.g.*, Sun *et al* 2004; Shen, 2005). This is actually not hard to understand since according to special theory of relativity a moving spin in an electric field sees a magnetic field.

Sun *et al* (2004) has shown that a moving spin is affected by an external electric field and feels a force/torque as $\mathbf{m}\times[(\mathbf{v}/c^2)\times\mathbf{E}]$ where **m** and **v** are respectively the magnetic moment and the velocity of the moving spin and **E** is the external magnetic field.

Shen (2005) has shown that, as a relativistic quantum mechanical effect, an external electric field exerts a transverse force on an electron spin 1/2 if the electron is moving. The said spin force, analogue to the Lorentz force on an electron charge in a magnetic field, is perpendicular to the electric field and the spin motion when the spin polarization is projected along the electric field (*Id*).

Indeed, while this paper is been written, this effect has just been successfully used in the laboratory to flip the spin of an electron in a quantum dot by applying an oscillating electric field (Nowack, *et al*, 2007). The electric field induces coherent transitions (Rabi oscillations) between spin-up and spin-down with 90° rotations as fast as ~55 ns and the analysis done by the authors indicates that the electrically-induced spin transitions are mediated by the spin-orbit interaction (*Id*).

Therefore, we specifically propose here (Proposition II) that the interactions between the moving nuclear/electronic spins in neural membranes and proteins and the varying high-voltage electric fields there directly feed information into mind in the dualistic mind-brain approach of spin mediated consciousness theory.

To illustrate this particular mechanism, we now consider the spin transverse force exerted on a proton spin of a hydrogen atom connected to the carbon chain of a phosphate lipid located inside the neural membranes as shown in Figure 1. As the carbon chain rotates in parallel to the intense electric field **E** across the neural membranes, the vertical proton spin moving in a circle perpendicular to the carbon chain sees a magnetic field in the rotating frame of reference thus feels a transverse torque/force ***f*** toward the rotating plane. Quantitative calculations shall be performed in a separate paper.

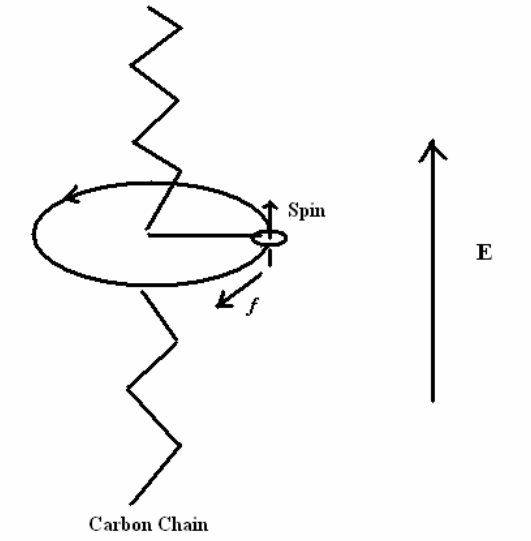

Fig.1. Illustration of spin transverse torque/force ***f*** exerted on a nuclear/electronic spin on a molecular chain or fragment inside the neural membranes and proteins.

This spin transverse torque/force enables the neural spike trains to directly influence the nuclear/electronic spin networks in neural membranes and proteins thus inputting information into mind in the dualistic approach.

4. Output Process through Proactive Spin

Previously, we have explored how mind influences the brain through primordial self-referential spin processes (Hu & Wu, 2007c). Our thoughts were that the manifestation of free will is intrinsically associated with the nuclear and/or electron spin processes inside the varying high-voltage environment of the neural membranes and proteins which likely enable the said spin processes to be proactive, that is, being able to utilize non-local energy (potential) and quantum information to influence brain activities through spin chemistry and possibly other chemical and/or physical processes in defiance of the second law of thermodynamics (*Id*).

With respect to possible evidence, we pointed out that: (1) our own experiments suggest that non-local energy/potential and quantum information may influence brain function through quantum entanglement mediated processes (Hu & Wu, 2006a-d; 2007a); (2) the well-known placebo effect clearly indicates the influence of the mind over body; (3) many experimental reports in parapsychology indicate the plausibility of mind's influences over brain or matter (e.g., Jahn & Dunn, 2005; Tiller, 2007; Graham, 2006; Radin, 2006); and (4) in the field of alternative energy research, there are numerous papers reporting excess heat being produced through electrophoreses and various plasma discharge schemes the common feature of which is that somehow under the influence of electric fields or high electric voltages, excess heat was claimed to be produced from the vacuum or age-old ether (e.g., Graneau & Graneau, 1983; Correa & Correa, 2004).

Here we suggest possible additional mechanisms besides what our own experiments have shown. One such possible additional mechanism is connected to the Dirac-Hestenes electric dipole associated with nuclear/electronic spin. As Rivas (2005) pointed out that what is lacking in the quantum mechanical wave equation is possibly the oscillating electric dipole which in high intensity fields or in intergranular areas should not be negligible in its contributions to dynamics of the Dirac particle.

The complication is that the appearance of an imaginary dipole energy term H_{int}= (–*i***d.E)** in the Hamiltonian makes it non-hermitian and the corresponding energy spectrum complex-valued instead of real valued. However, various studies of the non-hermitian Hamiltonians indicate that not only very interesting novel dynamics appear due to non-hermiticity (See, *e.g.*, Aguiar Pinto *et al*, 2003) but also certain classes of non-hermitian Hamiltonians still have real energy spectra (See, e.g., Bender, 2007). We propose (Proposition III) that these new dynamics may be just what are needed to enable the proactive spin process.

Another possible mechanism is the Dirac negative energy extraction in a varying electric field which has been shown to be theoretically possible by Solomon (e.g., Solomon, 2006 & 2007). The vacuum electrons obey the Dirac equation and the energy of these electrons will change in response to an applied electric field (*Id.*).

Solomon has examined the vacuum in Dirac's hole theory and he showed that it is possible to find a varying electric field for which the change in the energy of each vacuum electron is negative (*Id.*). Therefore, according to Solomon, the total change in the energy of the vacuum state is negative and this new state will have less energy than the original unperturbed vacuum state (*id*).

Solomon's theoretical results provide support to the claims of excess heat being produced through electrophoreses and various plasma discharge schemes (e.g., Graneau & Graneau, 1983; Correa & Correa, 2004). We suspect that the Dirac negative energy extraction process shown by Solomon is connected to the dynamics of the Dirac-Hestenes electric dipole in a varying electric field. Further, we don't think that a vacuum electron in a varying electric field can fall into the negative energy state occupied by the un-manifested antiparticle.

Instead, we propose (Proposition IV) that in certain varying external electric field the vacuum electron pumps energy from the vacuum and release the same in our spacetime in order to maintain its minimal energy state in the vacuum. We will discuss where the vacuum energy comes from in a separate paper.

We further propose (Proposition V) that these output processes modulate the action potentials, thus influencing the brain, by affecting the cross-membrane electric voltages and currents directly and/or indirectly through changing the capacitance, conductance and/or battery in the Hudgkin-Huxley model.

5. **Conclusion**

Electric spin effects are effects of electric fields on the dynamics of nuclear/electronic spins and related phenomena. In this paper, we have explored several such effects and their possible roles in the mind-brain interactions within the framework of spin mediated consciousness theory. We have outlined five propositions. In particulars, we have considered a more specific model of mind-brain interaction in which these effects in the varying high-voltage electric fields inside neural membranes and proteins mediate mind-brain input and output processes.

We have suggested that the input processes in said electric fields are possibly mediated by Dirac-Hestenes electric dipoles (Proposition I) and/or spin transverse force/torque (Proposition II) both of which are associated with the nuclear/electronic spin processes. We then suggest that the output processes (proactive spin processes) in said electric fields possibly also involve Dirac-Hestenes electric dipole interactions in said electric fields (Proposition III) and Dirac negative energy extraction processes, as shown by Solomon, of nuclei/electrons (Proposition IV) besides non-local processes driven by quantum information. We have proposed (Proposition V) that these output processes modulate the action potentials, thus influencing the brain, by affecting the cross-membrane electric voltages and currents directly and/or indirectly through changing the capacitance, conductance and/or battery in the Hudgkin-Huxley model.

These propositions are based on our own experimental findings, further theoretical considerations within the framework of spin-mediated consciousness theory, and studies reported by others in the

fields of spintronics, high-energy physics and alternative energy research.

Finally, we stress again the importance of experimental work and quantitative calculations and computer simulations in order to verify these propositions and make substantial progresses. We have done some preliminary work in these directions. As usual, results will be reported, when feasible.

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