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Article

Consciousness-mediated Spin Theory: The Transcendental Ground of Quantum Reality

Huping Hu* & Maoxin Wu

ABSTRACT

It is our comprehension that Consciousness is both transcendent and immanent as similarly understood in Hinduism. The transcendental aspect of Consciousness produces and influences reality through self-referential spin as the interactive output of Consciousness. In turn, reality produces and influences immanent aspect of Consciousness as the interactive input to Consciousness through self-referential spin. The spin-mediated consciousness theory as originally proposed has mainly dealt with the immanent aspect of Consciousness which is driven by the self-referential spin processes. This paper focuses and "regurgitates" on the transcendental aspect of Consciousness which drives the self-referential spin processes.

Key Words: Consciousness, prespacetime, spin, self-reference, transcendental, immanent.

1. Introduction

The spin-mediated consciousness theory as originally proposed (Hu & Wu, 2002) has mainly dealt with the immanent aspect of consciousness such as awareness. However, ourexperimental results on quantum entanglement of the brain with external substances suggest that Consciousness is not located in the brain but associated with prespacetime (Hu & Wu, 2006a-c). These results support the proposition in some spiritual traditions such as Hinduism that the transcendental aspect of Consciousness is the basis of reality.

Indeed, our current view is that reality is an interactive quantum reality centered on Consciousness (prespacetime) and the interaction between Consciousness and reality is the most fundamental self-reference (Hu, 2008b & 2009). The perplexing questions we have tried to answer are: (1) Is quantum reality produced and influenced by Consciousness; or (2) is Consciousness produced and influenced by quantum reality? As shown previously, our answers are that Consciousness is both transcendent and immanent, that is, the transcendental aspect of Consciousness produces and influences reality through

*Corresponding author: Huping Hu, Ph.D., J.D. Address: QuantumDream, Inc., P.O. Box 267, Stony Brook, NY 11790, USA.
E-mail: hupinghu@quantumbrain.org

self-referential spin as the interactive output of Consciousness and, in turn, reality produces and influences immanent aspect of Consciousness as the interactive input to Consciousness also through self-referential spin (*Id.*).

We have also been asking the question: Where and what is human consciousness in the big scheme of things? Our answer is that human consciousness is a limited or individualized version of the above dual-aspect Consciousness such that we have limited free will and limited observation/experience which is mostly classical at macroscopic levels but quantum at microscopic levels (*Id.*). For example, as a limited transcendental consciousness, we have through free will the choice of what measurement to do in a quantum experiment but not the ability to control the result of measurement (at least not until we can harness the abilities of our consciousness). That is, the result appears to us as random. On the other hand, at the macroscopic level, we also have the choice through free will of what to do but the outcome, depending on context, is sometimes certain and at other times uncertain. Further, as a limited immanent consciousness, we can only observe the measurement result in a quantum experiment that we conduct and experience the macroscopic environment surrounding us as the classical world (*Id.*).

2. Self-referential Spin Driven by Transcendental Aspect of Consciousness

In the beginning there was Consciousness (prespacetime) $\mathbf{e}^{h}$ by itself $\mathbf{e}^{i0}$ =1materially empty and spiritually restless. And it began to imagine through primordial self-referential spin $1=\mathbf{e}^{0}=\mathbf{e}^{\mathbf{i}M-\mathbf{i}M}=\mathbf{e}^{\mathbf{i}M}\mathbf{e}^{-\mathbf{i}M}=\mathbf{e}^{-\mathbf{i}M}/\,\mathbf{e}^{-\mathbf{i}M} = \mathbf{e}^{\mathbf{i}M}/\,\mathbf{e}^{\mathbf{i}M}$…such that it created the external object to be observed and internal object as observed, separated them into external world and internal world, caused them to interact through self-referential Matrix Law and thus gave birth to the Universe which it has since passionately loved, sustained and made to evolve (Hu & Wu, 2009, 2010).

In this Universe, the Body of Consciousness (ether), represented by Euler number **e**, is the ground of existence and can form external and internal wave functions as external and internal objects (each pair forms an elementary entity) and interaction fields between elementary entities which accompany the imaginations of the Head $\boldsymbol{h}$ of Consciousness. The Body can be self-acted on by Consciousness' self-referential Matrix Law $\boldsymbol{L_M}$. The Head $\boldsymbol{h}$ has imagining power $\boldsymbol{i}$ to project external and internal objects by projecting, e.g., external and internal phase $\pm M = \pm(Et-\mathbf{p}\cdot\mathbf{x})/\hbar$ above Body **e**. The Universe so created is a dual-world comprising of the external world to be observed and internal world as observed under each relativistic frame $x^{\mu}=(t, \mathbf{x})$. In one perspective of transcendental view, the internal world (which by convention has negative energy) is the negation/image of the external world (which by convention has positive energy). The absolute frame of reference is the Body (ether). Thus, if Consciousness stops imagining ($\mathbf{h}=\boldsymbol{i}0=0$), the Universe would disappear into materially nothingness $\mathbf{e}^{\boldsymbol{i}0}=\mathbf{e}^{0}=1$.

The accounting principle of the dual-world is conservation of zero. For example, the total energy of an external object and its counterpart, the internal object, is zero. Also in this dual-world, self-gravity is the nonlocal self-interaction (wave mixing) between an external object in the external world and its negation/image in the internal world, that is, the negation appears to its external counterpart as a black hole *visa versa*. Gravity is the nonlocal interaction (quantum entanglement) between an external object with the internal world as a whole. Some other most basic conclusions are: (1) the two spinors of the Dirac electron or positron are respectively the external and internal objects of the electron or positron; (2) the electric and magnetic fields of a linear photon are respectively the external and internal objects of a photon which are always self-entangled; (3) the proton is likely a spatially confined (hadronized) positron through imaginary momentum (downward self-reference); and (4) a neutron is likely comprised of an unspinized (spinless) proton and a bound and spinized electron. In this dual-world, Consciousness is simply prespacetime having both transcendental and immanent properties/qualities. The transcendental aspect of consciousness is the origin of primordial self-referential spin (including the self-referential Matrix Law) and it projects the external and internal worlds through spin and, in turn, the immanent aspect of consciousness observes the external world as the observed internal world through the said spin. Human consciousness is a limited and particular version of this dual-aspect consciousness such that we have limited free will and limited observation which is mostly classical at macroscopic levels but quantum at microscopic levels.

Before mathematical presentations, we draw below several diagrams illustrating the hypothesis of how Consciousness created the Universe comprising of the external world and the internal world (the dual-world) and how the external object and internal object and the external world and internal world interact.

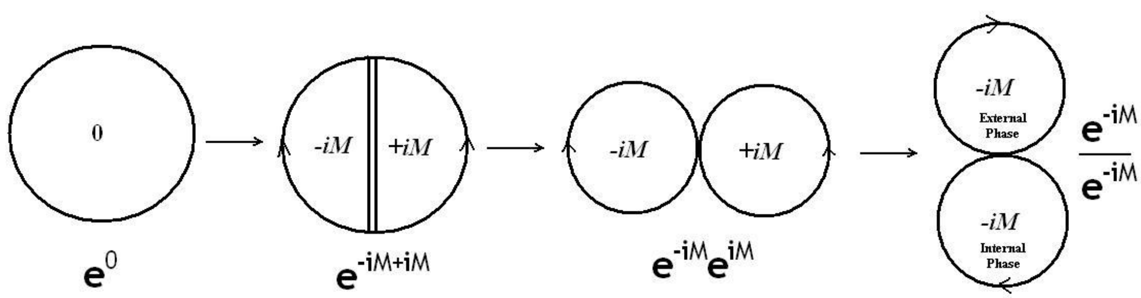

Figure2.1. Illustration of primordial phase distinction

As shown in Figure 2.1, a primordial phase distinction (dualization), e.g., $\pm M = \pm(Et - \mathbf{p \cdot r})/\hbar$, was made in the Head **h** through imagination ***i***. At the Body level, this is $\mathbf{e}^0 = \mathbf{e}^{\mathbf{i}M-\mathbf{i}M} = \mathbf{e}^{\mathbf{i}M}\mathbf{e}^{-\mathbf{i}M} = \mathbf{e}^{-\mathbf{i}M} / \mathbf{e}^{-\mathbf{i}M} = \mathbf{e}^{\mathbf{i}M} / \mathbf{e}^{\mathbf{i}M}$….

The primordial phase distinction in Figure 2.1 is accompanied by matrixing of the Body **e** into: (1) external and internal wave functions as external and internal objects, (2) interaction fields (e.g., gauge fields) for interacting with other elementary entities, and (3) self-acting and self-referential Matrix Law, which accompany the imaginations of the Head **h** so as to enforce (maintain) the accounting principle of conservation of zero, as illustrated in Figure 2.2.

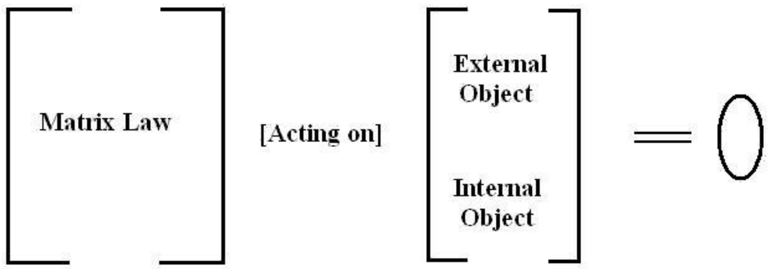

Figure2.2 Consciousness Equation

Figure 2.3 shows from another perspective of the relationship among external object, internal object and the self-acting and self-referential Matrix Law. According to our ontology, self-interactions (self-gravity) are quantum entanglement between the external object and the internal object.

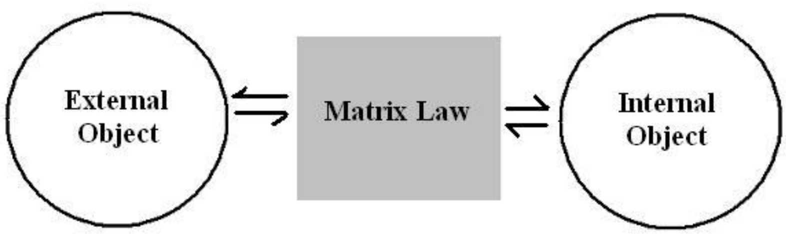

Figure2.3 Self-interaction between external and internal objects of a quantum entity

As shown in Figure 2.4, the two worlds interact with each other through gravity or quantum entanglement since gravity is an aspect of quantum entanglement (Hu & Wu, 2006). Importantly, the interactions within the external world obey classical and relativistic physical laws with influence of the internal world on external world shown as gravity macroscopically, quantum effect (e.g., quantum potential) microscopically, and light speed c as interaction speed limit, *visa versa*.

Please note that, although in Figure 2.4 prespacetime is shown as a strip, both the dualized external world and internal world are embedded in prepacetime.

The above ideas (ontology) were forced upon (or rather revealed to) us by our recent theoretical and experimental studies (Hu & Wu, 2006a-d, 2007a). Among other things, we experimentally demonstrated that gravity is the manifestation of quantum entanglement (*Id.*). We materially live in the external world but experience the external world through its negation, the internal world in the relativistic frame x^{μ}=(t, **x**) attached to each of our bodies. Interactions within the external world and the internal world are local interactions and conform to special theory of relativity. But interactions across the dual world are nonlocal interactions (quantum entanglement). Strong interaction is likely spatially confining nonlocal self-interaction and nonlocal interaction among spatially confined fermions (hadrons).

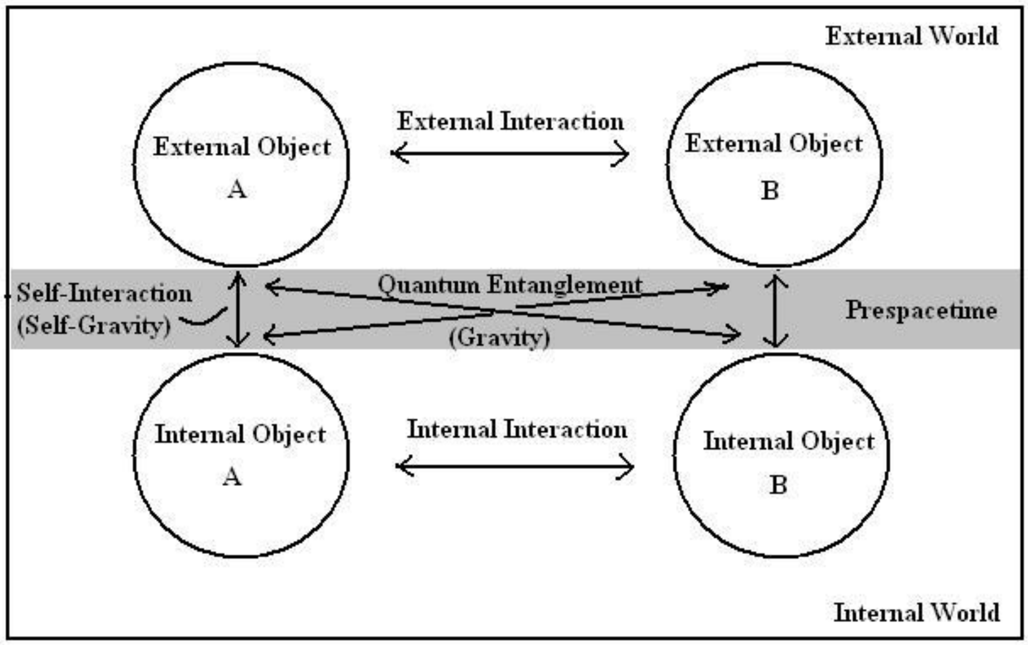

Figure2.4 Interactions in the Dual-World

Therefore, the meaning of the special theory of relativity is that the speed limit *c* is only applicable in each of the dual worlds but not interactions between the dual worlds. Indeed, the reason that no external object can move faster than the speed of light and the same gets heavier and heavier as its speed approaches the speed of light is due to its increased quantum entanglement with the internal world through its counterpart the internal object.

3. Mathematical Expression

3.1 Overview

Our comprehension is that: ***Consciousness = Prespacetime = Omnipotent, Omnipresent & Omniscient Being = ONE*.** The transcendental aspect of Consciousness creates, sustains and causes evolution of primordial entities (elementary particles) in prespacetime, that is, within Consciousness itself, by self-referential spin as follows:

$$1 = e^h = e^{i0} = 1e^{i0} = L_1 e^{-iM+iM} = L_e L_i^{-1}\left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow$$
$$\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} A_e e^{-iM} \\ A_i e^{-iM} \end{pmatrix} = L_M \begin{pmatrix} A_e \\ A_i \end{pmatrix} e^{-iM} = L_M \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0 \quad (3.1)$$

In expression (3.1), e is Euler number representing the Body (ether or aether) of Consciousness, h above e represents the Head of Consciousness, i is imaginary unit representing the imagination of Consciousness, ±M is content of imagination i, L_1=1 is the Law of One of Consciousness before matrixization, L_e is external law, L_i is internal law, $L_{M,e}$ is external matrix law, and $L_{M,i}$ is internal matrix law, L_M is the self-referential Matrix Law of Consciousness comprised of external and internal matrix laws which governs elementary entities and conserves zero, $A_e e^{-iM} = \psi_e$ is external wave function (external object), $A_i e^{-iM} = \psi_i$ is internal wave function (internal object)and ψ is the complete wave function (object/entity in the dual-world as a whole).

Therefore, transcendental aspect of Consciousness spins as: 1=$\mathbf{e}^{i0}$=$\mathbf{e}^{iM-iM}$=$\mathbf{e}^{iM}\mathbf{e}^{-iM}$=$\mathbf{e}^{-iM}/\mathbf{e}^{-iM}$ =$\mathbf{e}^{iM}/\mathbf{e}^{iM}$…before matrixization. Transcendental aspect of Consciousness also spins through self-acting and self-referential Matrix Law L_M after matrixization which acts on external object and internal object to cause them to interact with each other as further described below.

3.2 Self-Referential Matrix Law

The Matrix Law $\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M$ of Consciousness is derived from the following fundamental relationship:

$$E^2 - m^2 - \mathbf{p}^2 = 0 \quad (3.2)$$

through self-reference within this relationship which accompanies the imagination (spin i) in the Head. For simplicity, we have set c=1 in equation (3.2) and will set c=$\hbar$=1 through out this work unless indicated otherwise. Expression (3.2) was discovered by Einstein.

In the presence of an interacting field of a second primordial entity such as an electromagnetic potential $A^\mu = (\phi, \mathbf{A})$, equation (3.2) becomes the following for an elementary entity with electric charge e:

$$\left(E - e\phi\right)^2 - m^2 - \left(\mathbf{p} - e\mathbf{A}\right)^2 = 0 \quad (3.3)$$

One form of the Matrix Law of Consciousness is derived through self-reference as follows:

$$L = 1 = \frac{E^2 - m^2}{\mathbf{p}^2} = \left(\frac{E-m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{p}|}{E+m}\right)^{-1} \tag{3.4}$$

$$\rightarrow \frac{E-m}{-|\mathbf{p}|} = \frac{-|\mathbf{p}|}{E+m} \rightarrow \frac{E-m}{-|\mathbf{p}|} - \frac{-|\mathbf{p}|}{E+m} = 0$$

where $|\mathbf{p}| = \sqrt{\mathbf{p}^2}$. Matrixing left-land side of the last expression in (3.4) such that $\mathrm{Det}(L^M) = E^2 - m^2 - \mathbf{p}^2 = 0$ so as to satisfy the fundamental relationship (3.2) in the determinant view, we have:

$$\begin{pmatrix} E-m & -|\mathbf{p}| \\ -|\mathbf{p}| & E+m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.5}$$

After fermionic spinization:

$$|\mathbf{p}| = \sqrt{\mathbf{p}^2} = \sqrt{-Det(\boldsymbol{\sigma}\cdot\mathbf{p})} \rightarrow \boldsymbol{\sigma}\cdot\mathbf{p} \tag{3.6}$$

where $\boldsymbol{\sigma} = (\sigma_1, \sigma_2, \sigma_3)$ are Pauli matrices:

$$\sigma_1 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \quad \sigma_2 = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \quad \sigma_3 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \tag{3.7}$$

expression (3.5) becomes:

$$\begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E+m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M = E - \boldsymbol{\alpha}\bullet\mathbf{p} - \beta \mathrm{m} = E - H \tag{3.8}$$

where $\boldsymbol{\alpha} = (\alpha_1, \alpha_2, \alpha_3)$ and β are Dirac matrices and $H = \boldsymbol{\alpha}\bullet\mathbf{p} + \beta\mathrm{m}$ is the Dirac Hamiltonian. Expression (3.8) governs fermions in Dirac form such as Dirac electron and positron and we propose that expression (3.5) governs the third state of matter (unspinized or spinless entity/particle) with electric charge *e* and mass *m* such as a meson or a meson-like particle. Bosonic Spinization of expression (3.5) $|\mathbf{p}| = \sqrt{\mathbf{p}^2} \longrightarrow \mathbf{s}\cdot\mathbf{p}$ shall be discussed later.

If we define:

$$Det_{\sigma}\begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E+m \end{pmatrix} = (E-m)(E+m) - (-\boldsymbol{\sigma}\cdot\mathbf{p})(-\boldsymbol{\sigma}\cdot\mathbf{p}) \tag{3.9}$$

We get:

$$Det_{\sigma}\begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E+m \end{pmatrix} = \left(E^2 - m^2 - \mathbf{p}^2\right)I_2 = 0 \quad (3.10)$$

Thus, fundamental relationship (3.2) is also satisfied under the determinant view of expression (3.9). Indeed, we can also obtain the following conventional determinant:

$$Det\begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E+m \end{pmatrix} = \left(E^2 - m^2 - \mathbf{p}^2\right)^2 = 0 \quad (3.11)$$

If *m*=0, we have from expressions (3.5):

$$\begin{pmatrix} E & -|\mathbf{p}| \\ -|\mathbf{p}| & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.12)$$

After bosonic spinization:

$$|\mathbf{p}| = \sqrt{\mathbf{p}^2} = \sqrt{-(Det(\mathbf{s}\cdot\mathbf{p}+I_3) - Det(I_3))} \rightarrow \mathbf{s}\cdot\mathbf{p} \quad (3.13)$$

expression (3.12) becomes:

$$\begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.14)$$

where $\mathbf{s} = (s_1, s_2, s_3)$ are spin operators for spin 1 particle:

$$s_1 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & -i \\ 0 & i & 0 \end{pmatrix} \quad s_2 = \begin{pmatrix} 0 & 0 & i \\ 0 & 0 & 0 \\ -i & 0 & 0 \end{pmatrix} \quad s_3 = \begin{pmatrix} 0 & -i & 0 \\ i & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \quad (3.15)$$

If we define:

$$Det_{s}\begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix} = (E)(E) - (-\mathbf{s}\cdot\mathbf{p})(-\mathbf{s}\cdot\mathbf{p}) \quad (3.16)$$

We get:

$$Det_s\begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix} = \left(E^2 - \mathbf{p}^2\right)I_3 - \begin{pmatrix} p_x^2 & p_x p_y & p_x p_z \\ p_y p_x & p_y^2 & p_y p_z \\ p_z p_x & p_z p_y & p_z^2 \end{pmatrix} \tag{3.17}$$

To obey fundamental relationship (3.2) in determinant view (3.16), we shall require the last term in (3.17) acting on the external and internal wave functions respectively to produce null result (zero) in source-free zone as discussed later. We propose that expression (3.12) governs massless particle with unobservable spin (spinless). After bosonic spinization, the spinless and massless particle gains its spin 1.

Importantly, if *E*=0, we have from expression (3.2):

$$-m^2 - \mathbf{p}^2 = 0 \tag{3.18}$$

Thus, if Consciousness allows timeless forms of Matrix Law, we can derive, for example, the following from (3.2):

$$\begin{pmatrix} -m & -|\mathbf{p}| \\ -|\mathbf{p}| & +m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.19}$$

$$\begin{pmatrix} -|\mathbf{p}| & -m \\ -m & +|\mathbf{p}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.20}$$

Further, if |**p**|=0, we have from expression (3.2):

$$E^2 - m^2 = 0 \tag{3.21}$$

Thus, if Consciousness allows spaceless forms of Matrix Law, we can derive, for example, the following:

$$\begin{pmatrix} E-m & 0 \\ 0 & E+m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.22}$$

$$\begin{pmatrix} E & -m \\ -m & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.23}$$

The significance of these forms of Matrix Law shall be elucidated later. We suggest for now that the timeless forms of Matrix Law govern external and internal wave functions (self-fields) which play the roles of timeless gravitons, that is, they mediate time-independent interactions through space (momentum) quantum entanglement. On the other hand, the spaceless forms of Matrix Law govern the external and internal wave functions (self-fields) which play the roles of spaceless gravitons, that is, they mediate space (distance) independent interactions through proper time (mass) entanglement.

The above metamorphoses of the self-referential Matrix Law of Consciousness are derived from one-tier matrixization (self-reference) and two-tier matrixization (self-reference) based on the fundamental relationship (3.2). The first-tier matrixization makes distinctions in time (energy), proper time (mass) and undifferentiated space (total momentum) that involve scalar unit 1 and imaginary unit (spin) ***i***. Then the second-tier matrixization makes distinction in three-dimensional space (three-dimensional momentum) based on spin ***σ***, ***s*** or other spin structure if it exists.

3.3 Downward Self-Reference

If Consciousness creates spatial self-confinement of an elementary entity through imaginary momentum $\mathbf{p}_i$ (downward self-reference such that $m^2 > E^2$) we have:

$$m^2 - E^2 = -\mathbf{p}_i^2 = -p_{i,1}^2 - p_{i,2}^2 - p_{i,3}^2 = (i\mathbf{p}_i)^2 = -Det(\boldsymbol{\sigma} \cdot i\mathbf{p}_i) \quad (3.24)$$

that is:

$$E^2 - m^2 - \mathbf{p}_i^2 = 0 \quad (3.25)$$

Therefore, allowing imaginary momentum (downward self-reference) for an elementary entity, we can derive the following Matrix Law in Dirac-like form:

$$\begin{pmatrix} E-m & -|\mathbf{p}_i| \\ -|\mathbf{p}_i| & E+m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.26)$$

$$\begin{pmatrix} -m & -\boldsymbol{\sigma}\cdot\mathbf{p}_i \\ -\boldsymbol{\sigma}\cdot\mathbf{p}_i & +m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.27)$$

3.4 Scientific Genesis of Primordial Entities (Elementary Particles)

Therefore, transcendental aspect of Consciousness creates, sustains and causes evolution of a free plane-wave fermion such as an electron in Dirac form as follows:

$$1 = e^h = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{E^2 - m^2}{\mathbf{p}^2} e^{-ip^\mu x_\mu + ip^\mu x_\mu} =$$

$$\left(\frac{E-m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{p}|}{E+m}\right)^{-1}\left(e^{-ip^\mu x_\mu}\right)\left(e^{-ip^\mu x_\mu}\right)^{-1} \rightarrow \quad (3.28)$$

$$\frac{E-m}{-|\mathbf{p}|} e^{-ip^\mu x_\mu} = \frac{-|\mathbf{p}|}{E+m} e^{-ip^\mu x_\mu} \rightarrow \frac{E-m}{-|\mathbf{p}|} e^{-ip^\mu x_\mu} - \frac{-|\mathbf{p}|}{E+m} e^{-ip^\mu x_\mu} = 0$$

$$\rightarrow \begin{pmatrix} E-m & -|\mathbf{p}| \\ -|\mathbf{p}| & E+m \end{pmatrix} \begin{pmatrix} a_{e,+}e^{-ip^{\mu}x_{\mu}} \\ a_{i,-}e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0$$

$$\rightarrow \begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E+m \end{pmatrix} \begin{pmatrix} A_{e,+}e^{-ip^{\mu}x_{\mu}} \\ A_{i,-}e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0$$

that is:

$$\begin{pmatrix} (E-m)\psi_{e,+} = \boldsymbol{\sigma}\cdot\mathbf{p}\,\psi_{i,-} \\ (E+m)\psi_{i,-} = \boldsymbol{\sigma}\cdot\mathbf{p}\,\psi_{e,+} \end{pmatrix} \text{ or } \begin{pmatrix} i\partial_t\psi_{e,+} - m\psi_{e,+} = -i\boldsymbol{\sigma}\cdot\nabla\psi_{i,-} \\ i\partial_t\psi_{i,-} + m\psi_{i,-} = -i\boldsymbol{\sigma}\cdot\nabla\psi_{e,+} \end{pmatrix} \quad (3.29)$$

where substitutions $E \rightarrow i\partial_t$ and $\mathbf{p} \rightarrow -i\nabla$ have been made so that components of L_M can act on external and internal wave functions.

Transcendental Consciousness creates, sustains and causes evolution of a linear plane-wave photon as follows:

$$1 = e^h = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{E^2}{\mathbf{p}^2}e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} =$$

$$\left(\frac{E}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{p}|}{E}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow \quad (3.30)$$

$$\frac{E}{-|\mathbf{p}|}e^{-ip^{\mu}x_{\mu}} = \frac{-|\mathbf{p}|}{E}e^{-ip^{\mu}x_{\mu}} \rightarrow \frac{E}{-|\mathbf{p}|}e^{-ip^{\mu}x_{\mu}} - \frac{-|\mathbf{p}|}{E}e^{-ip^{\mu}x_{\mu}} = 0$$

$$\rightarrow \begin{pmatrix} E & -|\mathbf{p}| \\ -|\mathbf{p}| & E \end{pmatrix} \begin{pmatrix} a_{e,+}e^{-ip^{\mu}x_{\mu}} \\ a_{i,-}e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0$$

$$\rightarrow \begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix} \begin{pmatrix} \mathbf{E}_{0e,+}e^{-ip^{\mu}x_{\mu}} \\ i\mathbf{B}_{0i,-}e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi_{photon} = 0$$

This photon wave function can be written as:

$$\psi_{photon} = \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = \begin{pmatrix} \mathbf{E} \\ i\mathbf{B} \end{pmatrix} = \begin{pmatrix} \mathbf{E_0} e^{-i(\omega t - \mathbf{k}\cdot\mathbf{x})} \\ i\mathbf{B_0} e^{-i(\omega t - \mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = \begin{pmatrix} \mathbf{E_0} \\ i\mathbf{B_0} \end{pmatrix} e^{-i(\omega t - \mathbf{k}\cdot\mathbf{x})} \qquad (3.31)$$

After the substitutions $E \to i\partial_t$ and $\mathbf{p} \to -i\nabla$, we have from the last expression in (3.30):

$$\begin{pmatrix} i\partial_t & i\mathbf{S}\cdot\nabla \\ i\mathbf{S}\cdot\nabla & i\partial_t \end{pmatrix} \begin{pmatrix} \mathbf{E} \\ i\mathbf{B} \end{pmatrix} = 0 \to \begin{pmatrix} \partial_t \mathbf{E} = \nabla \times \mathbf{B} \\ \partial_t \mathbf{B} = -\nabla \times \mathbf{E} \end{pmatrix} \qquad (3.32)$$

where we have used the relationship $\mathbf{S}\cdot(-i\nabla) = \nabla\times$ to derive the latter equations which together with $\nabla\cdot\mathbf{E} = \mathbf{0}$ and $\nabla\cdot\mathbf{B} = \mathbf{0}$ are the Maxwell equations in the source-free vacuum.

Transcendental aspect of Consciousness likely creates and sustains timeless (instantaneous) external and internal wave functions (timeless graviton) of a mass *m* in Dirac form as follows:

$$1 = e^h = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{-m^2}{\mathbf{p}^2} e^{-iM+iM} = \qquad (3.33)$$

$$\left(\frac{-m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{p}|}{+m}\right)^{-1} \left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \to$$

$$\frac{-m}{-|\mathbf{p}|} e^{-iM} = \frac{-|\mathbf{p}|}{+m} e^{-iM} \to \frac{-m}{-|\mathbf{p}|} e^{-iM} - \frac{-|\mathbf{p}|}{+m} e^{-iM} = 0$$

$$\to \begin{pmatrix} -m & -|\mathbf{p}| \\ -|\mathbf{p}| & +m \end{pmatrix} \begin{pmatrix} g_{D,e} e^{-iM} \\ g_{D,i} e^{-iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = L_M V_D = 0$$

We will determine the form of imaginary content *M* in expression (3.33) later.

Transcendental aspect of Consciousness likely creates and sustains spaceless (space/distance independent) external and internal wave functions of a mass *m* in Dirac form as follows:

$$0 = 0e^{h} = 0e^{0} = L_0 e^{-iM+iM} = \left(E^2 - m^2\right)e^{-imt+imt} = \tag{3.34}$$

$$\left(Det\begin{pmatrix} E & 0 \\ 0 & E \end{pmatrix} + Det\begin{pmatrix} -m & 0 \\ 0 & +m \end{pmatrix}\right)\left(e^{-imt}\right)\left(e^{-imt}\right)^{-1} \rightarrow$$

$$\left(\begin{pmatrix} E & 0 \\ 0 & E \end{pmatrix} + \begin{pmatrix} -m & 0 \\ 0 & +m \end{pmatrix}\right)\begin{pmatrix} g_{D,e}e^{-imt} \\ g_{D,i}e^{-imt} \end{pmatrix} = \begin{pmatrix} E-m & 0 \\ 0 & E+m \end{pmatrix}\begin{pmatrix} g_{D,e}e^{-imt} \\ g_{D,i}e^{-imt} \end{pmatrix} = 0$$

Transcendental aspect of Consciousness likely creates, sustains and causes evolution of a spatially self-confined entity such as a proton through imaginary momentum $\mathbf{p}_i$ (downward self-reference such that $m^2 > E^2$) in Dirac form as follows:

$$1 = e^{h} = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{E^2 - m^2}{\mathbf{p}_i^2} e^{+ip^{\mu}x_{\mu} - ip^{\mu}x_{\mu}} = \tag{3.35}$$

$$\left(\frac{E-m}{-|\mathbf{p}_i|}\right)\left(\frac{-|\mathbf{p}_i|}{E+m}\right)^{-1}\left(e^{+ip^{\mu}x_{\mu}}\right)\left(e^{+ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow$$

$$\frac{E-m}{-|\mathbf{p}_i|}e^{+ip^{\mu}x_{\mu}} = \frac{-|\mathbf{p}_i|}{E+m}e^{+ip^{\mu}x_{\mu}} \rightarrow \frac{E-m}{-|\mathbf{p}_i|}e^{+ip^{\mu}x_{\mu}} - \frac{-|\mathbf{p}_i|}{E+m}e^{+ip^{\mu}x_{\mu}} = 0$$

$$\rightarrow \begin{pmatrix} E-m & -|\mathbf{p}_i| \\ -|\mathbf{p}_i| & E+m \end{pmatrix}\begin{pmatrix} s_{e,-}e^{+iEt} \\ s_{i,+}e^{+iEt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0 \tag{3.36}$$

After spinization of expression (3.36), we have:

$$\rightarrow \begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{p}_i \\ -\boldsymbol{\sigma}\cdot\mathbf{p}_i & E+m \end{pmatrix}\begin{pmatrix} S_{e,-}e^{+iEt} \\ S_{i,+}e^{+iEt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0 \tag{3.37}$$

It is likely that expression (3.36) governs the confinement structure of the unspinized proton in Dirac form through imaginary momentum $\mathbf{p}_i$ and, on the other hand, expression (3.37) governs the confinement structure of spinized proton through $\mathbf{p}_i$.

3.4 Scientific Genesis of Composite Entities

Then, transcendental aspect of Consciousness may create, sustain and cause evolution of a neutron in Dirac form which is comprised of an unspinized proton:

$$\left(\begin{pmatrix} E-e\phi-m & -|\mathbf{p}_i-e\mathbf{A}| \\ -|\mathbf{p}_i-e\mathbf{A}| & E-e\phi+m \end{pmatrix}\begin{pmatrix} s_{e,-}e^{+iEt} \\ s_{i,+}e^{+iEt} \end{pmatrix}=0\right)_p \tag{3.38}$$

and a spinized electron:

$$\left(\begin{pmatrix} E+e\phi-V-m & -\boldsymbol{\sigma}\cdot(\mathbf{p}+e\mathbf{A}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{p}+e\mathbf{A}) & E+e\phi-V+m \end{pmatrix}\begin{pmatrix} S_{e,+}e^{-iEt} \\ S_{i,-}e^{-iEt} \end{pmatrix}=0\right)_e \tag{3.39}$$

as follows:

$$1=e^h=e^{i0}e^{i0}=1e^{i0}1e^{i0}=\left(Le^{-iM+iM}\right)_p\left(Le^{-iM+iM}\right)_e \tag{3.40}$$

$$=\left(\frac{E^2-m^2}{\mathbf{p}_i^2}e^{+ip^\mu x_\mu-ip^\mu x_\mu}\right)_p\left(\frac{E^2-m^2}{\mathbf{p}^2}e^{-ip^\mu x_\mu+ip^\mu x_\mu}\right)_e=$$

$$\left(\left(\frac{E-m}{-|\mathbf{p}_i|}\right)\left(\frac{-|\mathbf{p}_i|}{E+m}\right)^{-1}\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1}\right)_p\left(\left(\frac{E-m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{p}|}{E+m}\right)^{-1}\left(e^{-ip^\mu x_\mu}\right)\left(e^{-ip^\mu x_\mu}\right)^{-1}\right)_e$$

$$\to\left(\frac{E-m}{-|\mathbf{p}_i|}e^{+ip^\mu x_\mu}=\frac{-|\mathbf{p}_i|}{E+m}e^{+ip^\mu x_\mu}\right)_p\left(\frac{E-m}{-|\mathbf{p}|}e^{-ip^\mu x_\mu}=\frac{-|\mathbf{p}|}{E+m}e^{-ip^\mu x_\mu}\right)_e$$

$$\to\left(\frac{E-m}{-|\mathbf{p}_i|}e^{+ip^\mu x_\mu}-\frac{-|\mathbf{p}_i|}{E+m}e^{+ip^\mu x_\mu}=0\right)_p\left(\frac{E-m}{-|\mathbf{p}|}e^{-ip^\mu x_\mu}-\frac{-|\mathbf{p}|}{E+m}e^{-ip^\mu x_\mu}=0\right)_e$$

$$\to\left(\begin{pmatrix} E-m & -|\mathbf{p}_i| \\ -|\mathbf{p}_i| & E+m \end{pmatrix}\begin{pmatrix} s_{e,-}e^{+iEt} \\ s_{i,+}e^{+iEt} \end{pmatrix}=0\right)_p\left(\begin{pmatrix} E-m & -|\mathbf{p}| \\ -|\mathbf{p}| & E+m \end{pmatrix}\begin{pmatrix} s_{e,+}e^{-iEt} \\ s_{i,-}e^{-iEt} \end{pmatrix}=0\right)_e$$

$$\to\begin{pmatrix} \left(\begin{pmatrix} E-e\phi-m & -|\mathbf{p}_i-e\mathbf{A}| \\ -|\mathbf{p}_i-e\mathbf{A}| & E-e\phi+m \end{pmatrix}\begin{pmatrix} s_{e,-}e^{+iEt} \\ s_{i,+}e^{+iEt} \end{pmatrix}=0\right)_p \\ \left(\begin{pmatrix} E+e\phi-V-m & -\boldsymbol{\sigma}\cdot(\mathbf{p}+e\mathbf{A}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{p}+e\mathbf{A}) & E+e\phi-V+m \end{pmatrix}\begin{pmatrix} S_{e,+}e^{-iEt} \\ S_{i,-}e^{-iEt} \end{pmatrix}=0\right)_e \end{pmatrix}_n$$

In expressions (3.38), (3.39) and (3.40), $(\ )_p$, $(\ )_e$ and $(\ )_n$ indicate proton, electron and neutron respectively. Further, unspinized proton has charge e, electron has charge –e, $\left(A^\mu=(\phi,\mathbf{A})\right)_p$ and $\left(A^\mu=(\phi,\mathbf{A})\right)_e$ are the electromagnetic potentials acting on unspinized proton and tightly bound spinized electron respectively, and $(V)_e$ is a binding potential from the unspinized proton acting on the spinized electron causing tight binding as discussed later. Experimental data on charge distribution and *g*-factor of neutron seem to support a neutron comprising of an unspinized proton and a tightly bound spinized electron.

4. Metamorphous Transcendental View

4.1. Metamorphoses & the Essence of Spin

The preceding sections make it clear that the particle e^{i0} of Consciousness can take many different forms as different primordial entities and, further, can have different manifestations as different wave functions and/or fields in different contexts even as a single primordial entity. For example, the wave functions of an electron can take the Dirac, Weyl, quaternion or determinant form respectively in different contexts depending on the questions one asks and the answer one seeks. However, the answer one gets is determined by the free will of Consciousness commonly termed as the measurement problem and is understood currently as the randomness of Nature. For another example, depending on the context, the manifestations of an entity such as an electron can take the form of a bi-spinor $(\psi_e, \psi_i)^T$ in spinized self-interaction and bi-vector $(\mathbf{E}, i\mathbf{B})^T$ or electromagnetic potential $A^u=(\phi, \mathbf{A})$ in electromagnetic interactions. Further, these forms are self-contained through their respective self-referential Matrix Law.

Now, if we ask the question how transcendental aspect of Consciousness creates a free fermion, we have shown several versions of it. If we ask the question how an entity participates in weak interaction, the answer is: through fermionic spinization and unspinization. If we ask the question how an entity participates in the strong interaction, the answer is: imaginary momentum (downward self-reference). If we ask the question how an entity participates in an electromagnetic interaction, the answer is: through bosonic spinization and unspinization. If we ask the question, how an entity participates in a gravitational interaction, the answer is: through a timeless, spaceless and/or massless external and internal wave function in prespacetime.

Further, this work also makes it clear that primordial self-referential spin in prespacetime (Consciousness) is hierarchical and that it is the cause of primordial distinctions for creating the self-referential entities in the dual world. There are several levels of spin: (1) spin in the Head of Consciousness making primordial external and internal phase distinctions of external and internal wave functions; (2) spin of the Body (ether) of Consciousness making primordial external and internal wave functions which accompanies the primordial phase distinctions; (3) self-referential mixing of these wave functions through Matrix Law before spatial spinization (energy/time spin); (4) unconfining spatial spin through spatial spinization (electromagnetic and weak interaction) for creating bosonic and fermionic entities; and (5) confining spatial spin (strong interactions) creating the appearance of quarks through imaginary momentum (downward self-reference).

4.2. The Determinant View & the Meaning of Klein-Gordon Equation

In the determinant view, the Matrix Law collapses into Klein-Gordon form as shown in § 3 but so far we have not defined the form of the wave function as a result of the said collapse. Here, we propose that the external and internal wave functions (objects) form a special product state $\psi_e \psi_i^*$ with ψ_i^* containing the hidden variables, quantum potentials or self-gravity as shown below, *visa versa*.

From the following equations for unspinized free particle in Dirac and Weyl form respectively:

$$\begin{pmatrix} E-m & -|\mathbf{p}| \\ -|\mathbf{p}| & E+m \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi_D = 0 \tag{4.1}$$

and

$$\begin{pmatrix} E-|\mathbf{p}| & -m \\ -m & E+|\mathbf{p}| \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi_W = 0 \tag{4.2}$$

we respectively obtained the following equations in the determinant view (Klein Gordon form):

$$\begin{pmatrix} (Det L_M)\psi_{e,+}\psi_{i,-}^* = (E^2 - m^2 - \mathbf{p}^2)\psi_{e,+}\psi_{i,-}^* = 0 \\ (E^2 - m^2 - \mathbf{p}^2)\psi_{e,+} = 0 \\ (E^2 - m^2 - \mathbf{p}^2)\psi_{i,-}^* = 0 \end{pmatrix} \tag{4.3}$$

and

$$\begin{pmatrix} (Det L_M)\psi_{e,l}\psi_{i,r}^* = (E^2 - \mathbf{p}^2 - m^2)\psi_{e,l}\psi_{i,r}^* = 0 \\ (E^2 - \mathbf{p}^2 - m^2)\psi_{e,l} = 0 \\ (E^2 - \mathbf{p}^2 - m^2)\psi_{i,r}^* = 0 \end{pmatrix} \tag{4.4}$$

By way of an example, equation (4.1) has the following plane-wave solution:

$$\begin{pmatrix} \psi_{e,+} = a_{e,+} e^{-i(Et - \mathbf{p}\cdot\mathbf{x})} \\ \psi_{e,-} = a_{i,-} e^{-i(Et - \mathbf{p}\cdot\mathbf{x})} \end{pmatrix} \tag{4.5}$$

from which we have:

$$\psi_{e,+}\psi_{i,-}^* = \left(a_{e,+} e^{-i(Et - \mathbf{p}\cdot\mathbf{x})}\right)_e \left(a_{i,-}^* e^{+i(Et - \mathbf{p}\cdot\mathbf{x})}\right)_i \tag{4.6}$$

where

$$\begin{pmatrix} (Et - \mathbf{p}\cdot\mathbf{x})_e = \phi_e \\ -(Et - \mathbf{p}\cdot\mathbf{x})_i = \phi_i \end{pmatrix} \quad (4.7)$$

are respectively the external and internal phase in the determinant view. The variables in $\psi^*_{i,-}$ play the roles of hidden variables to $\psi_{e,+}$ which would be annihilated, if $\psi^*_{i,-}$ were allowed to merged with $\psi_{e,+}$. Indeed, if relativistic mass in the external wave function $\psi_{e,+}$ is considered to be inertial mass, then the relativistic mass in the conjugate internal wave function $\psi^*_{i,-}$ plays the role of gravitational mass. We will discuss quantum potential later.

Similarly, from the following equations for spinized free fermion in Dirac and Weyl form respectively:

$$\begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E+m \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M\psi = 0 \quad (4.8)$$

and

$$\begin{pmatrix} E-\boldsymbol{\sigma}\cdot\mathbf{p} & -m \\ -m & E+\boldsymbol{\sigma}\cdot\mathbf{p} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M\psi = 0 \quad (4.9)$$

where $\psi_D=(\psi_{e,+}, \psi_{i,-})^T=(\psi_1,\psi_2, \psi_3, \psi_4)^T$ and $\psi_W=(\psi_{e,l}, \psi_{i,r})^T=(\phi_1, \phi_2, \phi_3, \phi_4)^T$, we respectively obtained following equations in the determinant view (Klein Gordon form):

$$\begin{pmatrix} (Det_\sigma L_M)\psi_{e,+}\psi^*_{i,-} = (E^2 - m^2 - \mathbf{p}^2)I_2\psi_{e,+}\psi^*_{i,-} = 0 \\ (E^2 - m^2 - \mathbf{p}^2)\psi_1 = 0 \\ (E^2 - m^2 - \mathbf{p}^2)\psi_2 = 0 \\ (E^2 - m^2 - \mathbf{p}^2)\psi^*_3 = 0 \\ (E^2 - m^2 - \mathbf{p}^2)\psi^*_4 = 0 \end{pmatrix} \quad (4.10)$$

and

$$\begin{pmatrix} (Det_\sigma L_M)\psi_{e,l}\psi^*_{i,r} = (E^2 - \mathbf{p}^2 - m^2)I_2\psi_{e,l}\psi^*_{i,r} = 0 \\ (E^2 - \mathbf{p}^2 - m^2)\phi_1 = 0 \\ (E^2 - \mathbf{p}^2 - m^2)\phi_2 = 0 \\ (E^2 - \mathbf{p}^2 - m^2)\phi^*_3 = 0 \\ (E^2 - \mathbf{p}^2 - m^2)\phi^*_4 = 0 \end{pmatrix} \quad (4.11)$$

In the presence of electromagnetic potential $A^\mu = (\phi, \mathbf{A})$, we have from equations (4.1) and (4.2) the following equations:

$$\begin{pmatrix} E-e\phi-m & -|\mathbf{p}\text{-}e\mathbf{A}| \\ -|\mathbf{p}\text{-}e\mathbf{A}| & E-e\phi+m \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi_D = 0 \tag{4.12}$$

and

$$\begin{pmatrix} E-e\phi-|\mathbf{p}\text{-}e\mathbf{A}| & -m \\ -m & E-e\phi+|\mathbf{p}\text{-}e\mathbf{A}| \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi_W = 0 \tag{4.13}$$

from which we respectively obtained the following equations in the determinant view (Klein Gordon form):

$$\begin{pmatrix} (DetL_M)\psi_{e,+}\psi_{i,-}^* = \left((E-e\phi)^2 - m^2 - (\mathbf{p}\text{-}e\mathbf{A})^2\right)\psi_{e,+}\psi_{i,-}^* = 0 \\ \left((E-e\phi)^2 - m^2 - (\mathbf{p}\text{-}e\mathbf{A})^2\right)\psi_{e,+} = 0 \\ \left((E-e\phi)^2 - m^2 - (\mathbf{p}\text{-}e\mathbf{A})^2\right)\psi_{i,-}^* = 0 \end{pmatrix} \tag{4.14}$$

and

$$\begin{pmatrix} (DetL_M)\psi_{e,l}\psi_{i,r}^* = \left((E-e\phi)^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 - m^2 + \alpha\beta - \beta\alpha\right)\psi_{e,l}\psi_{i,r}^* = 0 \\ \left((E-e\phi)^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 - m^2 + \alpha\beta - \beta\alpha\right)\psi_{e,l} = 0 \\ \left((E-e\phi)^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 - m^2 + \alpha\beta - \beta\alpha\right)\psi_{i,r}^* = 0 \end{pmatrix} \tag{4.15}$$

where $\alpha = E - e\phi$ and $\beta = |\mathbf{p}\text{-}e\mathbf{A}|$. After spinization of equations (4.12) and (4.13), we have:

$$\begin{pmatrix} E-e\phi-m & -\boldsymbol{\sigma}\cdot(\mathbf{p}\text{-}e\mathbf{A}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{p}\text{-}e\mathbf{A}) & E-e\phi+m \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi_D = 0 \tag{4.16}$$

and

$$\begin{pmatrix} E-e\phi-\boldsymbol{\sigma}\cdot(\mathbf{p}\text{-}e\mathbf{A}) & -m \\ -m & E-e\phi+\boldsymbol{\sigma}\cdot(\mathbf{p}\text{-}e\mathbf{A}) \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi_W = 0 \tag{4.17}$$

from which we respectively obtained the following equations in the determinant view (Klein Gordon form):

$$\begin{pmatrix} (Det_\sigma L_M)\psi_{e,+}\psi_{i,-}^* = \left((E-e\phi)^2 - m^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 + e\boldsymbol{\sigma}\cdot\mathbf{B}\right)I_2\psi_{e,+}\psi_{i,-}^* = 0 \\ \left((E-e\phi)^2 - m^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 + e\boldsymbol{\sigma}\cdot\mathbf{B}\right)I_2\psi_{e,+} = 0 \\ \left((E-e\phi)^2 - m^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 + e\boldsymbol{\sigma}\cdot\mathbf{B}\right)I_2\psi_{i,-}^* = 0 \end{pmatrix} \tag{4.18}$$

and

$$\begin{pmatrix} (Det_\sigma L_M)\psi_{e,l}\psi_{i,r}^* = \left((E-e\phi)^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 - m^2 + e\sigma\cdot\mathbf{B}\text{-}ie\sigma\cdot\mathbf{E}\right)I_2\psi_{e,l}\psi_{i,r}^* = 0 \\ \left((E-e\phi)^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 - m^2 + e\sigma\cdot\mathbf{B}\text{-}ie\sigma\cdot\mathbf{E}\right)I_2\psi_{e,l} = 0 \\ \left((E-e\phi)^2 - (\mathbf{p}\text{-}e\mathbf{A})^2 - m^2 + e\sigma\cdot\mathbf{B}\text{-}ie\sigma\cdot\mathbf{E}\right)I_2\psi_{i,r}^* = 0 \end{pmatrix} \tag{4.19}$$

In equations (4.16) and (4.17), the couplings of **E** and/or **B** with spin **σ** are either implicit or hidden. These interactions are due to self-referential Matrix Law L_M which causes mixing of the external and internal wave functions. However, in the determinant view, these interactions are made explicit as shown in equations (4.18) and (4.19) respectively.

4.3. The Meaning of Schrodinger Equation & Quantum Potential

It can be shown that the following Schrodinger Equation is the non-relativistic approximation of equation (4.3) or (4.4):

$$i\partial_t \psi = H\psi = -\frac{1}{2m}\nabla^2\psi \tag{4.20}$$

where $\psi = \psi_{\mathrm{Re}} + i\,\psi_{\mathrm{Im}}$. Equation (4.20) can be written as two coupled equations:

$$\begin{pmatrix} \partial_t \psi_{\mathrm{Re}} = H\psi_{\mathrm{Im}} \\ \partial_t \psi_{\mathrm{Im}} = -H\psi_{\mathrm{Re}} \end{pmatrix} \quad \text{or} \quad \begin{pmatrix} \partial_t & -H \\ H & \partial_t \end{pmatrix}\begin{pmatrix} \psi_{\mathrm{Re}} \\ \psi_{\mathrm{Im}} \end{pmatrix} = 0 \tag{4.21}$$

The above equation describes the non-relativistic self-reference of the wave components ψ_{Re} and ψ_{Im} due to spin *i*. If we designate ψ_{Re} as external object, ψ_{Im} is the internal object. It is the non-relativistic approximation of the determinant view of an unspinized particle (Klein-Gordon form) with self-referential interaction reduced to spin *i* and contained in the wave function from which the quantum potential *Q* can be extracted.

For example, in the case:

$$\psi_{e,+}\psi_{i,-}^{*} = a_{e,+}e^{-i(Et-\mathbf{p}\cdot\mathbf{x})}a_{i,-}e^{+i(Et-\mathbf{p}\cdot\mathbf{x})} \approx \psi = \rho e^{-iS}e^{+i\zeta} \tag{4.22}$$

where $a_{e,+}$ and $a_{i,-}$ are real, ζ contains the hidden variables and:

$$\begin{pmatrix} \rho = a_{e,+}a_{i,-} \\ S = \left(E_p t - \mathbf{p}\cdot\mathbf{x}\right)_e \\ \zeta = \left(E_p t - \mathbf{p}\cdot\mathbf{x}\right)_i \\ E_p = \dfrac{\mathbf{p}^2}{2m} \end{pmatrix} \tag{4.23}$$

we can derive the following quantum potential (details will be given elsewhere):

$$Q = -\frac{1}{2m}(\nabla\zeta)^2 = \left(-\frac{\mathbf{p}^2}{2m}\right)_i = \left(-E_p\right)_i \tag{4.24}$$

which originates from spin *i* in:

$$\psi_{i,-}^{*} = a_{i,-}e^{i(Et-\mathbf{p}\cdot\mathbf{x})} \approx a_{i,-}e^{+i\,m\,t}e^{+i\zeta} \tag{4.25}$$

Q would negate the non-relativistic kinetic energy of the external wave function if the external wave function and the conjugate internal wave function would merge.

Further, it can be shown that the Pauli Equation is the non-relativistic approximation of equation (4.18) which is the determinant view of a fermion in an electromagnetic field in Dirac form:

$$i\partial_t \begin{pmatrix} \varphi_1 \\ \varphi_2 \end{pmatrix} = \left(\frac{1}{2m}\left(-i\nabla - e\mathbf{A}\right)^2 - \frac{e}{2m}\boldsymbol{\sigma}\cdot\mathbf{B} + e\phi \right)\begin{pmatrix} \varphi_1 \\ \varphi_2 \end{pmatrix} \tag{4.24}$$

It contain non-relativistic self-reference due to both spin i and $\boldsymbol{\sigma}$ and will be treated elsewhere in detail when and if time permits.

4.4 The Third State of Matter

Traditionally, a scalar (spinless) particle is presumed to be described by the Klein-Gordon equation and is classified as a boson. However, in this work we have suggested that Kein-Gordon equation is a determinant view of a fermion, boson or an unspinized entity (spinlesson) in which the external and internal wave functions (objects) form a special product state $\psi_e \psi_i^*$ with ψ_i^* as the origin of hidden variable, quantum potentials or self-gravity. The unspinized entity (spinlesson) is neither a boson nor a fermion but may be classified as a third state of matter described by the unspinized equation in Dirac form, for example:

$$\begin{pmatrix} E-m & -|\mathbf{p}| \\ -|\mathbf{p}| & E+m \end{pmatrix}\begin{pmatrix} a_{e,+}e^{-ip^\mu x_\mu} \\ a_{i,-}e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0 \tag{4.25}$$

The hadronized version of the above equation in which the momentum is imaginary is as follows:

$$\begin{pmatrix} E-m & -|\mathbf{p}_i| \\ -|\mathbf{p}_i| & E+m \end{pmatrix}\begin{pmatrix} s_{e,+}e^{-iEt} \\ s_{i,-}e^{-iEt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0 \tag{4.26}$$

The third state of matter may not be subject to the statistical behavior of either bosons or fermions. The wave functions of a fermion and boson are respectively a bispinor and bi-vector but that of the third state (spinlesson) is two-component complex scalar field. The third state of matter is the precursor of both fermionic and bosonic matters/fields before fermionic or bosonic spinization. Thus, we suggest that it steps into the shoes played by the Higgs field in the standard model which so far has not been found. Further, in this scenario, mass is created by the self-referential spin (imagination) of Consciousness.

5. Electromagnetic Interaction

Electromagnetic interaction is an expressive process (radiation or emission) through bosonic spinization of a massless and spinless entity and the associated reverse process (absorption). There are possibly two kinds of mechanisms at play. One kind is the direct bosonic spinization (spinizing radiation):

$$|\mathbf{p}| = \sqrt{\mathbf{p}^2} = \sqrt{-(Det(\mathbf{s}\cdot\mathbf{p}+I_3)-Det(I_3))} \rightarrow \mathbf{s}\cdot\mathbf{p} \qquad (5.1)$$

that is, for example:

$$\begin{pmatrix} E & -|\mathbf{p}| \\ -|\mathbf{p}| & E \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \rightarrow \begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}.\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \qquad (5.2)$$

and the following reverse process (unspinizing absorption):

$$\mathbf{s}\cdot\mathbf{p} \rightarrow \sqrt{-(Det(\mathbf{s}\cdot\mathbf{p}+I_3)-Det(I_3))} = \sqrt{\mathbf{p}^2} = |\mathbf{p}| \qquad (5.3)$$

that is, for example:

$$\begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}.\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \rightarrow \begin{pmatrix} E & -|\mathbf{p}| \\ -|\mathbf{p}| & E \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \qquad (5.4)$$

The radiation or absorption of a photon during acceleration of a charged particle may be direct bosonic spinizing or unspinizing process respectively:

(1) Bound Spinless & Massless Particle → Bound Spinized Photon → Free Spinized Photon; and

(2) Free Spinized Photon → Bound Spinized Photon → Bound Spinless & Massless Particle.

These two processes may also occur in nuclear decay and perhaps in other processes. Assuming a plane wave $\psi_{e,+} = e^{-ip^{\mu}x_{\mu}}$ exists for the spinless and massless particle:

$$\begin{pmatrix} E & -|\mathbf{p}| \\ -|\mathbf{p}| & E \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \quad \text{or} \quad \begin{pmatrix} E\psi_e = |\mathbf{p}|\psi_i \\ E\psi_i = |\mathbf{p}|\psi_e \end{pmatrix} \qquad (5.5)$$

we obtain the following solution for this equation:

$$\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}}\begin{pmatrix} e^{-ip^{\mu}x_{\mu}} \\ \frac{|\mathbf{p}|}{E}e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = N\begin{pmatrix} 1 \\ \frac{|\mathbf{p}|}{E} \end{pmatrix} e^{-ip^{\mu}x_{\mu}} \qquad (5.6)$$

where we have utilized the following relation for an energy eigenstate and N is the normalization factor :

$$E\psi_{i,-} = |\mathbf{p}|\psi_{e,+} \rightarrow \psi_{i,-} = \frac{|\mathbf{p}|}{E}\psi_{e,+} \qquad (5.7)$$

After spinization:

$$\frac{|\mathbf{p}|}{E} \to \frac{\mathbf{s}\cdot\mathbf{p}}{E} = \begin{pmatrix} 0 & \frac{-ip_z}{E} & \frac{ip_y}{E} \\ \frac{ip_z}{E} & 0 & -\frac{ip_x}{E} \\ -\frac{ip_y}{E} & \frac{ip_x}{E} & 0 \end{pmatrix} \tag{5.8}$$

We arrive at the plane-wave solution:

$$\begin{pmatrix} \psi^x_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}} \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ \frac{ip_z}{E} \\ \frac{-ip_y}{E} \end{pmatrix} e^{-ip^\mu x_\mu} \quad \begin{pmatrix} \psi^y_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}} \begin{pmatrix} 0 \\ 1 \\ 0 \\ \frac{-ip_z}{E} \\ 0 \\ \frac{ip_x}{E} \end{pmatrix} e^{-ip^\mu x_\mu} \quad \begin{pmatrix} \psi^z_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}} \begin{pmatrix} 0 \\ 0 \\ 1 \\ \frac{ip_y}{E} \\ \frac{-ip_x}{E} \\ 0 \end{pmatrix} e^{-ip^\mu x_\mu} \tag{5.9}$$

for the spinized photon equation:

$$\begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix} \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \quad \text{or} \quad \begin{pmatrix} E\psi_e = \mathbf{s}\cdot\mathbf{p}\,\psi_i \\ E\psi_i = \mathbf{s}\cdot\mathbf{p}\,\psi_e \end{pmatrix} \tag{5.10}$$

The second kind of electromagnetic interaction is the release (radiation) or binding (absorption) of a spinized photon without unspinization:

(3) Bound Spinized Photon → Free Spinized Photon; and

(4) Free Spinized Photon → Bound Spinized Photon.

Processes (3) and (4) occur at the openings of an optical cavity or waveguide and may also occur in atomic photon excitation and emission and perhaps other processes.

For bosonic spinization $|\mathbf{p}| = \sqrt{\mathbf{p}^2} \to \mathbf{s}\cdot\mathbf{p}$, the Maxwell equations in the vacuum (c=1; ε_0=1) are as follows:

$$\begin{pmatrix} \begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \mathbf{E} \\ i\mathbf{B} \end{pmatrix} = 0 \\ \mathbf{p}\cdot\mathbf{E} = 0 \\ \mathbf{p}\cdot\mathbf{B} = 0 \end{pmatrix}, \quad \begin{pmatrix} \begin{pmatrix} \partial_t & -\nabla\times \\ \nabla\times & \partial_t \end{pmatrix}\begin{pmatrix} \mathbf{E} \\ \mathbf{B} \end{pmatrix} = 0 \\ \nabla\cdot\mathbf{E} = 0 \\ \nabla\cdot\mathbf{B} = 0 \end{pmatrix} \quad \text{or} \quad \begin{pmatrix} \partial_t\mathbf{E} = \nabla\times\mathbf{B} \\ \partial_t\mathbf{B} = -\nabla\times\mathbf{E} \\ \nabla\cdot\mathbf{E} = 0 \\ \nabla\cdot\mathbf{B} = 0 \end{pmatrix} \tag{5.11}$$

If we calculate the determinant:

$$Det_s\begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix} = E\cdot E-(-\mathbf{s}\cdot\mathbf{p})(-\mathbf{s}\cdot\mathbf{p}) \tag{5.12}$$

We obtain the following:

$$Det_s\begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix} = \left(E^2-\mathbf{p}^2\right)I_3 - \begin{pmatrix} p_x^2 & p_xp_y & p_xp_z \\ p_yp_x & p_y^2 & p_yp_z \\ p_zp_x & p_zp_y & p_z^2 \end{pmatrix} = \left(E^2-\mathbf{p}^2\right)I_3 - M_T \tag{5.13}$$

The last term M_T in expression (5.13) makes fundamental relationship $E^2-\mathbf{p}^2=0$ not hold in the determinant view (5.12) unless the action of M_T on the external and internal components of the wave function produces null result.

Therefore, at the location of a massive charged particle such as an electron or proton, the photon appears to have mass M_T at the source, thus particle pairs may be created on collision of a photon with a massive charged particle. In the Maxwell equations, these violations are counter-balanced by adding source to the equations as discussed below. The Maxwell equations with source are, in turn, coupled to the Dirac Equation of the fermions such as electron or proton forming the Dirac-Maxwell system as further discussed in § 7. Indeed, if source $j^\mu=(\rho,\mathbf{j})\neq 0$, we have instead:

$$\begin{pmatrix} \begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \mathbf{E} \\ i\mathbf{B} \end{pmatrix} = \begin{pmatrix} -i\mathbf{j} \\ 0 \end{pmatrix} \\ \mathbf{p}\cdot\mathbf{E} = -i\rho \\ \mathbf{p}\cdot\mathbf{B}=0 \end{pmatrix}, \quad \begin{pmatrix} \begin{pmatrix} \partial_t & -\nabla\times \\ \nabla\times & \partial_t \end{pmatrix}\begin{pmatrix} \mathbf{E} \\ \mathbf{B} \end{pmatrix} = \begin{pmatrix} -\mathbf{j} \\ 0 \end{pmatrix} \\ \nabla\cdot\mathbf{E}=\rho \\ \nabla\cdot\mathbf{B}=0 \end{pmatrix} \text{ or } \begin{pmatrix} \partial_t\mathbf{E}=\nabla\times\mathbf{B}-\mathbf{j} \\ \partial_t\mathbf{B}=-\nabla\times\mathbf{E} \\ \nabla\cdot\mathbf{E}=\rho \\ \nabla\cdot\mathbf{B}=0 \end{pmatrix} \tag{5.14}$$

Importantly, we can also choose to use fermionic spinization scheme $|\mathbf{p}|=\sqrt{\mathbf{p}^2}\rightarrow\boldsymbol{\sigma}\cdot\mathbf{p}$ to describe Maxwell equations. In this case, the Maxwell equation in the vacuum has the form:

$$\begin{pmatrix} E & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E} \\ i\boldsymbol{\sigma}\cdot\mathbf{B} \end{pmatrix} = 0 \tag{5.15}$$

which gives:

$$\begin{pmatrix} \partial_t\mathbf{E}=\nabla\times\mathbf{B} \\ \partial_t\mathbf{B}=-\nabla\times\mathbf{E} \\ \nabla\cdot\mathbf{E}=0 \\ \nabla\cdot\mathbf{B}=0 \end{pmatrix} \tag{5.16}$$

If source $j^{\mu} = (\rho, \mathbf{j}) \neq 0$, we have:

$$\begin{pmatrix} E & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E} \\ i\boldsymbol{\sigma}\cdot\mathbf{B} \end{pmatrix} = \begin{pmatrix} -i\boldsymbol{\sigma}\cdot\mathbf{j} \\ -i\rho \end{pmatrix} \tag{5.17}$$

which gives:

$$\begin{pmatrix} \partial_t \mathbf{E} = \nabla\times\mathbf{B} - \mathbf{j} \\ \partial_t \mathbf{B} = -\nabla\times\mathbf{E} \\ \nabla\cdot\mathbf{E} = \rho \\ \nabla\cdot\mathbf{B} = 0 \end{pmatrix} \tag{5.18}$$

Therefore, in the fermionic spinization scheme, we have in place of the bi-vector wave function a 4x4 tensor comprising of two bi-spinors (instead of the bi-vector itself) generated by projecting the bi-vector comprised of **E** and ***i*B** to spin $\boldsymbol{\sigma}$.

Further, we point out here that for a linear photon its electric field **E** is the external wave function (external object) and its magnetic field **B** is the internal wave function (internal object). These two fields are always self-entangled and their entanglement is their self-gravity. Therefore, the relation between **E** and **B** in a propagating electromagnetic wave is not that change in **E** induces **B** *visa versa* but that change in **E** is always accompanied by change in **B** *visa versa* due to their entanglement (self-gravity). That is, the relationship between **E** and **B** are gravitational and instantaneous.

6. Gravity (Quantum Entanglement)

Gravity is quantum entanglement (instantaneous interaction) across the dual-world (see, e.g., Hu & Wu, 2006a-d, 2007a). There are two types of gravity at play. One is self-gravity (self-interaction) between the external object (external wave function) and internal object (internal wave function) of an entity (wave function) governed by the metamorphous Matrix Law described in this work and the other is the quantum entanglement (instantaneous interaction) between two entities or one entity and the dual-world as a whole which may be either attractive or repulsive. As further shown below, gravitational field (graviton) is just the wave function itself which expresses the intensity distribution and dynamics of self-quantum-entanglement (nonlocality) of an entity. Indeed, strong interaction actually is strong quantum entanglement (strong gravity). We point out here that some have suspected that strong interaction is strong gravity.

We focus here on three particular forms of gravitational fields. One is timeless (zero energy) external and internal wave functions (self-fields) that play the role of timeless graviton, that is, they mediate time-independent interactions through space quantum entanglement. The second is spaceless external and internal wave functions (self-fields) that play the role of spaceless graviton, that is, they mediate space (distance) independent interactions through proper time (mass) entanglement. The third is massless external and internal wave functions (self-fields) that play the role of massless graviton, that is, they mediate mass (proper-time) independent interactions through massless energy entanglement. The typical wave function (self-fields) contains all three (timeless, spaceless and massless) components. In addition, the typical wave function also contains components related to fermionic or bosonic spinization.

As shown below, timeless quantum entanglement between two entities accounts for Newtonian gravity. Spaceless and/or massless quantum entanglement between two entities may account for dark matter (also see Hu & Wu, 2006) and the Casimir effect. Importantly, gravitational components related to spinization may account for dark energy (also see Hu & Wu, 2006).

When E=0, we have from fundamental relationship (3.2):

$$-m^2-\mathbf{p}^2=0 \quad \text{or} \quad m^2+\mathbf{p}^2=0 \tag{6.1}$$

We can regard expression (6.1) as a relationship governing the Machian quantum universe in which the total energy is zero. Classically, this may be seen as: (1) the rest mass m being comprised of imaginary momentum $\mathbf{P}=i\mathbf{P}_i$, or (2) momentum $\mathbf{P}$ being comprised of imaginary rest mass $m=im_i$.

As shown in § 3, the timeless Matrix Law in Dirac form is the following:

$$\begin{pmatrix} -m & -|\mathbf{p}| \\ -|\mathbf{p}| & +m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{6.2}$$

Thus, the equations of the timeless wave functions (self-fields) is as follows:

$$\begin{pmatrix} -m & -|\mathbf{p}| \\ -|\mathbf{p}| & +m \end{pmatrix}\begin{pmatrix} g_{D,e}e^{-iM} \\ g_{D,i}e^{-iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = L_M V_D = 0 \tag{6.3}$$

Equation (8.3) can be rewritten as:

$$\begin{pmatrix} mV_{D,e} = -|\mathbf{p}|V_{D,i} \\ mV_{D,i} = |\mathbf{p}|V_{D,e} \end{pmatrix} \quad \text{or} \quad \begin{pmatrix} V_{D,e} = -\dfrac{|\mathbf{p}|}{m}V_{D,i} \\ V_{D,i} = \dfrac{|\mathbf{p}|}{m}V_{D,e} \end{pmatrix} \tag{6.4}$$

To see the coupling of external and internal wave functions (self-fields) in a different perspective we can rewrite (6.4) as follows:

$$\begin{pmatrix} mmV_{D,e}V_{D,i} = \left(-|\mathbf{p}|V_{D,i}\right)\left(|\mathbf{p}|V_{D,e}\right) \\ \left(|\mathbf{p}|V_{D,e}\right)\left(mV_{D,e}\right) = \left(mV_{D,i}\right)\left(-|\mathbf{p}|V_{D,i}\right) \end{pmatrix} \tag{6.5}$$

From expression (6.4), we can derive the following:

$$\left(m^2 + \mathbf{p}^2\right)V_{D,e} = 0 \quad \text{or} \quad \left(m^2 - \nabla^2\right)V_{D,e} = 0 \qquad (6.6)$$

Equation (6.6) has radial solution in the form of Yukawa potential:

$$V_{D,e}(r) = \frac{1}{4\pi r} e^{-mr} \qquad (6.7)$$

So in expression (6.3), M=-imr, that is, momentum is comprised of imaginary mass. The external timeless self-field in expression (6.7) has the form of Newton gravitational or Coulomb electric potential at large distance $r \to \infty$. We have from expression (6.4):

$$V_{D,i} = \frac{|\mathbf{p}|}{m} V_{D,e} = \frac{|\mathbf{p}|}{m} \frac{1}{4\pi r} e^{-mr} \to i \frac{1}{4\pi r} e^{-mr} \qquad (6.8)$$

where we have utilized the following (for reasons to be discussed elsewhere):

$$|\mathbf{p}| V_{D,e} = \sqrt{-\nabla^2} \frac{1}{4\pi r} e^{-mr} \to im \frac{1}{4\pi r} e^{-mr} \qquad (6.9)$$

The complete radial solution of equation (6.4) is then:

$$V_D(r) = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N \begin{pmatrix} \frac{1}{4\pi r} e^{-mr} \\ i \frac{1}{4\pi r} e^{-mr} \end{pmatrix} = N \begin{pmatrix} 1 \\ i \end{pmatrix} \frac{1}{4\pi r} e^{-mr} \qquad (6.10)$$

where N is a normalization factor.

If we assume that the internal self-field $V_{D,i}$ (which is self-coupled to its external self-field $V_{D,e}$ also couples through timeless quantum entanglement with the external wave function ψ_e of another entity of test mass m_t (which is also self-coupled to its internal wave function ψ_i) as, for example:

$$i\kappa m V_{D,i} m_t \psi_e = i\kappa m i \frac{1}{4\pi r} e^{-mr} m_t \psi_e = -G \frac{m}{r} e^{-mr} m_t \psi_e \qquad (6.11)$$

where $i\kappa$ is a coupling constant and $G=\kappa/4\pi$ is Newton's Gravitational Constant, we have gravitational potential at large distance $r \to \infty$ as:

$$V_g = -G \frac{m}{r} \qquad (6.12)$$

When $|\mathbf{p}|=0$, we have from fundamental relationship (3.2):

$$E^2 - m^2 = 0 \qquad (6.13)$$

We can regard expression (6.13) as a relationship governing a spaceless quantum universe. Classically, this may be seen as the rest mass m being comprised of time momentum (energy E). As shown in § 3, the spaceless Matrix Law in Weyl form is the following:

$$\begin{pmatrix} E & -m \\ -m & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{6.14}$$

and the equation of spaceless wave functions (self- fields) is as the follows:

$$\begin{pmatrix} E & -m \\ -m & E \end{pmatrix}\begin{pmatrix} g_{W,e}e^{-imt} \\ g_{W,i}e^{-imt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = L_M V_W = 0 \tag{6.15}$$

The external and internal (spaceless) wave functions $V_{W,e}$ and $V_{W,i}$ in equation (6.15) are coupled to each other:

$$\begin{pmatrix} EV_{W,e} = mV_{W,i} \\ EV_{W,i} = mV_{W,e} \end{pmatrix} \tag{6.16}$$

It can be easily verified that the solutions to equation (6.16) are in forms of:

$$V_W = \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = N\begin{pmatrix} 1e^{-imt} \\ 1e^{-imt} \end{pmatrix} = N\begin{pmatrix} 1 \\ 1 \end{pmatrix}e^{-im} \tag{6.17}$$

or

$$V_W = \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = N\begin{pmatrix} 1e^{imt} \\ 1e^{imt} \end{pmatrix} = N\begin{pmatrix} 1 \\ 1 \end{pmatrix}e^{im} \tag{6.18}$$

Most quantum entanglements one speaks of in quantum mechanics are spaceless quantum entanglements (gravity) between two entities; dark matter may be a manifestation of this non-Newtonian gravity; and the Casimir effect may be due to this type of spaceless quantum entanglement or, at least, may have a contribution from spaceless quantum entanglement.

When m=0, we have from fundamental relationship (3.2):

$$E^2 - \mathbf{p}^2 = 0 \tag{6.19}$$

We can regard expression (6.19) as a relationship governing the massless quantum universe in which the total rest mass (proper time) is zero. Classically, this may be seen as energy E being comprised of momentum $\mathbf{p}$. As shown in § 3, the massless Matrix Law in Dirac form is the following:

$$\begin{pmatrix} E & -|\mathbf{p}| \\ -|\mathbf{p}| & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{6.20}$$

and the equation of massless wave functions (self-fields) is the following:

$$\begin{pmatrix} E & -|\mathbf{p}| \\ -|\mathbf{p}| & E \end{pmatrix}\begin{pmatrix} g_{D,e}e^{-iM} \\ g_{D,i}e^{-iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = L_M V_D = 0 \tag{6.21}$$

Equation (6.21) has plane-wave solutions. The external and internal (masssless) wave functions $V_{D,e}$ and $V_{D,i}$ in equation (6.21) are coupled with each other:

$$\begin{pmatrix} EV_{D,e} = |\mathbf{p}|V_{D,i} \\ EV_{D,i} = |\mathbf{p}|V_{D,e} \end{pmatrix} \tag{6.22}$$

For eigenstate of E and |**p**|, the solutions to equation (6.22) are in the forms of:

$$V_D = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N \begin{pmatrix} 1e^{-i(\omega t - \mathbf{k}\cdot\mathbf{x})} \\ \frac{|\mathbf{p}|}{E} e^{-i(\omega t - \mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = N \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{-i(\omega t - \mathbf{k}\cdot\mathbf{x})} \tag{6.23}$$

or

$$V_D = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N \begin{pmatrix} \frac{|\mathbf{p}|}{E} e^{i(\omega t - \mathbf{k}\cdot\mathbf{x})} \\ 1e^{i(\omega t - \mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = N \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{i(\omega t - \mathbf{k}\cdot\mathbf{x})} \tag{6.24}$$

Equations (6.22) describes the self-interaction of external and internal massless and spinless wave functions (self-fields). It is suggested that this rest mass-independent quantum entanglement (non-Newtonian gravity) between two massless entities may also contribute to the cause of dark matter (also see, Hu & Wu, 2006).

7. Immanent Consciousness Driven by Self-Referential Spin

We now focus on some of the details of how human experience (as limited immanent consciousness) is produced through the brain and how human free-will (as limited transcendental Consciousness) may operate through the brain. These questions have also been considered by us previously.

As illustrated in Figure 7.1, there are two kinds of interactions between an object (entity) outside the brain (body) and the brain (body). The first and commonly known kind is the direct physical and/or chemical interactions such as sensory input through the eyes. The second and lesser-known but experimentally proven to be true kind is the instantaneous interactions through quantum entanglement. The entire world outside our brain (body) is associated with our brain (body) through quantum entanglement thus influencing and/or generating not only our feelings, emotions and dreams but also the physical, chemical and physiological states of our brain and body.

Importantly, quantum entanglement may participate in sensory experience such as vision, for example, as follows (keep in mind that an interaction with the external world is accompanied by its counterpart interaction with the internal world): (1) A light ray reflected and/or emitted from an object outside the brain enters the eye, gets absorbed, converted and amplified in the retina as propagating action potentials which travel to the

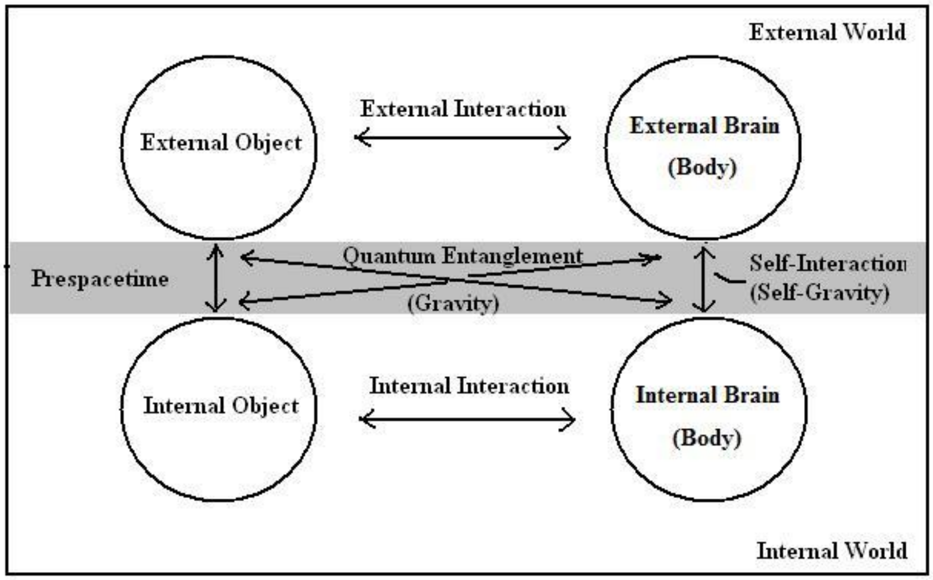

Figure 7.1 Interaction between an object and the brain (body) in the dual-world

central nervous system (CNS); (2) In the CNS, the action potentials drive and influence the mind pixels which according our theory is the nuclei such as protons with net nuclear spins and/or electrons with unpaired spins; and (3) Either the driven or influenced dynamic patterns of the mind-pixels in the internal world form the experience of the object, or more likely our visual experience of the object is the direct experience of the object in the external world through quantum entanglement established by the physical interactions. In the latter case, there is no image of the outside world in the brain. Further, in the case in which the object outside the brain is an image such as a photograph, there also exists the possibility that our visual experience is not only the experience of the photograph as such through quantum entanglement but also the experience of the object within the photograph through additional quantum entanglement. We hope that through careful experiments, we can find out which mechanism is actually true or whether both are true in reality.

The action potentials in the retina, the neural pathways and the CNS are driven by voltage-gated ion channels on neural membranes as embodied by the Hodgkin-Huxley model:

$$\partial_t V_m = -\frac{1}{C_m}\left(\sum_i (V_m - E_i) g_i\right) \tag{7.1}$$

where V_m is the electric potential across the neural membranes, C_m is the capacitance of the membranes, g_i is the *i*th voltage-gated or constant-leak ion channel (also see, Hu & Wu, 2004c & 2004d). The overall effect of the action potentials and other surrounding factors, especially the magnetic dipoles carried by oxygen molecules due to their two unpaired electrons, is that inside the neural membranes and proteins, there exist varying strong electric field **E** and fluctuating magnetic field **B** that are also governed by the Maxwell equation:

$$\begin{pmatrix} E & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E} \\ i\boldsymbol{\sigma}\cdot\mathbf{B} \end{pmatrix} = 0 \quad \text{or} \quad \begin{pmatrix} \partial_t \mathbf{E} = \nabla\times\mathbf{B} \\ \partial_t \mathbf{B} = -\nabla\times\mathbf{E} \\ \nabla\cdot\mathbf{E} = 0 \\ \nabla\cdot\mathbf{B} = 0 \end{pmatrix} \tag{7.2}$$

where we have set the classical (macroscopic) electric density and current $j^\mu = (\rho, \mathbf{j}) = 0$ inside the neural membranes. Further, for simplicity, we have not considered the medium effect of the membranes, that is, we have treated the membranes as a vacuum.

Microscopically, electromagnetic fields **E** and **B** or their electromagnetic potential representation $A^\mu = (\phi, \mathbf{A})$:

$$\begin{pmatrix} \mathbf{E} = -\nabla\phi - \partial_t \mathbf{A} \\ \mathbf{B} = \nabla\times\mathbf{A} \end{pmatrix} \tag{7.3}$$

interact with proton of charge *e* and unpaired electron of charge –*e* respectively as the following Dirac-Maxwell systems:

$$\left(\begin{pmatrix} E-e\phi-m & -\boldsymbol{\sigma}\cdot(\mathbf{p}-e\mathbf{A}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{p}-e\mathbf{A}) & E-e\phi+m \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0\right)_p \tag{7.4}$$

$$\begin{pmatrix} E & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E} \\ i\boldsymbol{\sigma}\cdot\mathbf{B} \end{pmatrix} = \begin{pmatrix} -i\boldsymbol{\sigma}\cdot(\psi^\dagger\beta\boldsymbol{\alpha}\psi) \\ -i(\psi^\dagger\beta\beta\psi) \end{pmatrix}_p \tag{7.5}$$

and

$$\left(\begin{pmatrix} E+e\phi-m & -\boldsymbol{\sigma}\cdot(\mathbf{p}+e\mathbf{A}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{p}+e\mathbf{A}) & E+e\phi+m \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0\right)_e \tag{7.6}$$

$$\begin{pmatrix} E & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & E \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E} \\ i\boldsymbol{\sigma}\cdot\mathbf{B} \end{pmatrix} = \begin{pmatrix} -i\boldsymbol{\sigma}\cdot(\psi^\dagger\beta\boldsymbol{\alpha}\psi) \\ -i(\psi^\dagger\beta\beta\psi) \end{pmatrix}_e \tag{7.7}$$

where β and $\boldsymbol{\alpha}$ are Dirac matrices

In equations (7.4) and (7.6), the interactions (couplings) of **E** and/or **B** with proton and/or electron spin operator $(\boldsymbol{\sigma})_p$ and $(\boldsymbol{\sigma})_e$ are hidden. But they are due to the self-referential Matrix Law which causes mixing of the external and internal wave functions and can be made explicit in the determinant view as follows. For Dirac form, we have:

$$\left(\begin{pmatrix} E-e\phi-m & -\boldsymbol{\sigma}\cdot(\mathbf{p}-e\mathbf{A}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{p}-e\mathbf{A}) & E-e\phi+m \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0\right)_p \tag{7.8}$$

$$\rightarrow\left(\begin{pmatrix}(E-e\phi-m)(E-e\phi+m)- \\ (-\boldsymbol{\sigma}\cdot(\mathsf{p}-e\mathbf{A}))(-\boldsymbol{\sigma}\cdot(\mathsf{p}-e\mathbf{A}))\end{pmatrix} I_2\psi_{e,-}\psi^*_{i,+}=0\right)_p$$

$$\rightarrow\left(\left((E-e\phi)^2-m^2-(\mathsf{p}-e\mathbf{A})^2+e\boldsymbol{\sigma}\cdot\mathbf{B}\right)I_2\psi_{e,-}\psi^*_{i,+}=0\right)_p$$

For Weyl (chiral) form, we have:

$$\left(\begin{pmatrix}E-e\phi-\boldsymbol{\sigma}\cdot(\mathsf{p}-e\mathbf{A}) & -m \\ -m & E-e\phi+\boldsymbol{\sigma}\cdot(\mathsf{p}-e\mathbf{A})\end{pmatrix}\begin{pmatrix}\psi_{e,r} \\ \psi_{i,l}\end{pmatrix}=0\right)_p \tag{7.9}$$

$$\rightarrow\left(\left((E-e\phi-\boldsymbol{\sigma}\cdot(\mathsf{p}-e\mathbf{A}))(E-e\phi+\boldsymbol{\sigma}\cdot(\mathsf{p}-e\mathbf{A}))-m^2\right)I_2\psi_{e,r}\psi^*_{i,l}=0\right)_p$$

$$\rightarrow\left(\left((E-e\phi)^2-m^2-(\mathsf{p}-e\mathbf{A})^2+e\boldsymbol{\sigma}\cdot\mathbf{B}\text{-}ie\boldsymbol{\sigma}\cdot\mathbf{E}\right)I_2\psi_{e,r}\psi^*_{i,l}=0\right)_p$$

These two couplings are also explicitly shown in Dirac-Hestenes formulism or during the process of non-relativistic approximation of the Dirac equation in the present of external electromagnetic potential A^μ. We can carry out the same procedures for an electron to show the explicit couplings of $(\boldsymbol{\sigma})_e$ with **E** and **B**.

One effect of the couplings is that the action potentials through **E** and **B** (or A^μ) input information into the mind-pixels in the brain (Hu & Wu, 2004c, 2004d & 2008a). Judging from the above Dirac-Maxwell systems, we are inclined to think that said information is likely carried in the temporal and spatial variations of **E** and **B** (frequencies and timing of neural electric spikes and their spatial distributions in the CNS). Another possible effect of the couplings is that they allow the transcendental aspect of consciousness through wave functions (the self fields) of the proton and/or electron to back-influence **E** and **B** (or A^μ) which in turn back-affect the action potentials through the Hodgkin-Huxley neural circuits in the CNS (also see, Hu & Wu, 2007d & 2008a).

We will carry out detailed studies of the above sketched possible mechanisms elsewhere. Here we will speculate a bit about how human free-will as a macroscopic quality of limited transcendental consciousness may originate microscopically under the particular high electric voltage environment inside the neural membranes. For example, one possibility is that the human free will as thought or imagination produces changes in the phase of external and internal wave functions:

$$e^{i0}=e^{-i(\Delta Et-\Delta\mathbf{p}\cdot\mathbf{x})+i(\Delta Et-\Delta\mathbf{p}\cdot\mathbf{x})}=\left(e^{-i(\Delta Et-\Delta\mathbf{p}\cdot\mathbf{x})}\right)_e\left(e^{+i(\Delta Et-\Delta\mathbf{p}\cdot\mathbf{x})}\right)_i \tag{7.10}$$

where $(\ )_e$ and $(\ )_i$ respectively indicate external and internal wave functions, which in turn back-affect **E** and **B** (or A^μ) in the high electric voltage neural membranes through the Dirac Maxwell systems illustrated above.

8. Conclusion

It is our comprehension that Consciousness is both transcendent and immanent as similarly understood in Hinduism. The transcendental aspect of Consciousness produces and influences reality through self-referential spin as the interactive output of Consciousness. In turn, reality produces and influences immanent aspect of Consciousness as the interactive input to Consciousness through self-referential spin. The spin-mediated consciousness theory as originally proposed has dealt with the immanent aspect of Consciousness which is driven by the self-referential spin processes. This paper has focused and "regurgitated" on the transcendental aspect of Consciousness which drives the self-referential spin processes (Hu & Wu, 2009, 2010).

It is also our comprehension is that: ***Consciousness = Prespacetime = Omnipotent, Omnipresent & Omniscient Being = ONE.*** The transcendental aspect of Consciousness creates, sustains and causes evolution of primordial entities (elementary particles) in prespacetime, that is, within Consciousness itself, by self-referential spin as follows:

$$1 = e^{h} = e^{i0} = 1e^{i0} = L_1 e^{-iM+iM} = L_e L_i^{-1}\left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow$$

$$\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} A_e e^{-iM} \\ A_i e^{-iM} \end{pmatrix} = L_M \begin{pmatrix} A_e \\ A_i \end{pmatrix} e^{-iM} = L_M \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0$$

Thus, in the beginning there was Consciousness (prespacetime) $\mathbf{e}^{h}$ by itself $\mathbf{e}^{0}$ =1materially empty and spiritually restless. And it began to imagine through primordial self-referential spin $1=\mathbf{e}^{0}=\mathbf{e}^{iM-iM}=\mathbf{e}^{iM}\mathbf{e}^{-iM}=\mathbf{e}^{-iM}/\mathbf{e}^{-iM}=\mathbf{e}^{iM}/\mathbf{e}^{iM}$… such that it created the external object to be observed and internal object as observed, separated them into external world and internal world, caused them to interact through self-referential Matrix Law and thus gave birth to the Universe which it has since passionately loved, sustained and made to evolve (Hu & Wu, 2009, 2010).

Transcendental aspect of Consciousness spins as: $1=\mathbf{e}^{i0}=\mathbf{e}^{iM-iM}=\mathbf{e}^{iM}\mathbf{e}^{-iM}=\mathbf{e}^{-iM}/\mathbf{e}^{-iM}=\mathbf{e}^{iM}/\mathbf{e}^{iM}$… before matrixization. Transcendental aspect of Consciousness also spins through self-acting and self-referential Matrix Law L_M after matrixization which acts on external object and internal object to cause them to interact with each other.

In this dual-world, Consciousness is simply prespacetime having both transcendental and immanent properties/qualities. The transcendental aspect of Consciousness is the origin of primordial self-referential spin (including the self-referential Matrix Law) and it projects the external and internal worlds through spin and, in turn, the immanent aspect of Consciousness observes the external world as the observed internal world through the said spin. Human consciousness is a limited and particular version of this dual-aspect

Consciousness such that we have limited free will and limited observation which is mostly classical at macroscopic levels but quantum at microscopic levels.

The above ideas (ontology) are forced upon (or rather revealed to) us by our recent theoretical and experimental studies (Hu & Wu, 2006a-d, 2007a). Among other things, we experimentally demonstrated that gravity is the manifestation of quantum entanglement (*Id.*). We materially live in the external world but experience the external world through its negation, the internal world in the relativistic frame $x^{\mu}=(t, \mathbf{x})$ attached to each of our bodies. Interactions within the external world and the internal world are local interactions and conform to special theory of relativity. But interactions across the dual world are nonlocal interactions (quantum entanglement). Therefore, the meaning of the special theory of relativity is that the speed limit *c* is only applicable in each of the dual world but not interactions between the dual-world. Indeed, the reason that no external object can move faster than the speed of light and the same gets heavier and heavier as its speed approach the speed of light is due to its increased quantum entanglement with the internal world through its counterpart the internal object.

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