Article

Premomentumenergy Model I: Generation of Relativistic Quantum Mechanics for a Dual Momentum-Energy Universe

Huping Hu* & Maoxin Wu

ABSTRACT

This article is a continuation of the Principle of Existence. A premomentumenergy model of elementary particles, four forces and human consciousness is formulated, which illustrates how the self-referential hierarchical spin structure of the premomentumenergy provides a foundation for creating, sustaining and causing evolution of elementary particles through matrixing processes embedded in said premomentumenergy. This model generates elementary particles and their governing matrix laws for a dual universe (quantum frame) comprised of an external momentum-energy space and an internal momentum-energy space. In contrast, the prespacetime model described previously generates elementary particles and their governing matrix laws for a dual universe (quantum frame) comprised of an external spacetime and an internal spacetime. These quantum frames and their metamorphoses are interconnected through quantum jumps as demonstrated in forthcoming articles.

The premomentumenergy model reveals the creation, sustenance and evolution of fermions, bosons and spinless entities each of which is comprised of an external wave function or external object in the external momentum-energy space and an internal wave function or internal object in the internal momentum-energy space. The model provides a unified causal structure in said dual universe (quantum frame) for weak interaction, strong interaction, electromagnetic interaction, gravitational interaction, quantum entanglement, human consciousness. Further, the model provides a unique tool for teaching, demonstration, rendering, and experimentation related to subatomic and atomic structures and interactions, quantum entanglement generation, gravitational mechanisms in cosmology, structures and mechanisms of human consciousness.

Key Words: principle of existence, premomentumenergy, prespacetime, four forces, consciousness, spin, existence.

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1. Introduction

In premomentumenergy we contemplate

As a continuation of the Principle of Existence [1-4], the beauty and awe of the manifestations of premomentumenergy are described in this article. The premomentum-energy model generates elementary particles and their governing matrix laws for a dual momentum-energy universe (quantum frame) comprised of an external momentum-energy space and an internal momentum-energy space. This model creates Relativistic Quantum Mechanics for a dual momentum-energy universe. In contrast, the prespacetime model described previously [1-4] generates elementary particles and their governing matrix laws for a dual spacetime universe comprised of an external spacetime and an internal spacetime. The prespacetime model creates the usual Relativistic Quantum Mechanics for the dual spacetime universe. These dual universes (quantum frames) and their metamorphoses are interconnected through quantum jumps as illustrated below in Figure 1.1 and demonstrated in forthcoming articles.

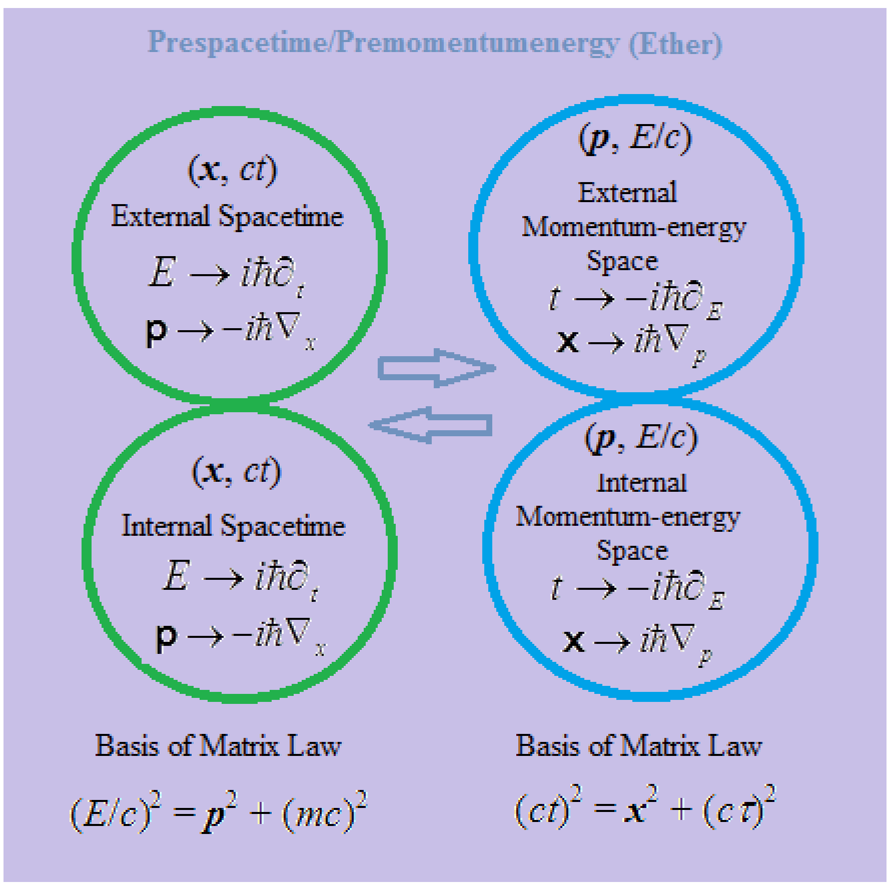

Figure 1.1 Illustration of Prespacetime model & premomentumenergy model

This work is organized as follows. In § 2, we shall use words and drawings to lay out the ontology of the premomentumenergy model. In § 3, we shall express in mathematics the premomentumenergy model in the order of: (1) scientific genesis in a nutshell; (2) self-referential matrix law and its metamorphoses; (3) additional forms of matrix law; (4) scientific genesis of primordial entities; and (5) scientific genesis of composite entities. In § 4, we shall discuss within the context of premomentumenergy model: (1) metamorphoses & the essence of spin; (2) the determinant view & the meaning of Klein-Gordon-like equation; (3) the meaning of Schrodinger-like equation & quantum potential; and (4) the third state of matter. In § 5 through § 8, we shall discuss, within the context of premomentumenergy model, weak, electromagnetic, strong and gravitational interactions respectively. In § 9, we shall focus on the essence of consciousness and the mechanism of human conscious experience within the context of premomentumenergy model. In § 10, we shall pose and answer some anticipated questions related to this work. Finally, in § 11, we shall conclude this work.

Readers are reminded that we can only strive for perfection, completeness and correctness in our comprehensions and writings because we are limited and imperfect.

2. Ontology

In words and drawings we illustrate

In the beginning there was premomentumenergy e^{i0} materially empty but spiritually restless. And it began to imagine through primordial self-referential spin $1=e^{i0}=e^{iM-iM}=e^{iM}e^{-iM}=e^{-iM}/e^{-iM} = e^{iM}/e^{iM}$...such that it created the external object to be observed and internal object as observed, separated them into external momentum-energy space and internal momentum-energy space, caused them to interact through self-referential matrix law and thus gave birth to the dual momentum-energy universe which it has since sustained and made to evolve.

In this universe, premomentumenergy (ether), represented by Euler's Number *e*, is the ground of existence and can form external and internal wave functions as external and internal momentum-energy objects (each pair forms an elementary entity in the dual momentum-energy universe) and interaction fields between elementary entities which accompany the imaginations of the premomentumenergy.

Premomentumenergy can be self-acted on by self-referential matrix law L_M. Premomentumenergy has imagining power *i* to project external and internal objects by projecting, e.g., external and internal phase $\underline{+}M = \underline{+}(Et-\boldsymbol{p}\cdot\boldsymbol{x})/\hbar$ at the power level of premomentumenergy. The universe so created is a dual momentum-energy universe comprising of the external momentum-energy space to be observed and internal momentum-energy space as observed under each relativistic frame $p^{\mu}=(E/c, \boldsymbol{p})$. In one perspective of premomentumenergy view, the internal momentum-energy space (which by convention has negative time) is the negation/image of the external momentum-energy space (which by convention has positive time). The absolute frame of reference is the premomentumenergy itself. Thus, if premomentumenergy stops imagining ($i0=0$), the dual momentum-energy universe would disappear into materially nothingness $e^{i0}=e^{0}=1$.

The accounting principle of the dual momentum-energy universe is conservation of zero. For example, the total time of an external object and its counterpart, the internal object, is zero. Also in this dual momentum-energy universe, self-gravity is the nonlocal-momentum-energy self-interaction (wave mixing) between an external object in the external momentum-energy space and its negation/image in the internal momentum-energy space, *vice versa*. Gravity in external momentum-energy space is the nonlocal-momentum-energy interaction (quantum entanglement) between an external object with the internal momentum-energy space as a whole.

Some other most basic conclusions are: (1) the two spinors of the Dirac electron or positron in the dual momentum-energy universe are respectively the external and internal objects of the electron or positron; (2) the electric and magnetic fields of a linear photon in the dual momentum-energy universe are respectively the external and internal objects of a photon which are always self-entangled; (3) the proton may be a momentumly confined positron through imaginary position in the dual momentum-energy universe; and (4) a neutron may be comprised of an unspinized (spinless) proton and a bound and spinized electron in the dual momentum-energy universe.

In this dual momentum-energy universe, premomentumenergy has both transcendental and immanent properties. The transcendental aspect of premomentumenergy is the origin of primordial self-referential spin (including the self-referential matrix law) and it projects the external and internal momentum-energy spaces through spin and, in turn, the immanent aspect of premomentumenergy observes the external momentum-energy space through the internal momentum-energy space. Human consciousness in the dual momentum-energy universe is a limited and particular version of this dual-aspect premomentumenergy 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 mechanism of how premomentumenergy creates the dual momentum-energy universe comprising of the external momentum-energy space and the internal momentum-energy space and how the external object and internal object and the external momentum-energy space and internal momentum-energy space interact.

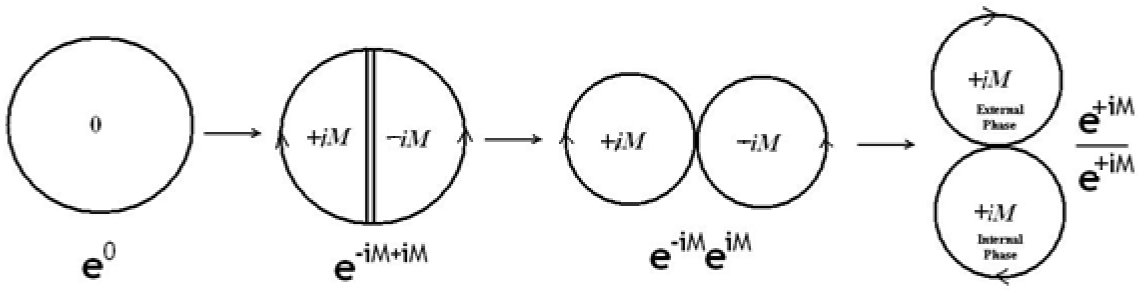

Figure 2.1. Illustration of primordial phase distinction

As shown in Figure 2.1, a primordial phase distinction (dualization), e.g., $\pm M = \pm(Et-\boldsymbol{p}\cdot\boldsymbol{x})/\hbar$, was made at the power level of premomentumenergy through imagination ***i***. At the ground level of premomentumenergy, this is $1=e^0=e^{iM-iM}=e^{iM}e^{-iM}=e^{-iM}/e^{-iM} = e^{iM}/e^{iM}\ldots$.

The primordial phase distinction in Figure 2.1 is accompanied by matrixing of *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 premomentumenergy at the power level so as to enforce the accounting principle of conservation of zero, as illustrated in Figure 2.2.

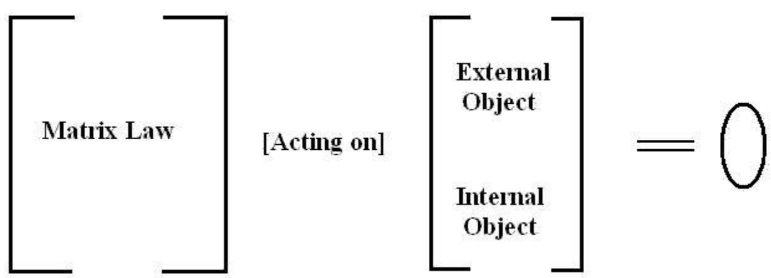

Figure 2.2 Premomentumenergy Equation

Figure 2.3 shows from another perspective of the relationship among external object in the external momentum-energy space, internal object in the internal momentum-energy space and the self-acting and self-referential matrix law. According to the Principle of Existence, self-interactions (self-gravity) are quantum entanglement between the external object in the external momentum-energy space and the internal object in the internal momentum-energy space.

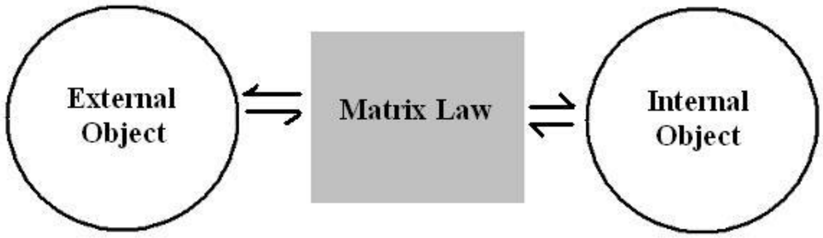

Figure2.3 Self-interaction between external and internal objects of a quantum entity in a dual momentum-energy universe

As shown in Figure 2.4, the external object and internal object in the two momentum-energy spaces interact with each other through gravity or quantum entanglement since gravity is an aspect of quantum entanglement (See, e.g., [1]). Please note that, although in Figure 2.4 premomentumenergy is shown as a strip, both the dualized external energy-momentum space and internal energy-momentum space are embedded in premomentumenergy.

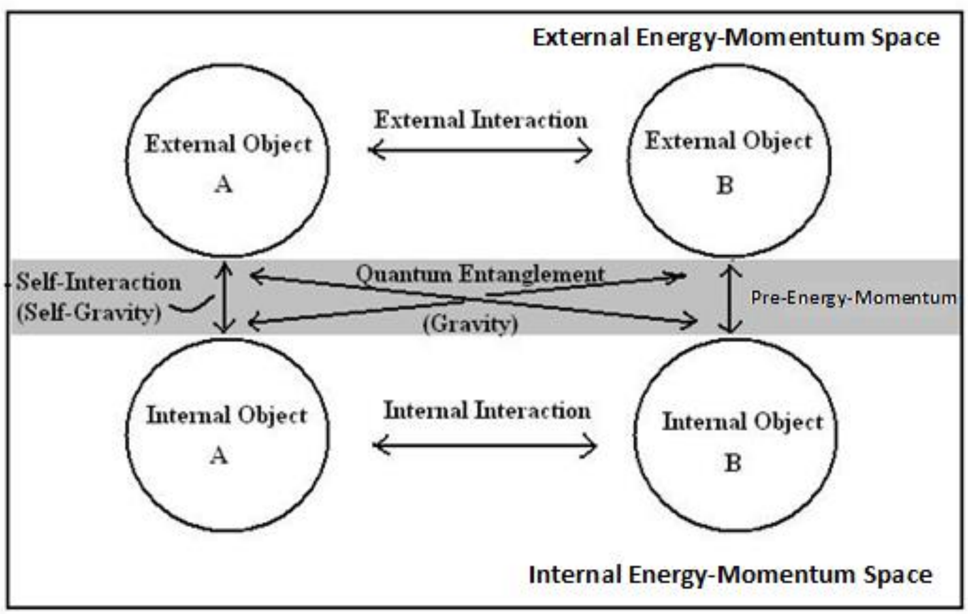

Figure2.4 Interactions in the dual momentum-energy universe

3. Mathematics of the Premomentumenergy Model

In mathematics we express

3.1 Scientific Genesis in a Nutshell

It is our comprehension that:

$$\text{Premomentumenergy} = \text{Prespacetime} = \text{Omnipotent, Omnipresent \& Omniscient Being/State} = \text{ONE} \quad (3.1)$$

Premomentumenergy creates, sustains and causes evolution of primordial entities (elementary particles) in premomentumenergy by self-referential spin as follows:

$$1 = e^{i0} = 1e^{i0} = L_1 e^{+iM-iM} = L_e L_i^{-1}\left(e^{+iM}\right)\left(e^{+iM}\right)^{-1} \rightarrow$$
$$\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} A_e e^{+iM} \\ A_i e^{+iM} \end{pmatrix} = L_M \begin{pmatrix} A_e \\ A_i \end{pmatrix} e^{+iM} = L_M \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0 \quad (3.2)$$

In expression (3.2), e is Euler's Number representing premomentumenergy (ether), i is imaginary unit representing the imagination of premomentumenergy, $\pm M$ is the content of imagination i, L_1=1 is the Law of One of premomentumenergy 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 in premomentumenergy comprised of external and internal matrix laws which governs elementary entities and conserves zero in the dual momentum-energy universe,

$$A_e e^{+iM} = \psi_e$$

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 momentum-energy universe as a whole).

Alternatively, premomentumenergy creates, sustains and causes evolution of primordial entities in the premomentumenergy by self-referential spin as follows:

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = (\mathrm{Det}M_t + \mathrm{Det}M_\tau + \mathrm{Det}M_{\mathbf{x}})(e^{+iM})(e^{+iM})^{-1} \to$$

$$\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} A_e e^{+iM} \\ A_i e^{+iM} \end{pmatrix} = L_M \begin{pmatrix} A_e \\ A_i \end{pmatrix} e^{+iM} = L_M \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0 \tag{3.3}$$

where L_0 is the Law of Zero of the premomentumenergy as defined by fundamental relationship (3.4) below, *Det* means determinant and M_t, M_τ and M_x are respectively matrices with $\pm t$, $\pm\tau$ and $\pm|\mathbf{x}|$ as elements and t^2, $-\tau^2$ and $-\mathbf{x}^2$ as determinants.

Premomentumenergy spins as $1=e^{i0}=e^{iM-iM}=e^{iM}e^{-iM}=e^{-iM}/e^{-iM}=e^{iM}/e^{iM}$…before matrixization. It also spins through self-acting and self-referential matrix law L_M after matrixization which acts on the external object and the internal object to cause them to interact with each other in the dual momentum-energy universe as further described below.

3.2 Self-Referential Matrix Law and Its Metamorphoses

The matrix law

$$\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M$$

of the premomentumenergy is derived from the following fundamental relation through self-reference within this relation which accompanies the imagination (spin *i*) in premomentumenergy:

$$(ct)^2 - \boldsymbol{x}^2 - (c\tau)^2 = L_0 = 0 \tag{3.4}$$

where *t* and $\boldsymbol{x}$ are dynamical variables of time and position respectively and τ is an intrinsic proper time of an elementary particle (e.g., defined as Compton wavelength divided by speed of light $\tau = \lambda/c$). For simplicity, we will set $c=\hbar=1$ throughout this work unless indicated otherwise. Thus, we have from (3.4):

$$t^2 - \boldsymbol{x}^2 - \tau^2 = L_0 = 0 \tag{3.4a}$$

Expression (3.4) is based on the relation of four-position $x^\mu = (ct, \boldsymbol{x})$ in special theory of relativity:

$$(ct)^2 = \boldsymbol{x}^2 + (c\tau)^2$$

In the presence of a four-potential $A^{\mu} = (\phi, \boldsymbol{A})$ of a second primordial entity, equation (3.4a) for an elementary entity with charge *e* is modified as follows:

$$(t - e\phi)^2 - \tau^2 - (\mathbf{x} - e\mathbf{A})^2 = L_0 = 0 \tag{3.5}$$

One form of the matrix law of the premomentumenergy is derived through self-reference as follows:

$$\begin{gathered} L = 1 = \frac{t^2 - \tau^2}{\mathbf{x}^2} = \left(\frac{t-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t+\tau}\right)^{-1} \\ \rightarrow \frac{t-\tau}{-|\mathbf{x}|} = \frac{-|\mathbf{x}|}{t+\tau} \rightarrow \frac{t-\tau}{-|\mathbf{x}|} - \frac{-|\mathbf{x}|}{t+\tau} = 0 \end{gathered} \tag{3.6}$$

where $|\mathbf{x}| = \sqrt{\mathbf{x}^2}$. Matrixing left-land side of the last expression in (3.6) such that $\mathrm{Det}(L_M) = t^2 - \tau^2 - \mathbf{x}^2 = 0$ so as to satisfy the fundamental relation (3.4) in the determinant view, we have:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.7}$$

Indeed, expression (3.7) can also be obtained from expression (3.4) through self-reference as follows:

$$0 = t^2 - \tau^2 - \mathbf{x}^2 = Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \tag{3.8}$$

Matrixing expression (3.8) by removing determinant sign *Det*, we have:

$$\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix} + \begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} = \begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.9}$$

After fermionic spinization:

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-Det(\boldsymbol{\sigma} \cdot \mathbf{x})} \rightarrow \boldsymbol{\sigma} \cdot \mathbf{x} \tag{3.10}$$

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

$$\sigma_1 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \quad \sigma_2 = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \quad \sigma_3 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \tag{3.11}$$

expression (3.7) becomes:

$$\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M = t - \boldsymbol{\alpha}\bullet\mathbf{x} - \beta\tau \tag{3.12}$$

where $\boldsymbol{\alpha} = (\alpha_1, \alpha_2, \alpha_3)$ and β are Dirac matrices. Expression (3.12) governs fermions in dual-momentum-energy Universe in Dirac form such as Dirac electron and positron and expression (3.7) governs unspinized or spinless entity/particle with charge *e* and intrinsic proper time τ (e.g., a meson or a meson-like particle) in dual-momentum-energy universe. Bosonic spinization of expression (3.7) $|\mathbf{x}| = \sqrt{\mathbf{x}^2} \longrightarrow \mathbf{s}\cdot\mathbf{x}$ shall be discussed later.

If we define:

$$Det_\sigma \begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix} = (t-\tau)(t+\tau) - (-\boldsymbol{\sigma}\cdot\mathbf{x})(-\boldsymbol{\sigma}\cdot\mathbf{x}) \tag{3.13}$$

We get:

$$Det_\sigma \begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix} = \left(t^2 - \tau^2 - \mathbf{x}^2\right) I_2 = 0 \tag{3.14}$$

Thus, fundamental relationship (3.4) is also satisfied under the determinant view of expression (3.13). Indeed, we can also obtain the following conventional determinant:

$$Det \begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix} = \left(t^2 - \tau^2 - \mathbf{x}^2\right)^2 = 0 \tag{3.15}$$

One kind of metamorphosis of expressions (3.6) – (3.14) is respectively as follows:

$$\begin{gathered} L = 1 = \frac{t^2 - \mathbf{x}^2}{\tau^2} = \left(\frac{t - |\mathbf{x}|}{-\tau}\right)\left(\frac{-\tau}{t + |\mathbf{x}|}\right)^{-1} \\ \to \frac{t - |\mathbf{x}|}{-\tau} = \frac{-\tau}{t + |\mathbf{x}|} \to \frac{t - |\mathbf{x}|}{-\tau} - \frac{-\tau}{t + |\mathbf{x}|} = 0 \end{gathered} \tag{3.16}$$

$$\begin{pmatrix} t - |\mathbf{x}| & -\tau \\ -\tau & t + |\mathbf{x}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.17}$$

$$0 = t^2 - \tau^2 - \mathbf{x}^2 = Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} + Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} \tag{3.18}$$

$$\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} + \begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} = \begin{pmatrix} t-|\mathbf{x}| & -\tau \\ -\tau & t+|\mathbf{x}| \end{pmatrix} \tag{3.19}$$

$$\begin{pmatrix} t - \boldsymbol{\sigma}\cdot\mathbf{x} & -\tau \\ -\tau & t + \boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L \tag{3.20}$$

$$Det_\sigma\begin{pmatrix} t - \boldsymbol{\sigma}\cdot\mathbf{x} & -\tau \\ -\tau & t + \boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix} = (t - \boldsymbol{\sigma}\cdot\mathbf{x})(t + \boldsymbol{\sigma}\cdot\mathbf{x}) - (-\tau)(-\tau) \tag{3.21}$$

$$Det_\sigma\begin{pmatrix} t - \boldsymbol{\sigma}\cdot\mathbf{x} & -\tau \\ -\tau & t + \boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix} = (t^2 - \mathbf{x}^2 - \tau^2) I_2 = 0 \tag{3.22}$$

Expression (3.17) is the unspinized matrix law in Weyl-like (chiral-like) form and it is connected to expression (3.7) by Hadamard matrix $H = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$:

$$H\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix} H^{-1} = \begin{pmatrix} t-|\mathbf{x}| & -\tau \\ -\tau & t+|\mathbf{x}| \end{pmatrix} \tag{3.23}$$

Expression (3.20) is spinized matrix law in Weyl-like (chiral-like) form and it is connected to expression (3.12) by 4x4 Hadamard matrix:

$$H\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix} H^{-1} = \begin{pmatrix} t-\boldsymbol{\sigma}\cdot\mathbf{x} & -\tau \\ -\tau & t+\boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix} \tag{3.24}$$

Another kind of metamorphosis of expressions (3.6) - (3.14) is respectively as follows:

$$L = 1 = \frac{t^2}{\tau^2 + \mathbf{x}^2} = \left(\frac{t}{-\tau + i|\mathbf{x}|}\right)\left(\frac{-\tau - i|\mathbf{x}|}{t}\right)^{-1}$$
$$\rightarrow \frac{t}{-\tau + i|\mathbf{x}|} = \frac{-\tau - i|\mathbf{x}|}{t} \rightarrow \frac{t}{-\tau + i|\mathbf{x}|} - \frac{-\tau - i|\mathbf{x}|}{t} = 0 \tag{3.25}$$

$$\begin{pmatrix} t & -\tau - i|\mathbf{x}| \\ -\tau + i|\mathbf{x}| & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.26}$$

$$0 = t^2 - \tau^2 - \mathbf{x}^2 = Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} + Det\begin{pmatrix} 0 & -i|\tau| \\ i|\tau| & 0 \end{pmatrix} \tag{3.27}$$

$$\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} + \begin{pmatrix} 0 & -i|\mathbf{x}| \\ i|\mathbf{x}| & 0 \end{pmatrix} = \begin{pmatrix} t & -\tau - i|\mathbf{x}| \\ -\tau + i|\mathbf{x}| & t \end{pmatrix} \tag{3.28}$$

$$\begin{pmatrix} t & -\tau - i\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\tau + i\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.29}$$

$$Det_\sigma\begin{pmatrix} t & -\tau - i\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\tau + i\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix} = tt - (-\tau - i\boldsymbol{\sigma}\cdot\mathbf{x})(-\tau + i\boldsymbol{\sigma}\cdot\mathbf{x}) \tag{3.30}$$

$$Det_\sigma\begin{pmatrix} t & -\tau - i\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\tau + i\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix} = (t^2 - \tau^2 - \mathbf{x}^2)I_2 = 0 \tag{3.31}$$

Indeed, $Q = \tau + i\boldsymbol{\sigma}\cdot\tau$ is a quaternion and $Q^* = \tau - i\boldsymbol{\sigma}\cdot\mathbf{x}$ is its conjugate. So we can rewrite expression (3.29) as:

$$\begin{pmatrix} t & -Q \\ -Q^* & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.32}$$

Expression (3.26) is connected to expression (3.7) by unitary matrix $HS = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & i \\ 1 & -i \end{pmatrix}$:

$$HS\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}(HS)^{-1} = \begin{pmatrix} t & -\tau - i|\mathbf{x}| \\ -\tau + i|\mathbf{x}| & t \end{pmatrix} \tag{3.33}$$

Similarly, expression (3.12) is connected to expression (3.29) by 4x4 matrix *HS*:

$$HS\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix}(HS)^{-1} = \begin{pmatrix} t & -\tau - i\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\tau + i\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix} \tag{3.34}$$

Yet another kind of metamorphosis of expressions (3.6), (3.7) & (3.12) is respectively as follows:

$$L = 1 = \frac{t^2 - \tau^2}{\mathbf{x}^2} = \left(\frac{t+\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t-\tau}\right)^{-1}$$
$$\rightarrow \frac{t+\tau}{-|\mathbf{x}|} = \frac{-|\mathbf{x}|}{t-\tau} \rightarrow \frac{t+\tau}{-|\mathbf{x}|} - \frac{-|\mathbf{x}|}{t-\tau} = 0 \quad (3.35)$$

$$\begin{pmatrix} t+\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t-\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.36)$$

$$\begin{pmatrix} t+\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t-\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M = t - \boldsymbol{\alpha} \bullet \mathbf{x} + \beta\tau \quad (3.37)$$

If τ=0, we have from expressions (3.6) - (3.14):

$$L = 1 = \frac{t^2}{\mathbf{x}^2} = \left(\frac{t}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t}\right)^{-1}$$
$$\rightarrow \frac{t}{-|\mathbf{x}|} = \frac{-|\mathbf{x}|}{t} \rightarrow \frac{t}{-|\mathbf{x}|} - \frac{-|\mathbf{x}|}{t} = 0 \quad (3.38)$$

$$\begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.39)$$

$$0 = t^2 - \mathbf{x}^2 = Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \quad (3.40)$$

$$\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} = \begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix} \quad (3.41)$$

After fermionic spinization $|\mathbf{x}| \rightarrow \boldsymbol{\sigma}\cdot\mathbf{x}$, expression (3.39) becomes:

$$\begin{pmatrix} t & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.42}$$

which governs massless fermion (neutrino) in Dirac-like form.

After bosonic spinization:

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{p}+I_3) - Det(I_3)\right)} \to \mathbf{s}\cdot\mathbf{p} \tag{3.43}$$

expression (3.39) becomes:

$$\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.44}$$

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

$$s_1 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & -i \\ 0 & i & 0 \end{pmatrix} \quad s_2 = \begin{pmatrix} 0 & 0 & i \\ 0 & 0 & 0 \\ -i & 0 & 0 \end{pmatrix} \quad s_3 = \begin{pmatrix} 0 & -i & 0 \\ i & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \tag{3.45}$$

If we define:

$$Det_s \begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix} = (t)(t) - (-\mathbf{s}\cdot\mathbf{x})(-\mathbf{s}\cdot\mathbf{x}) \tag{3.46}$$

We get:

$$Det_s \begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix} = (t^2 - \mathbf{x}^2) I_3 - \begin{pmatrix} x^2 & xy & xz \\ yz & y^2 & yz \\ zx & zy & z^2 \end{pmatrix} \tag{3.47}$$

To obey fundamental relation (3.4) in determinant view (3.46), we shall require the last term in (3.47) 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 (3.39) governs massless particle with unobservable spin (spinless) in the dual momentum-energy universe. After bosonic spinization, the spinless and massless particle gains its spin 1.

Another kind of metamorphosis of expressions (3.18) - (3.22) when τ=0 is respectively as follows:

$$0 = t^2 - \mathbf{x}^2 = Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} \tag{3.48}$$

$$\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} = \begin{pmatrix} t - |\mathbf{x}| & 0 \\ 0 & t + |\mathbf{x}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.49}$$

$$\begin{pmatrix} t - \sigma \cdot \mathbf{x} & 0 \\ 0 & t + \sigma \cdot \mathbf{x} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.50}$$

$$\begin{pmatrix} t - \mathbf{s} \cdot \mathbf{x} & 0 \\ 0 & t + \mathbf{s} \cdot \mathbf{x} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.51}$$

$$Det_s\begin{pmatrix} t - \mathbf{s} \cdot \mathbf{x} & 0 \\ 0 & t + \mathbf{s} \cdot \mathbf{x} \end{pmatrix} = (t - \mathbf{s} \cdot \mathbf{x})(t + \mathbf{s} \cdot \mathbf{x}) \tag{3.52}$$

$$Det_s\begin{pmatrix} t - \mathbf{s} \cdot \mathbf{x} & 0 \\ 0 & t + \mathbf{s} \cdot \mathbf{x} \end{pmatrix} = (t^2 - \mathbf{x}^2)I_3 - \begin{pmatrix} x^2 & xy & xz \\ yz & y^2 & yz \\ zx & zy & z^2 \end{pmatrix} \tag{3.53}$$

Again, we shall require the last term in expression (3.53) acting on external and internal wave functions respectively to produce null result (zero) in source-free zone in order to satisfy fundamental relation (3.4) in the determinant view (3.52) as further discussed later.

Importantly, if $t = 0$, we have from expression (3.4):

$$-\tau^2 - \mathbf{x}^2 = 0 \tag{3.54}$$

Thus, if premomentumenergy allows energy-less forms of matrix law, we can derive, for example, from (3.7) and (3.17) the following:

$$\begin{pmatrix} -\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & +\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.55}$$

$$\begin{pmatrix} -|\mathbf{x}| & -\tau \\ -\tau & +|\mathbf{x}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.56}$$

Further, if $|\mathbf{x}|=0$, we have from expression (3.4):

$$t^2 - \tau^2 = 0 \tag{3.57}$$

Thus, if premomentumenergy allows momentumless forms of matrix law, we can derive, for example, from (3.7) and (3.17) the following:

$$\begin{pmatrix} t-\tau & 0 \\ 0 & t+\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.58}$$

$$\begin{pmatrix} t & -\tau \\ -\tau & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.59}$$

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

The above metamorphoses of the self-referential matrix law of premomentumenergy are derived from one-tier matrixization (self-reference) and two-tier matrixization (self-reference) based on the fundamental relation (3.4). The first-tier matrixization makes distinctions in energy (time), mass (intrinsic proper time) and total momentum (undifferentiated space) that involve scalar unit 1 and imaginary unit (spin) *i*. Then the second-tier matrixization makes distinction in three-dimensional momentum (three-dimensional space) based on spin $\boldsymbol{\sigma}$, $\boldsymbol{s}$, or other higher spin structures, if they exist.

3.3 Additional Forms of Matrix Law

If premomentumenergy allows partial distinction within first-tier self-referential matrixization, we obtain, for example, the following additional forms of matrix law $\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M$:

$$\begin{pmatrix} \sqrt{t^2-\tau^2} & -|\mathbf{x}| \\ -|\mathbf{x}| & \sqrt{t^2-\tau^2} \end{pmatrix} \quad (3.60) \qquad \begin{pmatrix} \sqrt{t^2-\tau^2} & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & \sqrt{t^2-\tau^2} \end{pmatrix} \quad (3.61)$$

$$\begin{pmatrix} \sqrt{t^2-\tau^2}-|\mathbf{x}| & 0 \\ 0 & \sqrt{t^2-\tau^2}+|\mathbf{x}| \end{pmatrix} \quad (3.62) \quad \begin{pmatrix} \sqrt{t^2-\tau^2}-\boldsymbol{\sigma}\cdot\mathbf{x} & 0 \\ 0 & \sqrt{t^2-\tau^2}+\boldsymbol{\sigma}\cdot\tau \end{pmatrix} \quad (3.63)$$

$$\begin{pmatrix} \sqrt{t^2-\mathbf{x}^2} & -\tau \\ -\tau & \sqrt{t^2-\mathbf{x}^2} \end{pmatrix} \quad (3.64) \quad \begin{pmatrix} \sqrt{t^2-\mathbf{x}^2}-\tau & 0 \\ 0 & \sqrt{t^2-\mathbf{x}^2}+\tau \end{pmatrix} \quad (3.65)$$

$$\begin{pmatrix} t & -\sqrt{\tau^2+\mathbf{x}^2} \\ \sqrt{\tau^2+\mathbf{x}^2} & t \end{pmatrix} \quad (3.66) \quad \begin{pmatrix} t-\sqrt{\tau^2+\mathbf{x}^2} & 0 \\ 0 & t+\sqrt{\tau^2+\mathbf{x}^2} \end{pmatrix} \quad (3.67)$$

$$\begin{pmatrix} \sqrt{t^2-\tau^2-\mathbf{x}^2} & 0 \\ 0 & \sqrt{t^2-\tau^2-\mathbf{x}^2} \end{pmatrix} \quad (3.68)$$

Bosonic versions of expressions (3.61) and (3.63) are obtained by replacing **σ** with **s**.

If premomentumenergy creates momentum self-confinement of an elementary entity through imaginary position $\boldsymbol{x}_i$ (downward self-reference such that $\tau^2>t^2$) we have:

$$\tau^2 - t^2 = -\mathbf{x}_i^2 = -x_i^2 - y_i^2 - z_i^2 = (i\mathbf{x}_i)^2 = -Det(\boldsymbol{\sigma}\cdot i\mathbf{x}_i) \quad (3.69)$$

that is:

$$t^2 - \tau^2 - \mathbf{x}_i^2 = 0 \quad (3.70)$$

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

$$\begin{pmatrix} t-\tau & -|\mathbf{p}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.71)$$

$$\begin{pmatrix} -\tau & -\sigma\cdot\mathbf{x}_i \\ -\sigma\cdot\mathbf{x}_i & +\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.72)$$

Also, we can derive the following matrix law in Weyl-like (chiral-like) form:

$$\begin{pmatrix} t-|\mathbf{x}_i| & -\tau \\ -\tau & +|\mathbf{x}_i| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.73}$$

$$\begin{pmatrix} t-\sigma\cdot\mathbf{x}_i & -\tau \\ -\tau & E+\sigma\cdot\mathbf{x}_i \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.74}$$

Bosonic versions of expressions (3.72) and (3.74) are obtained by replacing **σ** with **s**. It is likely that the above additional forms of self-referential matrix law govern different particles of the particle zoo in the dual momentum-energy universe as discussed later.

3.4 Scientific Genesis of Primordial Entities in the Premomentumenergy Model

Therefore, premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion such as an electron in Dirac-like form in dual momentum-energy Universe as follows:

$$\begin{gathered} 1 = e^{i0} = 1e^{i0} = Le^{+M-iM} = \frac{t^2-\tau^2}{\mathbf{x}^2} e^{+ip^\mu x_\mu - ip^\mu x_\mu} = \\ \left(\left(\frac{t-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t+\tau}\right)^{-1}\right)\left(\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1}\right) \rightarrow \\ \frac{t-\tau}{-|\mathbf{x}|} e^{+ip^\mu x_\mu} = \frac{-|\mathbf{x}|}{t+\tau} e^{+ip^\mu x_\mu} \rightarrow \frac{t-\tau}{-|\mathbf{x}|} e^{+ip^\mu x_\mu} - \frac{-|\mathbf{x}|}{t+\tau} e^{+ip^\mu x_\mu} = 0 \end{gathered} \tag{3.75}$$

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

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

that is:

$$\begin{pmatrix} (t-\tau)\psi_{e,+} = \boldsymbol{\sigma}\cdot\mathbf{x}\psi_{i,-} \\ (t+\tau)\psi_{i,-} = \boldsymbol{\sigma}\cdot\mathbf{x}\psi_{e,+} \end{pmatrix} \text{ or } \begin{pmatrix} i\partial_E\psi_{e,+} + \tau\psi_{e,+} = -i\boldsymbol{\sigma}\cdot\nabla_p\psi_{i,-} \\ i\partial_E\psi_{i,-} - \tau\psi_{i,-} = -i\boldsymbol{\sigma}\cdot\nabla_p\psi_{e,+} \end{pmatrix} \tag{3.76}$$

where substitutions $t \rightarrow -i\partial_E$ and $\mathbf{x} \rightarrow i\nabla_p$ have been made so that components of L_M can act on external and internal wave functions. Equation (3.76) also has free spherical wave solution in the dual momentum-energy universe in the form:

$$\psi = \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = \begin{pmatrix} S_{e,+}e^{+iEt} \\ S_{i,-}e^{+iEt} \end{pmatrix} \tag{3.77}$$

Alternatively, premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion such as the electron in Dirac-like form in the dual momentum-energy universe as follows:

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(t^2 - \tau^2 - \mathbf{x}^2\right) e^{+ip^\mu x_\mu - ip^\mu x_\mu} = \tag{3.78}$$

$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \right) \left(e^{+ip^\mu x_\mu} \right) \left(e^{+ip^\mu x_\mu} \right)^{-1} \rightarrow$$

$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix} + \begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \right) \begin{pmatrix} a_{e,+}e^{+ip^\mu x_\mu} \\ a_{i,-}e^{+ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix} \begin{pmatrix} a_{e,+}e^{+ip^\mu x_\mu} \\ a_{i,-}e^{+ip^\mu x_\mu} \end{pmatrix} = 0$$

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

Premomentumenergy creates, sustains and causes evolution of a free plane-wave antifermion such as a positron in Dirac-like form in the dual momentum-energy universe as follows:

$$1. = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{t^2 - \tau^2}{\mathbf{x}^2} e^{-ip^\mu x_\mu + ip^\mu x_\mu} =$$

$$\left(\frac{t-\tau}{-|\mathbf{x}|} \right) \left(\frac{-|\mathbf{x}|}{t+\tau} \right)^{-1} \left(e^{-ip^\mu x_\mu} \right) \left(e^{-ip^\mu x_\mu} \right)^{-1} \longrightarrow \tag{3.79}$$

$$\frac{t-\tau}{-|\mathbf{x}|} e^{-ip^\mu x_\mu} = \frac{-|\mathbf{x}|}{t+\tau} e^{-ip^\mu x_\mu} \rightarrow \frac{t-\tau}{-|\mathbf{x}|} e^{-ip^\mu x_\mu} - \frac{-|\mathbf{x}|}{t+\tau} e^{-ip^\mu x_\mu} = 0$$

$$\to \begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix} \begin{pmatrix} a_{e,-}e^{-ip^\mu x_\mu} \\ a_{i,+}e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0$$

$$\to \begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix} \begin{pmatrix} A_{e,-}e^{-ip^\mu x_\mu} \\ A_{i,+}e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0$$

or

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(t^2 - \tau^2 - \mathbf{x}^2\right) e^{-ip^\mu x_\mu + ip^\mu x_\mu} = \tag{3.80}$$

$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \right) \left(e^{-ip^\mu x_\mu} \right) \left(e^{-ip^\mu x_\mu} \right)^{-1} \to$$

$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix} + \begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \right) \begin{pmatrix} a_{e,-}e^{-ip^\mu x_\mu} \\ a_{i,+}e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix} \begin{pmatrix} a_{e,-}e^{-ip^\mu x_\mu} \\ a_{i,+}e^{-ip^\mu x_\mu} \end{pmatrix} = 0$$

$$\to \begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix} \begin{pmatrix} A_{e,-}e^{-ip^\mu x_\mu} \\ A_{i,+}e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0$$

Similarly, premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion in Weyl-like (chiral-like) form in the dual momentum-energy universe as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{t^2 - \mathbf{x}^2}{\tau^2} e^{+ip^\mu x_\mu - ip^\mu x_\mu} =$$

$$\left(\left(\frac{t-|\mathbf{x}|}{-\tau} \right) \left(\frac{-\tau}{t+|\mathbf{x}|} \right)^{-1} \left(e^{+ip^\mu x_\mu} \right) \left(e^{+ip^\mu x_\mu} \right)^{-1} \right) \to \tag{3.81}$$

$$\frac{t-|\mathbf{x}|}{-\tau} e^{+ip^\mu x_\mu} = \frac{-\tau}{t+|\mathbf{x}|} e^{+ip^\mu x_\mu} \to \frac{t-|\mathbf{x}|}{-\tau} e^{+ip^\mu x_\mu} - \frac{-\tau}{t+|\mathbf{x}|} e^{+ip^\mu x_\mu} = 0$$

$$\to \begin{pmatrix} t-|\mathbf{x}| & -\tau \\ -\tau & t+|\mathbf{x}| \end{pmatrix} \begin{pmatrix} a_{e,l}e^{+ip^\mu x_\mu} \\ a_{i,r}e^{+ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi = 0$$

$$\to \begin{pmatrix} t-\boldsymbol{\sigma}\cdot\mathbf{x} & -\tau \\ -\tau & t+\boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix} \begin{pmatrix} A_{e,l}e^{+ip^\mu x_\mu} \\ A_{i,r}e^{+ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi = 0$$

that is:

$$\begin{pmatrix} (t-\boldsymbol{\sigma}\cdot\mathbf{x})\psi_{e,l}=\tau\psi_{i,r} \\ (t+\boldsymbol{\sigma}\cdot\mathbf{x})\psi_{i,r}=\tau\psi_{e,l} \end{pmatrix} \text{ or } \begin{pmatrix} i\partial_E\psi_{e,l}+i\boldsymbol{\sigma}\cdot\nabla_p\psi_{e,l}=-\tau\psi_{i,r} \\ i\partial_E\psi_{i,r}-i\boldsymbol{\sigma}\cdot\nabla\psi_{i,-}=-\tau\psi_{e,l} \end{pmatrix} \tag{3.82}$$

Alternatively, premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion in Weyl-like (chiral-like) form as follows:

$$0=0e^{i0}=L_0e^{-iM+iM}=(t^2-\tau^2-\mathbf{x}^2)e^{+ip^\mu x_\mu-ip^\mu x_\mu}=$$
$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t\end{pmatrix}+Det\begin{pmatrix} 0 & -\tau \\ -\tau & 0\end{pmatrix}+Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}|\end{pmatrix}\right)\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1}\rightarrow \tag{3.83}$$
$$\left(\begin{pmatrix} t & 0 \\ 0 & t\end{pmatrix}+\begin{pmatrix} 0 & -\tau \\ -\tau & 0\end{pmatrix}+\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}|\end{pmatrix}\right)\begin{pmatrix} a_{e,l}e^{+ip^\mu x_\mu} \\ a_{i,r}e^{+ip^\mu x_\mu}\end{pmatrix}=\begin{pmatrix} t-|\mathbf{x}| & -\tau \\ -\tau & t+|\mathbf{x}|\end{pmatrix}\begin{pmatrix} a_{e,l}e^{+ip^\mu x_\mu} \\ a_{i,r}e^{+ip^\mu x_\mu}\end{pmatrix}=0$$
$$\rightarrow\begin{pmatrix} t-\boldsymbol{\sigma}\cdot\mathbf{x} & -\tau \\ -\tau & t+\boldsymbol{\sigma}\cdot\mathbf{x}\end{pmatrix}\begin{pmatrix} A_{e,l}e^{+ip^\mu x_\mu} \\ A_{i,r}e^{+ip^\mu x_\mu}\end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i}\end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r}\end{pmatrix}=L_M\psi=0$$

Premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion in another form in the dual momentum-energy universe as follows:

$$1=e^{i0}=1e^{i0}=Le^{+iM-iM}=\frac{t^2}{\tau^2+\mathbf{x}^2}e^{+ip^\mu x_\mu-ip^\mu x_\mu}=$$
$$\left(\frac{t}{-\tau+i|\mathbf{x}|}\right)\left(\frac{-\tau-i|\mathbf{x}|}{t}\right)^{-1}\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1}\rightarrow\frac{t}{-\tau+i|\mathbf{x}|}e^{+ip^\mu x_\mu}= \tag{3.84}$$
$$\frac{-\tau-i|\mathbf{x}|}{t}e^{+ip^\mu x_\mu}\rightarrow\frac{t}{-\tau+i|\mathbf{x}|}e^{+ip^\mu x_\mu}-\frac{-\tau-i|\tau|}{t}e^{+ip^\mu x_\mu}=0$$
$$\rightarrow\begin{pmatrix} t & -Q \\ -Q^* & t\end{pmatrix}\begin{pmatrix} A_e e^{+ip^\mu x_\mu} \\ A_i e^{+ip^\mu x_\mu}\end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i}\end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i\end{pmatrix}=L_M\psi=0$$
$$\rightarrow\begin{pmatrix} t & -Q \\ -Q^* & t\end{pmatrix}\begin{pmatrix} A_e e^{-ip^\mu x_\mu} \\ A_i e^{-ip^\mu x_\mu}\end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i}\end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i\end{pmatrix}=L_M\psi=0$$

that is:

$$\begin{pmatrix} t\psi_e = (\tau + i\boldsymbol{\sigma}\cdot\mathbf{x})\psi_i \\ t\psi_i = (\tau - i\boldsymbol{\sigma}\cdot\mathbf{x})\psi_e \end{pmatrix} \text{ or } \begin{pmatrix} i\partial_E\psi_e = -\tau\psi_i - \boldsymbol{\sigma}\cdot\nabla_p\psi_i \\ i\partial_E\psi_i = -\tau\psi_e + \boldsymbol{\sigma}\cdot\nabla_p\psi_i \end{pmatrix} \quad (3.85)$$

Alternatively, premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion in another form in the dual momentum-energy universe as follows:

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(t^2 - \tau^2 - \mathbf{x}^2\right) e^{+ip^\mu x_\mu - ip^\mu x_\mu} =$$

$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} + Det\begin{pmatrix} 0 & -i|\mathbf{x}| \\ i|\mathbf{x}| & 0 \end{pmatrix} \right)\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1} \rightarrow$$

$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} + \begin{pmatrix} 0 & -i|\mathbf{x}| \\ i|\mathbf{x}| & 0 \end{pmatrix} \right) \begin{pmatrix} a_e e^{+ip^\mu x_\mu} \\ a_i e^{+ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} t & -\tau - i|\mathbf{x}| \\ -\tau + i|\mathbf{x}| & t \end{pmatrix} \begin{pmatrix} a_e e^{+ip^\mu x_\mu} \\ a_i e^{+ip^\mu x_\mu} \end{pmatrix} = 0$$

$$\rightarrow \begin{pmatrix} t & -\tau - i\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\tau + i\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix} \begin{pmatrix} A_e e^{-ip^\mu x_\mu} \\ A_i e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0$$

$$\rightarrow \begin{pmatrix} t & -Q \\ -Q^* & t \end{pmatrix} \begin{pmatrix} A_e e^{-ip^\mu x_\mu} \\ A_i e^{-ip^\mu x_\mu} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0 \quad (3.86)$$

Premomentumenergy creates, sustains and causes evolution of a linear plane-wave photon in the dual momentum-energy universe as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{t^2}{\mathbf{x}^2} e^{+ip^\mu x_\mu - ip^\mu x_\mu} =$$

$$\left(\frac{t}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t}\right)^{-1}\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1} \rightarrow \quad (3.87)$$

$$\frac{t}{-|\mathbf{x}|} e^{+ip^\mu x_\mu} = \frac{-|\mathbf{x}|}{t} e^{+ip^\mu x_\mu} \rightarrow \frac{t}{-|\mathbf{x}|} e^{+ip^\mu x_\mu} - \frac{-|\mathbf{x}|}{t} e^{+ip^\mu x_\mu} = 0$$

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

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

Alternatively, premomentumenergy creates, sustains and causes evolution of the linear plane-wave photon in the dual momentum-energy universe as follows:

$$0 = 0e^{h} = 0e^{i0} = L_0 e^{+iM-iM} = \left(t^2 - \mathbf{X}^2\right) e^{+ip^{\mu} x_{\mu} - ip^{\mu} x_{\mu}} =$$
$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{X}| \\ -|\mathbf{X}| & 0 \end{pmatrix} \right) \left(e^{+ip^{\mu} x_{\mu}}\right) \left(e^{+ip^{\mu} x_{\mu}}\right)^{-1} \rightarrow \tag{3.88}$$
$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -|\mathbf{X}| \\ -|\mathbf{X}| & 0 \end{pmatrix} \right) \begin{pmatrix} a_{e,+} e^{+ip^{\mu} x_{\mu}} \\ a_{i,-} e^{+ip^{\mu} x_{\mu}} \end{pmatrix} = \begin{pmatrix} t & -|\mathbf{X}| \\ -|\mathbf{X}| & t \end{pmatrix} \begin{pmatrix} a_{e,+} e^{+ip^{\mu} x_{\mu}} \\ a_{i,-} e^{+ip^{\mu} x_{\mu}} \end{pmatrix} = 0$$
$$\rightarrow \begin{pmatrix} t & -\mathbf{S}\cdot\mathbf{X} \\ -\mathbf{S}\cdot\mathbf{X} & t \end{pmatrix} \begin{pmatrix} \mathbf{E}_{0e,+} e^{+ip^{\mu} x_{\mu}} \\ i\mathbf{B}_{0i,-} e^{+ip^{\mu} x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi_{photon} = 0$$

This photon wave function in the dual momentum-energy universe can be written as:

$$\psi_{photon} = \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = \begin{pmatrix} \mathbf{E}_{(\mathbf{p},\, \mathrm{E})} \\ i\mathbf{B}_{(\mathbf{p},\, \mathrm{E})} \end{pmatrix} = \begin{pmatrix} \mathbf{E}_0 e^{+i(\omega t - \mathbf{k}\cdot\mathbf{x})} \\ i\mathbf{B}_0 e^{+i(\omega t - \mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = \begin{pmatrix} \mathbf{E}_0 \\ i\mathbf{B}_0 \end{pmatrix} e^{+i(\omega t - \mathbf{k}\cdot\mathbf{x})} \tag{3.89}$$

After the substitutions $t \rightarrow -i\partial_E$ and $\mathbf{x} \rightarrow i\nabla_p$, we have from the last expression in (3.87):

$$\begin{pmatrix} i\partial_E & i\mathbf{S}\cdot\nabla_p \\ i\mathbf{S}\cdot\nabla_p & i\partial_E \end{pmatrix} \begin{pmatrix} \mathbf{E}_{(\mathbf{p},\, \mathrm{E})} \\ i\mathbf{B}_{(\mathbf{p},\, \mathrm{E})} \end{pmatrix} = 0 \rightarrow \begin{pmatrix} \partial_E \mathbf{E}_{(\mathbf{p},\, \mathrm{E})} = \nabla_p \times \mathbf{B}_{(\mathbf{p},\, \mathrm{E})} \\ \partial_E \mathbf{B}_{(\mathbf{p},\, \mathrm{E})} = -\nabla_p \times \mathbf{E}_{(\mathbf{p},\, \mathrm{E})} \end{pmatrix} \tag{3.90}$$

where we have used the relationship $\mathbf{S}\cdot\left(i\nabla_p\right) = -\nabla_p \times$ to derive the latter equations which together with $\nabla_p \cdot \mathbf{E}_{(\mathbf{p},\, \mathrm{E})} = 0$ and $\nabla_p \cdot \mathbf{B}_{(\mathbf{p},\, \mathrm{E})} = 0$ are the Maxwell-like equations in the source-free vacuum in the dual momentum-energy universe.

Premomentumenergy creates a neutrino in Dirac-like form in the dual momentum-energy universe by replacing the last step of expression (3.87) with the following:

$$\rightarrow\begin{pmatrix} t & -\sigma\cdot\mathbf{x} \\ -\sigma\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} a_{e,+}e^{+ip^{\mu}x_{\mu}} \\ a_{i,-}e^{+ip^{\mu}x_{\mu}} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix}=L_M\psi=0 \tag{3.91}$$

Premomentumenergy creates, sustains and causes evolution of a linear plane-wave antiphoton in the dual momentum-energy universe as follows:

$$1=e^{i0}=1e^{i0}=Le^{-iM+iM}=\frac{t^2}{\mathbf{x}^2}e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}=$$
$$\left(\frac{t}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1}\rightarrow \tag{3.92}$$
$$\frac{t}{-|\mathbf{x}|}e^{-ip^{\mu}x_{\mu}}=\frac{-|\mathbf{x}|}{t}e^{-ip^{\mu}x_{\mu}}\rightarrow\frac{t}{-|\mathbf{x}|}e^{-ip^{\mu}x_{\mu}}-\frac{-|\mathbf{x}|}{t}e^{-ip^{\mu}x_{\mu}}=0$$
$$\rightarrow\begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=L_M\psi=0$$
$$\rightarrow\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} i\mathbf{B}_{0e,-}e^{-ip^{\mu}x_{\mu}} \\ \mathbf{E}_{0i,+}e^{-ip^{\mu}x_{\mu}} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=L_M\psi_{antiphoton}=0$$

This antiphoton wave function can also be written as:

$$\psi_{antiphoton}=\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=\begin{pmatrix} i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \\ \mathbf{E}_{(\mathbf{p},\mathrm{E})} \end{pmatrix}=\begin{pmatrix} i\mathbf{B}_0 e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ \mathbf{E}_0 e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix}=\begin{pmatrix} i\mathbf{B}_0 \\ \mathbf{E}_0 \end{pmatrix}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \tag{3.93}$$

Premomentumenergy creates an antineutrino in Dirac-like form in the dual momentum-energy universe form by replacing the last step of expression (3.92) with the following:

$$\rightarrow\begin{pmatrix} t & -\sigma\cdot\mathbf{x} \\ -\sigma\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} a_{e,-}e^{-ip^{\mu}x_{\mu}} \\ a_{i,+}e^{-ip^{\mu}x_{\mu}} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=L_M\psi=0 \tag{3.94}$$

Premomentumenergy creates, sustains and causes evolution of chiral-like plane-wave photons in the dual momentum-energy universe as follows:

$$0=0e^{i0}=L_0e^{+iM-iM}=\left(t^2-\mathbf{x}^2\right)e^{+ip^{\mu}x_{\mu}-ip^{\mu}x_{\mu}}= \tag{3.95}$$

$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix}+Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix}\right)\left(e^{+ip^{\mu}x_{\mu}}\right)\left(e^{+ip^{\mu}x_{\mu}}\right)^{-1}\rightarrow$$

$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix}+\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix}\right)\begin{pmatrix} a_{e,l}e^{+ip^{\mu}x_{\mu}} \\ a_{i,r}e^{+ip^{\mu}x_{\mu}} \end{pmatrix}=\begin{pmatrix} t-|\mathbf{x}| & 0 \\ 0 & t+|\mathbf{x}| \end{pmatrix}\begin{pmatrix} a_{e,l}e^{+ip^{\mu}x_{\mu}} \\ a_{i,r}e^{+ip^{\mu}x_{\mu}} \end{pmatrix}=0$$

$$\rightarrow\begin{pmatrix} t-\mathbf{s}\cdot\mathbf{x} & 0 \\ 0 & t+\mathbf{s}\cdot\mathbf{x} \end{pmatrix}\begin{pmatrix} A_{e,l}e^{+ip^{\mu}x_{\mu}} \\ A_{i,r}e^{+ip^{\mu}x_{\mu}} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix}=L_M\psi=0$$

that is, $\psi_{e,l}$ and $\psi_{i,r}$ are decoupled from each other and satisfy the following equations respectively:

$$\begin{pmatrix} (t-\mathbf{s}\cdot\mathbf{x})\psi_{e,l}=0 \\ (t+\mathbf{s}\cdot\mathbf{x})\psi_{i,r}=0 \end{pmatrix} \text{ or } \begin{pmatrix} \partial_E\psi_{e,l}+\mathbf{s}\cdot\nabla_p\psi_{e,l}=0 \\ \partial_E\psi_{i,r}-\mathbf{s}\cdot\nabla_p\psi_{i,r}=0 \end{pmatrix} \tag{3.96}$$

which have the following respective solutions:

$$\psi=\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix}=\begin{pmatrix} \mathbf{E}_{(\mathbf{p},\mathrm{E})}+i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \\ \mathbf{E}_{(\mathbf{p},\mathrm{E})}-i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix}=\begin{pmatrix} (\mathbf{E}_0+i\mathbf{B}_0)e^{i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ (\mathbf{E}_0-i\mathbf{B}_0)e^{i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix} \tag{3.97}$$

Both $\partial_E\psi_{e,l}+\mathbf{s}\cdot\nabla_p\psi_{e,l}=0$ and $\partial_E\psi_{i,r}-\mathbf{s}\cdot\nabla_p\psi_{i,r}=0$ produce the Maxwell-like equations in the source-free vacuum as shown in the second expression of (3.90).

Premomentumenergy creates neutrinos in Weyl-like (chiral-like) forms in the dual momentum-energy universe by replacing the last step of expression (3.95) with the following:

$$\rightarrow\begin{pmatrix} t-\boldsymbol{\sigma}\cdot\mathbf{x} & 0 \\ 0 & t+\boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix}\begin{pmatrix} A_{e,l}e^{+ip^{\mu}x_{\mu}} \\ A_{i,r}e^{+ip^{\mu}x_{\mu}} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix}=L_M\psi=0 \tag{3.98}$$

that is, $\psi_{e,l}$ and $\psi_{i,r}$ are decoupled from each other and satisfy the following equations respectively:

$$\begin{pmatrix} (t-\sigma\cdot\mathbf{x})\psi_{e,l}=0 \\ (t+\sigma\cdot\mathbf{x})\psi_{i,r}=0 \end{pmatrix} \text{ or } \begin{pmatrix} \partial_E\psi_{e,l}+\boldsymbol{\sigma}\cdot\nabla_p\psi_{e,l}=0 \\ \partial_t\psi_{i,r}-\boldsymbol{\sigma}\cdot\nabla_p\psi_{i,r}=0 \end{pmatrix} \tag{3.99}$$

Premomentumenergy creates and sustains energy-less external and internal wave functions (energy-less graviton) of an intrinsic proper time τ in Dirac-like form as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{-\tau^2}{\mathbf{x}^2}e^{+iM-iM} =$$
$$\left(\frac{-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{+\tau}\right)^{-1}\left(e^{+iM}\right)\left(e^{+iM}\right)^{-1} \rightarrow \tag{3.100}$$
$$\frac{-\tau}{-|\mathbf{x}|}e^{+iM} = \frac{-|\mathbf{x}|}{+\tau}e^{+iM} \rightarrow \frac{-\tau}{-|\mathbf{x}|}e^{+iM} - \frac{-|\mathbf{x}|}{+\tau}e^{+iM} = 0$$
$$\rightarrow \begin{pmatrix} -\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & +\tau \end{pmatrix}\begin{pmatrix} g_{D,e}e^{+iM} \\ g_{D,i}e^{+iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = L_M V_D = 0$$

We will determine the form of imaginary content M in expression (3.100) later.

Alternatively, premomentumenergy creates and sustains energy-less external and internal wave functions (energy-less graviton) of an intrinsic proper time τ in Dirac-like form as follows:

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(\tau^2 - \mathbf{x}^2\right)e^{+iM-iM} =$$
$$\left(Det\begin{pmatrix} -\tau & 0 \\ 0 & +\tau \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix}\right)\left(e^{+iM}\right)\left(e^{+iM}\right)^{-1} \rightarrow \tag{3.101}$$
$$\left(\begin{pmatrix} -\tau & 0 \\ 0 & +\tau \end{pmatrix} + \begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{x}| & 0 \end{pmatrix}\right)\begin{pmatrix} g_{D,e}e^{+iM} \\ g_{D,i}e^{+iM} \end{pmatrix} = \begin{pmatrix} -\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & +\tau \end{pmatrix}\begin{pmatrix} g_{D,e}e^{+iM} \\ g_{D,i}e^{+iM} \end{pmatrix} = 0$$

Similarly, premomentumenergy creates and sustains energy-less external and internal wave functions (energy-less graviton) of an intrinsic proper time τ in Weyl-like (chiral-like) form as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{-\tau^2}{\mathbf{x}^2} e^{+iM-iM} =$$
$$\left(\frac{-|\mathbf{x}|}{-\tau}\right)\left(\frac{-\tau}{+|\mathbf{x}|}\right)^{-1} \left(e^{+iM}\right)\left(e^{+iM}\right)^{-1} \rightarrow \tag{3.102}$$
$$\frac{-|\mathbf{x}|}{-\tau} e^{+iM} = \frac{-\tau}{+|\mathbf{x}|} e^{+iM} \rightarrow \frac{-|\mathbf{x}|}{-\tau} e^{+iM} - \frac{-\tau}{+|\mathbf{x}|} e^{+M} = 0$$
$$\rightarrow \begin{pmatrix} -|\mathbf{x}| & -\tau \\ -\tau & +|\mathbf{x}| \end{pmatrix} \begin{pmatrix} g_{W,e} e^{+iM} \\ g_{W,i} e^{+iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = L_M V_W = 0$$

Again, we will determine the form of the imaginary content M in expression (3.102) later.

Alternatively, premomentumenergy creates and sustains energy-less external and internal wave functions (energy-less graviton) of an intrinsic proper time τ in Weyl-like (chiral-like) form as follows:

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(\tau^2 - \mathbf{x}^2\right) e^{+iM-iM} = \tag{3.103}$$
$$\left(Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & +|\mathbf{x}| \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} \right) \left(e^{+iM}\right)\left(e^{+iM}\right)^{-1} \rightarrow$$
$$\left(\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & +|\mathbf{x}| \end{pmatrix} + \begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix} \right) \begin{pmatrix} g_{W,e} e^{+iM} \\ g_{W,i} e^{+iM} \end{pmatrix} = \begin{pmatrix} -\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & +\tau \end{pmatrix} \begin{pmatrix} g_{W,e} e^{+iM} \\ g_{w,i} e^{+iM} \end{pmatrix} = 0$$

Premomentumenergy creates and sustains momentum-less (momentum independent) external and internal wave functions of an intrinsic proper time τ in Dirac-like form as follows:

$$0 = 0e^{0} = L_0 e^{+iM-iM} = \left(t^2 - \tau^2\right) e^{+imt-imt} = \tag{3.104}$$
$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} -\tau & 0 \\ 0 & +\tau \end{pmatrix} \right) \left(e^{+imt}\right)\left(e^{+imt}\right)^{-1} \rightarrow$$
$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} -\tau & 0 \\ 0 & +\tau \end{pmatrix} \right) \begin{pmatrix} g_{D,e} e^{+imt} \\ g_{D,i} e^{+imt} \end{pmatrix} = \begin{pmatrix} t-\tau & 0 \\ 0 & t+\tau \end{pmatrix} \begin{pmatrix} g_{D,e} e^{+imt} \\ g_{D,i} e^{+imt} \end{pmatrix} = 0$$

Similarly, premomentumenergy creates and sustains momentum-less (momentum independent) external and internal wave functions of an intrinsic proper time τ in Weyl-like (chiral-like) form as follows:

$$1 = e^0 = 1e^0 = Le^{+iM-iM} = \frac{t^2}{\tau^2} e^{+imt-imt} =$$
$$\left(\frac{t}{-\tau}\right)\left(\frac{-\tau}{t}\right)^{-1} \left(e^{+imt}\right)\left(e^{+imt}\right)^{-1} \rightarrow \tag{3.105}$$
$$\frac{t}{-\tau} e^{+imt} = \frac{-\tau}{t} e^{+imt} \rightarrow \frac{t}{-\tau} e^{+imt} - \frac{-\tau}{t} e^{+imt} = 0$$
$$\rightarrow \begin{pmatrix} t & -\tau \\ -\tau & t \end{pmatrix} \begin{pmatrix} g_{W,e} e^{+imt} \\ g_{W,i} e^{+imt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = L_M V_W = 0$$

Alternatively, premomentumenergy creates and sustains momentum-less (momentum independent) external and internal wave functions of an intrinsic proper time τ in Weyl-like (chiral-like) form as follows:

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(t^2 - \tau^2\right) e^{+imt-imt} =$$
$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix}\right)\left(e^{+imt}\right)\left(e^{+imt}\right)^{-1} \rightarrow \tag{3.106}$$
$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix}\right)\begin{pmatrix} g_{W,e} e^{+imt} \\ g_{W,i} e^{+imt} \end{pmatrix} = \begin{pmatrix} t & -\tau \\ -\tau & t \end{pmatrix}\begin{pmatrix} g_{W,e} e^{+imt} \\ g_{w,i} e^{+imt} \end{pmatrix} = 0$$

Premomentumenergy creates, sustains and causes evolution of a momentumly self-confined entity such as a proton in the dual momentum-energy universe through imaginary position $\mathbf{x}_i$ (downward self-reference such that $\tau^2 > t^2$) in Dirac-like form as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{t^2 - \tau^2}{\mathbf{x}_i^2} e^{-ip^\mu x_\mu + ip^\mu x_\mu} =$$
$$\left(\frac{t-\tau}{-|\mathbf{x}_i|}\right)\left(\frac{-|\mathbf{x}_i|}{t+\tau}\right)^{-1}\left(e^{-ip^\mu x_\mu}\right)\left(e^{-ip^\mu x_\mu}\right)^{-1} \rightarrow \tag{3.107}$$
$$\frac{t-\tau}{-|\mathbf{x}_i|} e^{-ip^\mu x_\mu} = \frac{-|\mathbf{x}_i|}{t+\tau} e^{-ip^\mu x_\mu} \rightarrow \frac{t-\tau}{-|\mathbf{x}_i|} e^{-ip^\mu x_\mu} - \frac{-|\mathbf{x}_i|}{t+\tau} e^{-ip^\mu x_\mu} = 0$$

$$\rightarrow\begin{pmatrix} t-\tau & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,-}e^{-iEt} \\ s_{i,+}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=L_M\psi=0 \tag{3.108}$$

After spinization of expression (3.108), we have:

$$\rightarrow\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x}_i \\ -\boldsymbol{\sigma}\cdot\mathbf{x}_i & t+\tau \end{pmatrix}\begin{pmatrix} S_{e,-}e^{-iEt} \\ S_{i,+}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=L_M\psi=0 \tag{3.109}$$

As discussed later, it is plausible that expression (3.108) governs the confinement structure of the unspinized proton in Dirac-like form through imaginary position $\mathbf{x}_i$ and, on the other hand, expression (3.109) governs the confinement structure of spinized proton through $\mathbf{x}_i$.

Alternatively, premomentumenergy creates, sustains and causes evolution of the momentum-ly self-confined entity such as a proton in the dual momentum-energy universe in Dirac-like form as follows:

$$0=0e^{i0}=L_0e^{-iM+iM}=\left(t^2-\tau^2-\mathbf{x}_i^2\right)e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}= \tag{3.110}$$

$$Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix}+\left(Det\begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix}+Det\begin{pmatrix} 0 & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & 0 \end{pmatrix}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1}\rightarrow$$

$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix}+\begin{pmatrix} -\tau & 0 \\ 0 & \tau \end{pmatrix}+\begin{pmatrix} 0 & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & 0 \end{pmatrix}\right)\begin{pmatrix} s_{e,-}e^{-iEt} \\ s_{i,+}e^{-iEt} \end{pmatrix}=\begin{pmatrix} t-\tau & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,-}e^{-iEt} \\ s_{i,+}e^{-iEt} \end{pmatrix}=0$$

$$\rightarrow\begin{pmatrix} t-\tau & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,-}e^{-iEt} \\ s_{i,+}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{D,e} \\ \psi_{D,i} \end{pmatrix}=L_M\psi_D=0$$

$$\rightarrow\begin{pmatrix} t-\tau & -\sigma\cdot\mathbf{x}_i \\ -\sigma\cdot\mathbf{x}_i & t+\tau \end{pmatrix}\begin{pmatrix} S_{e,-}e^{-iEt} \\ S_{i,+}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{D,e} \\ \psi_{D,i} \end{pmatrix}=L_M\psi_D=0$$

Thus, an unspinized and spinized antiproton in Dirac-like form may be respectively governed as follows:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,+}e^{+iEt} \\ s_{i,-}e^{+iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{D,e} \\ \psi_{D,i} \end{pmatrix}=L_M\psi_D=0 \tag{3.111}$$

$$\begin{pmatrix} t-\tau & -\sigma\cdot\mathbf{x}_i \\ -\sigma\cdot\mathbf{x}_i & t+\tau \end{pmatrix}\begin{pmatrix} S_{e,+}e^{+iEt} \\ S_{i,-}e^{+iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{D,e} \\ \psi_{D,i} \end{pmatrix}=L_M\psi_D=0 \tag{3.112}$$

Similarly, premomentumenergy creates, sustains and causes evolution of a momentumly self-confined entity such as a proton in the dual momentum-energy universe through imaginary position $\mathbf{x}_i$ (downward self-reference) in Weyl-like (chiral-like) form as follows:

$$1=e^{i0}=1e^{i0}=Le^{-iM_\mu+iM}=\frac{t^2-\mathbf{x}_i^2}{\tau^2}e^{-ip^\mu x_\mu+ip^\mu x_\mu}=$$
$$\left(\frac{t-|\mathbf{x}_i|}{-\tau}\right)\left(\frac{-\tau}{t+|\mathbf{x}_i|}\right)^{-1}\left(e^{-ip^\mu x_\mu}\right)\left(e^{-ip^\mu x_\mu}\right)^{-1}\rightarrow \tag{3.113}$$
$$\frac{t-|\mathbf{x}_i|}{-\tau}e^{-ip^\mu x_\mu}=\frac{-\tau}{t+|\mathbf{x}_i|}e^{-ip^\mu x_\mu}\rightarrow\frac{t-|\mathbf{x}_i|}{-\tau}e^{-ip^\mu x_\mu}-\frac{-\tau}{t+|\mathbf{x}_i|}e^{-ip^\mu x_\mu}=0$$

$$\rightarrow\begin{pmatrix} t-|\mathbf{x}_i| & -\tau \\ -\tau & t+|\mathbf{x}_i| \end{pmatrix}\begin{pmatrix} s_{e,r}e^{-iEt} \\ s_{i,l}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,r} \\ \psi_{i,l} \end{pmatrix}=L_M\psi=0 \tag{3.114}$$

After spinization of expression (3.114), we have:

$$\rightarrow\begin{pmatrix} t-\sigma\cdot\mathbf{x}_i & -\tau \\ -\tau & t+\sigma\cdot\mathbf{x}_i \end{pmatrix}\begin{pmatrix} S_{e,r}e^{-iEt} \\ S_{i,l}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,r} \\ \psi_{i,l} \end{pmatrix}=L_M\psi=0 \tag{3.115}$$

It is plausible that expression (3.114) governs the structure of the unspinized proton in Weyl-like form and expression (3.115) governs the structure of spinized proton in Weyl-like form.

Alternatively, premomentumenergy creates, sustains and causes evolution of a spatially self-confined entity such as a proton in the dual momentum-energy universe in Weyl (chiral) form as follows:

$$0=0e^{i0}=L_0e^{-iM+iM}=\left(t^2-\tau^2-\mathbf{x}_i^2\right)e^{-ip^\mu x_\mu+ip^\mu x_\mu}= \tag{3.116}$$

$$\left(Det\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix}+Det\begin{pmatrix} -|\mathbf{x}_i| & 0 \\ 0 & +|\mathbf{x}_i| \end{pmatrix}+Det\begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow$$

$$\left(\begin{pmatrix} t & 0 \\ 0 & t \end{pmatrix}+\begin{pmatrix} -|\mathbf{x}_i| & 0 \\ 0 & +|\mathbf{x}_i| \end{pmatrix}+\begin{pmatrix} 0 & -\tau \\ -\tau & 0 \end{pmatrix}\right)\begin{pmatrix} s_{e,r}e^{-iEt} \\ s_{i,l}e^{-iEt} \end{pmatrix}=\begin{pmatrix} t-|\mathbf{x}_i| & -\tau \\ -\tau & t+|\mathbf{x}_i| \end{pmatrix}\begin{pmatrix} s_{e,r}e^{-iEt} \\ s_{i,l}e^{-iEt} \end{pmatrix}=0$$

$$\rightarrow\begin{pmatrix} t-|\mathbf{x}_i| & -\tau \\ -\tau & t+|\mathbf{x}_i| \end{pmatrix}\begin{pmatrix} s_{e,r}e^{-iEt} \\ s_{i,l}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,r} \\ \psi_{i,l} \end{pmatrix}=L_M\psi=0 \tag{3.117}$$

$$\rightarrow\begin{pmatrix} t-\sigma\cdot\mathbf{x}_i & -\tau \\ -\tau & t+\sigma\cdot\mathbf{x}_i \end{pmatrix}\begin{pmatrix} S_{e,r}e^{-iEt} \\ S_{i,l}e^{-iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,r} \\ \psi_{i,l} \end{pmatrix}=L_M\psi=0 \tag{3.118}$$

Thus, an unspinized and spinized antiproton in Weyl-like form may be respectively governed as follows:

$$\begin{pmatrix} t-|\mathbf{x}_i| & -\tau \\ -\tau & t+|\mathbf{x}_i| \end{pmatrix}\begin{pmatrix} s_{e,l}e^{+iEt} \\ s_{i,r}e^{+iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix}=L_M\psi=0 \tag{3.119}$$

$$\begin{pmatrix} t-\sigma\cdot\mathbf{x}_i & -\tau \\ -\tau & t+\sigma\cdot\mathbf{x}_i \end{pmatrix}\begin{pmatrix} S_{e,l}e^{+iEt} \\ S_{i,r}e^{+iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix}=L_M\psi=0 \tag{3.120}$$

3.4 Scientific Genesis of Composite Entities in the Premomentumenergy Model

Premomentumenergy may create, sustain and cause evolution of a neutron in the dual momentum-energy universe in Dirac-like form which is comprised of an unspinized proton:

$$\left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\tau & -|\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}| \\ -|\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}| & t-e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix} s_{e,-}e^{-iEt} \\ s_{i,+}e^{-iEt} \end{pmatrix}=0\right)_p \tag{3.121}$$

and a spinized electron:

$$\left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-V_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) & t+e\phi_{(\mathbf{p},E)}-V_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix} S_{e,+}e^{+iEt} \\ S_{i,-}e^{+iEt} \end{pmatrix}=0\right)_e \tag{3.122}$$

as follows:

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

$$=\left(\frac{t^2-\tau^2}{\mathbf{x}_i^2}e^{-ip^\mu x_\mu+ip^\mu x_\mu}\right)_p\left(\frac{t^2-\tau^2}{\mathbf{x}^2}e^{+ip^\mu x_\mu-ip^\mu x_\mu}\right)_e=$$

$$\left(\left(\frac{t-\tau}{-|\mathbf{x}_i|}\right)\left(\frac{-|\mathbf{x}_i|}{t+\tau}\right)^{-1}\left(e^{-ip^\mu x_\mu}\right)\left(e^{-ip^\mu x_\mu}\right)^{-1}\right)_p\left(\left(\frac{t-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t+s}\tau\right)^{-1}\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1}\right)_e$$

$$\rightarrow\left(\begin{pmatrix}t-\tau & -|\mathbf{x}_i|\\ -|\mathbf{x}_i| & t+\tau\end{pmatrix}\begin{pmatrix}s_{e,-}e^{-iEt}\\ s_{i,+}e^{-iEt}\end{pmatrix}=0\right)_p\left(\begin{pmatrix}t-\tau & -|\mathbf{x}|\\ -|\mathbf{x}| & t+\tau\end{pmatrix}\begin{pmatrix}s_{e,+}e^{+iEt}\\ s_{i,-}e^{+iEt}\end{pmatrix}=0\right)_e$$

$$\rightarrow\left(\begin{array}{l}\left(\begin{pmatrix}t-e\phi_{(\mathsf{p},E)}-\tau & -|\mathbf{x}_i-e\mathbf{A}_{(\mathsf{p},E)}|\\ -|\mathbf{x}_i-e\mathbf{A}_{(\mathsf{p},E)}| & t-e\phi_{(\mathsf{p},E)}+\tau\end{pmatrix}\begin{pmatrix}s_{e,-}e^{-iEt}\\ s_{i,+}e^{-iEt}\end{pmatrix}=0\right)_p\\ \left(\begin{pmatrix}t+e\phi_{(\mathsf{p},E)}-V_{(\mathsf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathsf{p},E)})\\ -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathsf{p},E)}) & t+e\phi_{(\mathsf{p},E)}-V_{(\mathsf{p},E)}+\tau\end{pmatrix}\begin{pmatrix}S_{e,+}e^{+iEt}\\ S_{i,-}e^{+iEt}\end{pmatrix}=0\right)_e\end{array}\right)_n \quad (3.123)$$

In expressions (3.121), (3.122) and (3.123), $(\ )_p$, $(\ )_e$ and $(\ )_n$ indicate proton, electron and neutron respectively. Further, unspinized proton has charge e, electron has charge –e, $\left(A^\mu=(\phi_{(\mathsf{p}.,E)},\mathbf{A}_{(\mathsf{p}.,E)})\right)_p$ and $\left(A^\mu=(\phi_{(\mathsf{p}.,E)},\mathbf{A}_{(\mathsf{p}.,E)})\right)_e$ are the electromagnetic potentials acting on unspinized proton and tightly bound spinized electron respectively, and $\left(V_{(\mathsf{p},E)}\right)_e$ is a binding potential from the unspinized proton acting on the spinized electron causing tight binding as discussed later.

If $\left(A^\mu=(\phi_{(\mathsf{p}.,E)},\mathbf{A}_{(\mathsf{p}.,E)})\right)_p$ is negligible due to the fast motion of the tightly bound spinized electron in the dual momentum-energy universe, we have from the last expression in (3.123):

$$\rightarrow\left(\begin{array}{l}\left(\begin{pmatrix}t-\tau & -|\mathbf{x}_i|\\ -|\mathbf{x}_i| & t+\tau\end{pmatrix}\begin{pmatrix}s_{e,-}e^{-iEt}\\ s_{i,+}e^{-iEt}\end{pmatrix}=0\right)_p\\ \left(\begin{pmatrix}t+e\phi_{(\mathsf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathsf{p},E)})\\ -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathsf{p},E)}) & t+e\phi_{(\mathsf{p},E)}+\tau\end{pmatrix}\begin{pmatrix}S_{e,+}e^{+iEt}\\ S_{i,-}e^{+iEt}\end{pmatrix}=0\right)_e\end{array}\right)_n \quad (3.124)$$

Experimental data on charge distribution and *g*-factor of neutron may support a neutron comprising of an unspinized proton and a tightly bound spinized electron.

The Weyl-like (chiral-like) form of the last expression in (3.123) and expression (3.124) are respectively as follows:

$$\begin{pmatrix} \left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\left|\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}\right| & -\tau \\ -\tau & -e\phi+\left|\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}\right| \end{pmatrix}\begin{pmatrix} s_{e,r}e^{-iEt} \\ s_{i,l}e^{-iEt} \end{pmatrix}=0\right)_p \\ \left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-V_{(\mathbf{p},E)}-\boldsymbol{\sigma}\cdot\left(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}\right) & -\tau \\ -\tau & t+e\phi_{(\mathbf{p},E)}-V_{(\mathbf{p},E)}+\boldsymbol{\sigma}\cdot\left(\mathbf{p}+e\mathbf{A}_{(\mathbf{p},E)}\right) \end{pmatrix}\begin{pmatrix} S_{e,l}e^{+iEt} \\ S_{i,r}e^{+iEt} \end{pmatrix}=0\right)_e \end{pmatrix}_n \quad (3.125)$$

$$\begin{pmatrix} \left(\begin{pmatrix} t-\left|\mathbf{x}_i\right| & -\tau \\ -\tau & t+\left|\mathbf{x}_i\right| \end{pmatrix}\begin{pmatrix} s_{e,r}e^{-iEt} \\ s_{i,l}e^{-iEt} \end{pmatrix}=0\right)_p \\ \left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-V_{(\mathbf{p},E)}-\boldsymbol{\sigma}\cdot\left(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}\right) & -\tau \\ -\tau & t+e\phi_{(\mathbf{p},E)}-V_{(\mathbf{p},E)}+\boldsymbol{\sigma}\cdot\left(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}\right) \end{pmatrix}\begin{pmatrix} S_{e,l}e^{+iEt} \\ S_{i,r}e^{+iEt} \end{pmatrix}=0\right)_e \end{pmatrix}_n \quad (3.126)$$

Then, premomentumenergy may create, sustain and cause evolution of a hydrogen atom in the dual momentum-energy universe comprising of a spinized proton:

$$\left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\tau & -\sigma\cdot\left(\mathbf{x}_i-e\mathrm{A}_{(\mathbf{p},E)}\right) \\ -\sigma\cdot\left(\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}\right) & t-e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix} S_{e,-}e^{-iEt} \\ S_{i,+}e^{-iEt} \end{pmatrix}=0\right)_p \quad (3.127)$$

and a spinized electron:

$$\left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot\left(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}\right) \\ -\boldsymbol{\sigma}\cdot\left(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}\right) & t+e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix} S_{e,+}e^{+iEt} \\ S_{i,-}e^{+iEt} \end{pmatrix}=0\right)_e \quad (3.128)$$

in Dirac-like form as follows:

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

$$=\left(\frac{t^2-\tau^2}{\mathbf{x}_i^2}e^{-ip^\mu x_\mu+ip^\mu x_\mu}\right)_p\left(\frac{t^2-\tau^2}{\mathbf{x}^2}e^{+ip^\mu x_\mu-ip^\mu x_\mu}\right)_e=$$

$$\left(\left(\frac{t-\tau}{-|\mathbf{x}_i|}\right)\left(\frac{-|\mathbf{x}_i|}{t+\tau}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1}\right)_p\left(\left(\frac{t-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{x}|}{t+\tau}\right)^{-1}\left(e^{+ip^{\mu}x_{\mu}}\right)\left(e^{+ip^{\mu}x_{\mu}}\right)^{-1}\right)_e$$

$$\rightarrow\left(\begin{pmatrix} t-\tau & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,-}e^{-iEt} \\ s_{i,+}e^{-iEt} \end{pmatrix}=0\right)_p\left(\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,+}e^{+iEt} \\ s_{i,-}e^{+iEt} \end{pmatrix}=0\right)_e$$

$$\rightarrow\begin{pmatrix} \left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot(\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}) & t-e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix} S_{e,-}e^{-iEt} \\ S_{i,+}e^{-iEt} \end{pmatrix}=0\right)_p \\ \left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) & t+e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix} S_{e,+}e^{+iEt} \\ S_{i,-}e^{+iEt} \end{pmatrix}=0\right)_e \end{pmatrix}_h \tag{3.129}$$

In expressions (3.127), (3.128) and (3.129), $(\ )_p$, $(\ )_e$ and $(\ )_h$ indicate proton, electron and hydrogen atom respectively. Again, proton has charge e, electron has charge –e, and $\left(A^{\mu}=(\phi_{(\mathbf{p}.,E)},\mathbf{A}_{(\mathbf{p}.,E)})\right)_p$ and $\left(A^{\mu}=(\phi_{(\mathbf{p}.,E)},\mathbf{A}_{(\mathbf{p}.,E)})\right)_e$ are the electromagnetic potentials acting on spinized proton and spinized electron respectively.

Again, if $\left(A^{\mu}=(\phi_{(\mathbf{p}.,E)},\mathbf{A}_{(\mathbf{p}.,E)})\right)_p$ is negligible due to fast motion of the orbiting spinized electron, we have from the last expression in (3.129):

$$\rightarrow\begin{pmatrix} \left(\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x}_i \\ -\boldsymbol{\sigma}\cdot\mathbf{x}_i & t+\tau \end{pmatrix}\begin{pmatrix} S_{e,-}e^{-iEt} \\ S_{i,+}e^{-iEt} \end{pmatrix}=0\right)_p \\ \left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) \\ -\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) & t+e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix} S_{e,+}e^{+iEt} \\ S_{i,-}e^{+iEt} \end{pmatrix}=0\right)_e \end{pmatrix}_h \tag{1.130}$$

The Weyl-like (chiral-like) form of the last expression in (3.129) and expression (3.130) are respectively as follows:

$$\begin{pmatrix} \left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\boldsymbol{\sigma}\cdot(\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}) & -\tau \\ -\tau & t-e\phi_{(\mathbf{p},E)}+\boldsymbol{\sigma}\cdot(\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}) \end{pmatrix}\begin{pmatrix} S_{e,r}e^{-iEt} \\ S_{i,l}e^{-iEt} \end{pmatrix}=0\right)_p \\ \left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) & -\tau \\ -\tau & t+e\phi_{(\mathbf{p},E)}+\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) \end{pmatrix}\begin{pmatrix} S_{e,l}e^{+iEt} \\ S_{i,r}e^{+iEt} \end{pmatrix}=0\right)_e \end{pmatrix}_h \quad (3.131)$$

$$\begin{pmatrix} \left(\begin{pmatrix} t-\boldsymbol{\sigma}\cdot\mathbf{x}_i & -\tau \\ -\tau & t+\boldsymbol{\sigma}\cdot\mathbf{x}_i \end{pmatrix}\begin{pmatrix} S_{e,r}e^{-iEt} \\ S_{i,l}e^{-iEt} \end{pmatrix}=0\right)_p \\ \left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) & -\tau \\ -\tau & t+e\phi_{(\mathbf{p},E)}+\boldsymbol{\sigma}\cdot(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}) \end{pmatrix}\begin{pmatrix} S_{e,l}e^{+iEt} \\ S_{i,r}e^{+iEt} \end{pmatrix}=0\right)_e \end{pmatrix}_h \quad (3.132)$$

4. Metamorphous Premomentumenergy View

4.1 Metamorphoses & the Essence of Spin in the Premomentumenergy Model

The preceding sections make it clear that the particle e^{i0} of premomentumenergy 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-like, Weyl-like, quaternion-like or determinant form respectively in different contexts in the dual momentum-energy universe depending on the questions one asks and the answer one seeks.

This work also makes it clear that primordial self-referential spin in premomentumenergy is hierarchical and it is the cause of primordial distinctions for creating the self-referential entities in the dual momentum-energy universe. There are several levels of spin: (1) spin in the power level in premomentumenergy making primordial external and internal phase distinctions of external and internal wave functions; (2) spin of the premomentumenergy on the ground level 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; (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 position (downward self-reference).

4.2 The Determinant View & the Meaning of Klein-Gordon-like Equation in the Premomentumenergy Model

In the determinant view, the matrix law collapses into Klein-Gordon-like 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, *vice versa*.

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

$$\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M\psi_D = 0 \quad (4.1)$$

and

$$\begin{pmatrix} t-|\mathbf{x}| & -\tau \\ -\tau & t+|\mathbf{x}| \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M\psi_W = 0 \quad (4.2)$$

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

$$\begin{pmatrix} (DetL_M)\psi_{e,+}\psi_{i,-}^* = (t^2-\tau^2-\mathbf{x}^2)\psi_{e,+}\psi_{i,-}^* = 0 \\ (t^2-\tau^2-\mathbf{x}^2)\psi_{e,+} = 0 \\ (t^2-\tau^2-\mathbf{x}^2)\psi_{i,-}^* = 0 \end{pmatrix} \quad (4.3)$$

and

$$\begin{pmatrix} (DetL_M)\psi_{e,l}\psi_{i,r}^* = (t^2-\mathbf{x}^2-\tau^2)\psi_{e,l}\psi_{i,r}^* = 0 \\ (t^2-\mathbf{x}^2-\tau^2)\psi_{e,l} = 0 \\ (t^2-\mathbf{x}^2-\tau^2)\psi_{i,r}^* = 0 \end{pmatrix} \quad (4.4)$$

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

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

from which we have:

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

where

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

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 time in the external wave function $\psi_{e,+}$ is considered to be inertial time, then the relativistic time in the conjugate internal wave function $\psi^*_{i,-}$ plays the role of gravitational time. We will discuss quantum potential later.

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

$$\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M\psi = 0 \tag{4.8}$$

and

$$\begin{pmatrix} t-\boldsymbol{\sigma}\cdot\mathbf{x} & -\tau \\ -\tau & t+\boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M\psi = 0 \tag{4.9}$$

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 the following equations in the determinant view (Klein-Gordon-like form):

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

and

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

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

$$\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\tau & -\left|\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right| \\ -\left|\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right| & t-e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix}\psi_{e,+}\\ \psi_{i,-}\end{pmatrix}=L_M\psi_D=0 \tag{4.12}$$

and

$$\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\left|\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right| & -\tau \\ -\tau & t-e\phi_{(\mathbf{p},E)}+\left|\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right| \end{pmatrix}\begin{pmatrix}\psi_{e,l}\\ \psi_{i,r}\end{pmatrix}=L_M\psi_W=0 \tag{4.13}$$

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

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

and

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

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

$$\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\tau & -\sigma\cdot\left(\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right) \\ -\sigma\cdot\left(\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right) & t-e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix}\psi_{e,+}\\ \psi_{i,-}\end{pmatrix}=L_M\psi_D=0 \tag{4.16}$$

and

$$\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\sigma\cdot\left(\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right) & -\tau \\ -\tau & t-e\phi_{(\mathbf{p},E)}+\sigma\cdot\left(\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)}\right) \end{pmatrix}\begin{pmatrix}\psi_{e,l}\\ \psi_{i,r}\end{pmatrix}=L_M\psi_W=0 \tag{4.17}$$

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

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

and

$$\begin{pmatrix} (Det_\sigma L_M)\psi_{e,l}\psi^*_{i,r} = \left((t-e\phi_{(\mathbf{p},E)})^2 - (\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)})^2 - \tau^2 + e\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},E)}\text{-}ie\boldsymbol{\sigma}\cdot\mathbf{E}_{(\mathbf{p},E)}\right)I_2\psi_{e,l}\psi^*_{i,r} = 0 \\ \left((t-e\phi_{(\mathbf{p},E)})^2 - (\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)})^2 - \tau^2 + e\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},E)}\text{-}ie\boldsymbol{\sigma}\cdot\mathbf{E}_{(\mathbf{p},E)}\right)I_2\psi_{e,l} = 0 \\ \left((t-e\phi_{(\mathbf{p},E)})^2 - (\mathbf{x}\text{-}e\mathbf{A}_{(\mathbf{p},E)})^2 - \tau^2 + e\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},E)}\text{-}ie\boldsymbol{\sigma}\cdot\mathbf{E}_{(\mathbf{p},E)}\right)I_2\psi^*_{i,r} = 0 \end{pmatrix} \quad (4.19)$$

In equations (4.16) and (4.17), the couplings of $\mathbf{E}_{(\mathbf{p},E)}$ and/or $\mathbf{B}_{(\mathbf{p},E)}$ with spin $\boldsymbol{\sigma}$ 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-like Equation & Quantum Potential in the Premomentumenergy Model

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

$$i\hbar\partial_E\psi = \hat{T}\psi = \frac{\hbar^2}{2\tau c^2}\nabla^2_{\mathrm{p}}\psi \quad \text{or} \quad i\partial_E\psi = \hat{T}\psi = \frac{1}{2\tau}\nabla^2_{\mathrm{p}}\psi \quad (c=\hbar=1) \quad (4.20)$$

where $\psi = \psi_{\mathrm{Re}} + i\psi_{\mathrm{Im}}$.

From $(ct)^2 = \boldsymbol{x}^2 + (c\tau)^2$, we have:

$$t = \pm\tau\sqrt{\frac{\mathbf{x}^2}{(c\tau)^2}+1} = \pm\tau\left(1+\frac{\mathbf{x}^2}{2(c\tau)^2}-\frac{1}{8}\left(\frac{(\mathbf{x}^2)^2}{(c\tau)^4}\right)\ldots\right) \approx \pm\frac{\mathbf{x}^2}{2\tau c^2}\pm\tau$$

Choosing +, omitting second term on the right, and making substitutions $T \to -i\hbar\partial_E$ and $\mathbf{x} \to i\hbar\nabla_p$, we arrive at equation (4.20).

Equation (4.20) can be written as two coupled equations ($c=\hbar=1$):

$$\begin{pmatrix} \partial_E\psi_{\mathrm{Re}} = -\hat{T}\psi_{\mathrm{Im}} \\ \partial_E\psi_{\mathrm{Im}} = \hat{T}\psi_{\mathrm{Re}} \end{pmatrix} \quad \text{or} \quad \begin{pmatrix} \partial_E & \hat{T} \\ -\hat{T} & \partial_E \end{pmatrix}\begin{pmatrix} \psi_{\mathrm{Re}} \\ \psi_{\mathrm{Im}} \end{pmatrix} = 0 \quad (4.21)$$

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-like form) in momentum-energy space 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:

$$\begin{pmatrix} \rho = a_{e,+}a_{i,-} \\ S = (Et_x - \mathbf{p}\cdot\mathbf{x})_e \\ \zeta = (Et_x - \mathbf{p}\cdot\mathbf{x})_i \\ t_x = \dfrac{\mathbf{x}^2}{2\tau} \end{pmatrix} \tag{4.23}$$

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

$$Q = -\frac{1}{2\tau}(\nabla_p\zeta)^2 = \left(-\frac{\mathbf{x}^2}{2\tau}\right)_i = (-t_x)_i \tag{4.24}$$

which originates from spin i in:

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

Q would negate the non-relativistic kinetic time $t_x = \boldsymbol{x}^2/2\tau$ 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-like Equation is the non-relativistic approximation of equation (4.18) which is the determinant view of a fermion in an electromagnetic field in Dirac-like form within the momentum-energy space:

$$-i\partial_E\begin{pmatrix}\varphi_1\\ \varphi_2\end{pmatrix} = \left(\frac{1}{2\tau}(i\nabla - e\mathbf{A}_{\mathbf{p},\mathrm{E})})^2 - \frac{e}{2\tau}\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} + e\phi_{(\mathbf{p},\mathrm{E})}\right)\begin{pmatrix}\varphi_1\\ \varphi_2\end{pmatrix} \tag{4.24}$$

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 in the Premomentumenergy Model

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-like 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 potential 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-like or Weyl-like (chiral-like) form in the dual momentum-energy universe, for example:

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

$$\begin{pmatrix} t-|\mathbf{x}| & -\tau \\ -\tau & t+|\mathbf{x}| \end{pmatrix}\begin{pmatrix} a_{e,l}e^{+ip^{\mu}x_{\mu}} \\ a_{i,r}e^{+ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M\psi = 0 \tag{4.26}$$

The hadronized versions of the above equations in which the position is imaginary are respectively as follows:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,+}e^{+iEt} \\ s_{i,-}e^{+iEt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M\psi = 0 \tag{4.27}$$

$$\begin{pmatrix} t-|\mathbf{x}_i| & -\tau \\ -\tau & t+|\mathbf{x}_i| \end{pmatrix}\begin{pmatrix} s_{e,l}e^{+iEt} \\ s_{i,r}e^{+iEt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M\psi = 0 \tag{4.28}$$

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, it may step into the shoes played by the Higgs field of the standard model. Further, in this scenario, intrinsic proper time is created by the self-referential spin (imagination) of premomentumenergy.

5. Weak Interaction in the Premomentumenergy Model

In this model, weak interaction is an expressive process (emission or radiation) through fermionic spinization with or without intermediary bosonic spinization and the associated reverse process (capture or absorption). There are two possible kinds of mechanisms at play. One kind is the direct fermionic spinization of an unspinized massive particle as shown in § 3:

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-Det(\boldsymbol{\sigma}\cdot\mathbf{x})} \rightarrow \boldsymbol{\sigma}\cdot\mathbf{x} \tag{5.1}$$

that is, for example:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \rightarrow \begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \tag{5.2}$$

and the following reverse process:

$$\boldsymbol{\sigma}\cdot\mathbf{x}\rightarrow\sqrt{-Det(\boldsymbol{\sigma}\cdot\mathbf{x})}=\sqrt{\mathbf{x}^2}=|\mathbf{x}| \tag{5.3}$$

that is, for example:

$$\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}.\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e\\ \psi_i\end{pmatrix}=0\rightarrow\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e\\ \psi_i\end{pmatrix}=0 \tag{5.4}$$

Processes (5.1) and (5.3) only conserve spin in the dual universe as a whole. If they hold in reality, neutrino may not be needed in the weak interaction in this model.

Accordingly, beta decay of a neutron may involve the spinizing process (5.1) during which an unspinized proton (or electron) gains its spin 1/2 and a bound spinized electron becomes free as follows:

(1) Spinless Proton → Spinized Proton → Release of Bound Electron; or

(2) Spinless Electron → Spinized Electron → Release of Spinized Electron.

Process (1) seems in closer agreement with experimental data on *g*-factor and charge density of neutron. There is no exchange particle involved in process (1) or (2). In neutron synthesis from proton and electron, if it exists, the reverse process (5.3) occurs in this model during which a spinized proton (or electron) loses its spin and free electron becomes tightly bound to proton.

We suggest that the following equation governs free unspinized particles having intrinsic proper time τ and charge e respectively but spinless, that is, they are pion-like particles (their combination generates π^0 -like particles):

$$\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e\\ \psi_i\end{pmatrix}=0 \quad \text{or} \quad \begin{pmatrix}(t-\tau)\psi_e=|\mathbf{x}|\psi_i\\ (t+\tau)\psi_i=|\mathbf{x}|\psi_e\end{pmatrix} \tag{5.5}$$

After spinization through (5.1), we arrive at Dirac-like equation:

$$\begin{pmatrix} t-\tau & -\sigma\cdot\mathbf{x} \\ -\sigma\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e\\ \psi_i\end{pmatrix}=0 \quad \text{or} \quad \begin{pmatrix}(t-\tau)\psi_e=\boldsymbol{\sigma}\cdot\mathbf{x}\psi_i\\ (t+\tau)\psi_i=\boldsymbol{\sigma}\cdot\mathbf{x}\psi_e\end{pmatrix} \tag{5.6}$$

Assuming a plane wave $\psi_{e,+}=e^{+ip^\mu x_\mu}$ exists for equation (5.5), we obtain the following solution for said equation (π^--like plane-wave solution):

$$\begin{pmatrix}\psi_{e,+}\\ \psi_{i,-}\end{pmatrix}=\sqrt{\frac{t+\tau}{2t}}\begin{pmatrix}e^{+ip^{\mu}x_{\mu}}\\ \frac{|\mathbf{x}|}{t+\tau}e^{+ip^{\mu}x_{\mu}}\end{pmatrix}=N\begin{pmatrix}1\\ \frac{|\mathbf{x}|}{t+\tau}\end{pmatrix}e^{+ip^{\mu}x_{\mu}} \quad (5.7)$$

where N is a normalization factor and we have utilized the following relation for a time eigenstate:

$$(t+\tau)\psi_{i,-}=|\mathbf{x}|\psi_{e,+}\rightarrow\psi_{i,-}=\frac{|\mathbf{x}|}{t+\tau}\psi_{e,+} \quad (5.8)$$

After spinization of solution (5.7):

$$\begin{pmatrix}1\\ \frac{|\mathbf{x}|}{t+\tau}\end{pmatrix}\rightarrow\begin{pmatrix}1 & 0\\ 0 & 1\\ \frac{\sigma\cdot\mathbf{x}}{t+\tau}\end{pmatrix}=\begin{pmatrix}1 & 0\\ 0 & 1\\ \frac{z}{t+\tau} & \frac{x-iy}{t+\tau}\\ \frac{x+iy}{t+\tau} & \frac{-z}{t+\tau}\end{pmatrix} \quad (5.9)$$

we arrive at the free plane-wave electron solution for Dirac-like equation (5.6) in the dual universe comprised of the external momentum-energy space and the internal momentum-energy space:

$$\begin{pmatrix}\psi^{\uparrow}_{e,+}\\ \psi_{i,-}\end{pmatrix}=\sqrt{\frac{t+\tau}{2t}}\begin{pmatrix}1\\ 0\\ \frac{z}{t+\tau}\\ \frac{x+iy}{t+\tau}\end{pmatrix}e^{+ip^{\mu}x_{\mu}} \text{ and } \begin{pmatrix}\psi^{\downarrow}_{e,+}\\ \psi_{i,-}\end{pmatrix}=\sqrt{\frac{t+\tau}{2t}}\begin{pmatrix}0\\ 1\\ \frac{x-iy}{t+\tau}\\ \frac{-z}{t+\tau}\end{pmatrix}e^{+ip^{\mu}x_{\mu}} \quad (5.10)$$

In the above solutions for external spin up and down respectively, the external spin 1/2 is balanced by the internal spin components which may be deemed as antineutrino such that the total spin in the dual universe is still conserved to zero. Therefore, in this model it may be that external spin up or down can be created without the need of a separate antineutrino in beta decay, if any excessive time Δt and/or position $\Delta\boldsymbol{x}$ are allowed to cancel each other in premomentumenergy:

$$\begin{pmatrix}e^{+i(E\Delta t-\mathbf{p}\cdot\mathbf{\Delta x})}\\ e^{+i(E\Delta t-\mathbf{p}\cdot\mathbf{\Delta x})}\end{pmatrix}\rightarrow e^{+i(E\Delta t-\mathbf{p}\cdot\mathbf{\Delta x})}e^{-i(E\Delta t-\mathbf{p}\cdot\mathbf{\Delta x})}=e^{+i(E\Delta t-\mathbf{p}\cdot\mathbf{\Delta x})-i(E\Delta t-\mathbf{p}\cdot\mathbf{\Delta x})}=e^{0}=1 \quad (5.11)$$

Further, if premomentumenergy allows the following bosonic spinization of massive spinless particle (e.g., as unstable particle with very short life-time):

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{x}+I_3)-Det\left(I_3\right)\right)} \leftrightarrow \mathbf{s}\cdot\mathbf{x} \tag{5.12}$$

that is, for example:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e \\ \psi_i\end{pmatrix}=0 \leftrightarrow \begin{pmatrix} t-\tau & -\mathrm{s}\cdot\mathbf{x} \\ -\mathrm{s}\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e \\ \psi_i\end{pmatrix}=0 \tag{5.13}$$

and/or

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{x}+I_3)-Det\left(I_3\right)\right)} \rightarrow \mathbf{s}\cdot\mathbf{x} \rightarrow (\boldsymbol{\sigma}\cdot\mathbf{x})_1 + (\boldsymbol{\sigma}\cdot\mathbf{x})_2 \tag{5.14}$$

that is, for example:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e \\ \psi_i\end{pmatrix}=0 \rightarrow \begin{pmatrix} t-\tau & -\mathrm{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e \\ \psi_i\end{pmatrix}=0 \tag{5.15}$$

$$\rightarrow \left(\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix}\psi_e \\ \psi_i\end{pmatrix}=0\right)_1 \left(\begin{pmatrix} t & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix}\psi_e \\ \psi_i\end{pmatrix}=0\right)_2$$

during which transitory states similarly to vector bosons W^-, W^+ and/or Z^0 appear and disappear, we have from expression (5.14) the second kind of weak interactions. We point out here that only process (5.14) mediates weak interactions since in process (5.12) vector-boson-like particles are just transitory states that do not decay into fermions.

The spinized equation in expression (5.13) for a free massive spin 1 particle may take the following Dirac-like form:

$$\begin{pmatrix} t-\tau & -\mathrm{s}\cdot\mathbf{p} \\ -\mathrm{s}\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix}\psi_{e,+} \\ \psi_{i,-}\end{pmatrix} = L_M\begin{pmatrix}\psi_{e,+} \\ \psi_{i,-}\end{pmatrix} = L_M\begin{pmatrix}\mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ i\mathbf{B}_{(\mathbf{p},\mathrm{E})}\end{pmatrix} = L_M\psi = 0 \tag{5.16}$$

or

$$\begin{pmatrix} t-\tau & -\mathrm{s}\cdot\mathbf{x} \\ -\mathrm{s}\cdot\mathbf{x} & t+\tau \end{pmatrix}\begin{pmatrix}\psi_{e,-} \\ \psi_{i,+}\end{pmatrix} = L_M\begin{pmatrix}\psi_{e,-} \\ \psi_{i,+}\end{pmatrix} = L_M\begin{pmatrix}i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \\ \mathbf{E}_{(\mathbf{p},\mathrm{E})}\end{pmatrix} = L_M\psi = 0 \tag{5.17}$$

After calculating the determinant:

$$Det_s\begin{pmatrix} t-\tau & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t+\tau \end{pmatrix} = (t-\tau)(t+\tau)-(-\mathbf{s}\cdot\mathbf{x})(-\mathbf{s}\cdot\mathbf{x}) \tag{5.18}$$

We obtain the following:

$$Det_s\begin{pmatrix} t-\tau & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t+\tau \end{pmatrix} = \left(t^2-\mathbf{x}^2-\tau^2\right)I_3 - \begin{pmatrix} x^2 & xy & xz \\ yz & y^2 & yz \\ zx & zy & z^2 \end{pmatrix} \tag{5.19}$$

$$= \left(t^2-\mathbf{x}^2-\tau^2\right)I_3 - M_T$$

As mentioned in § 3, the last term M_T in expression (5.19) makes fundamental relation $t^2-\mathbf{x}^2-\tau^2=0$ not to hold in the determinant view (5.18) unless the action of M_T on the external and internal components of the wave function produces null result, that is:

$$M_T\begin{pmatrix} E_x \\ E_y \\ E_z \end{pmatrix} = -(\partial_{p_x}+\partial_{p_y}+\partial_{p_z})\nabla_{\mathbf{p}}\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = 0 \tag{5.20}$$

and

$$M_T\begin{pmatrix} B_x \\ B_y \\ B_z \end{pmatrix} = -(\partial_{p_x}+\partial_{p_y}+\partial_{p_z})\nabla_{\mathbf{p}}\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \tag{5.21}$$

Thus, if premomentumenergy allows these violations to exist transitorily, equations (5.16) and (5.17) may describe free vector bosons W^- and W^+ in the dual momentum-energy universe respectively; their combination then describes free vector boson Z^0 and M_T may be deemed as transitory intrinsic proper time (or intrinsic proper time operator).

In contrast to processes (1) and (2), vector bosons W^- and W^+ or the like mediate the spinization of spinless proton or electron respectively as follows:

(3) Spinless Proton → Spinized Vector Boson W^+ → Spinized Proton + Spinized 2nd Fermion → Release of Bound Electron + Spinized 2nd Fermion; and

(4) Spinless Electron → Spinized Vector Boson W^- → Spinized Electron + Spinized 2nd Fermion → Release of Spinized Electron + Spinized 2nd Fermion.

It is hoped that the metamorphous forms of matrix maw in § 3, their further metamorphoses and the corresponding wave functions that these laws govern will be able to accommodate all known particles of the particle zoo in the dual momentum-energy universe.

Very importantly, in this model there may be no parity violations in weak interactions such as beta decay as the apparent parity violation in the experiment may simply be explained as a spin polarization effect in which the spin polarization influences the dynamics and directions of the emitted electron in an external magnetic field. Also, there may be no need for Higgs boson to generate mass since mass is generated by self-referential spin at the power level of premomentumenergy, so the primordial particle of premomentumenergy is simply $1= e^{i0}$.

6. Electromagnetic Interaction in the Premomentumenergy Model

Electromagnetic interaction is an expressive process (radiation or emission) through bosonic spinization of an intrinsic-proper-time-less (massless) and spinless entity and the associated reverse process (absorption). In this model, there are possibly two kinds of mechanisms at play. One kind is the direct bosonic spinization (spinizing radiation):

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{x}+I_3)-Det\left(I_3\right)\right)} \rightarrow \mathbf{s}\cdot\mathbf{x} \tag{6.1}$$

that is, for example:

$$\begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \rightarrow \begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}.\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \tag{6.2}$$

and the following reverse process (unspinizing absorption):

$$\mathbf{s}\cdot\mathbf{x} \rightarrow \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{x}+I_3)-Det\left(I_3\right)\right)} = \sqrt{\mathbf{x}^2} = |\mathbf{x}| \tag{6.3}$$

that is, for example:

$$\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \rightarrow \begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \tag{6.4}$$

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 & Intrinsic-proper-time-less Particle → Bound Spinized Photon → Free Spinized Photon; and

(2) Free Spinized Photon → Bound Spinized Photon → Bound Spinless & & Intrinsic-proper-time-less Particle.

In this model, 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:

$$\begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \quad \text{or} \quad \begin{pmatrix} t\psi_e = |\mathbf{x}|\psi_i \\ t\psi_i = |\mathbf{x}|\psi_e \end{pmatrix} \tag{6.5}$$

we obtain the following solution for this equation:

$$\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}}\begin{pmatrix} e^{+ip^\mu x_\mu} \\ \frac{|\mathbf{x}|}{t} e^{+ip^\mu x_\mu} \end{pmatrix} = N\begin{pmatrix} 1 \\ \frac{|\mathbf{x}|}{t} \end{pmatrix} e^{+ip^\mu x_\mu} \tag{6.6}$$

where we have utilized the following relation for a time eigenstate and N is the normalization factor :

$$t\psi_{i,-} = |\mathbf{x}|\psi_{e,+} \rightarrow \psi_{i,-} = \frac{|\mathbf{x}|}{t}\psi_{e,+} \tag{6.7}$$

After spinization:

$$\frac{|\mathbf{x}|}{t} \rightarrow \frac{\mathbf{s}\cdot\mathbf{x}}{t} = \begin{pmatrix} 0 & \frac{-iz}{t} & \frac{iy}{t} \\ \frac{iz}{t} & 0 & -\frac{ix}{t} \\ -\frac{iy}{t} & \frac{ix}{t} & 0 \end{pmatrix} \tag{6.8}$$

We arrive at the plane-wave solution:

$$\begin{pmatrix} \psi^x_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}}\begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ \frac{iz}{t} \\ \frac{-iy}{t} \end{pmatrix} e^{+ip^\mu x_\mu} \quad \begin{pmatrix} \psi^y_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}}\begin{pmatrix} 0 \\ 1 \\ 0 \\ \frac{-iz}{t} \\ 0 \\ \frac{ix}{t} \end{pmatrix} e^{-ip^\mu x_\mu} \quad \begin{pmatrix} \psi^z_{e,+} \\ \psi_{i,-} \end{pmatrix} = \sqrt{\frac{1}{2}}\begin{pmatrix} 0 \\ 0 \\ 1 \\ \frac{iy}{t} \\ \frac{-ix}{t} \\ 0 \end{pmatrix} e^{+ip^\mu x_\mu} \tag{6.9}$$

for the spinized photon equation:

$$\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \quad \text{or} \quad \begin{pmatrix} t\psi_e = \mathbf{s}\cdot\mathbf{x}\psi_i \\ t\psi_i = \mathbf{s}\cdot\mathbf{x}\psi_e \end{pmatrix} \tag{6.10}$$

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 $|\mathbf{x}| = \sqrt{\mathbf{x}^2} \to \mathbf{s}\cdot\mathbf{x}$, the Maxwell-like equations in the vacuum (c=1) in the dual momentum-energy universe are as follows:

$$\begin{pmatrix} \begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix} = 0 \\ \mathbf{x}\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = 0 \\ \mathbf{x}\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \end{pmatrix}, \begin{pmatrix} \begin{pmatrix} -i\partial_E & \nabla_p\times \\ \nabla_p\times & -i\partial_E \end{pmatrix}\begin{pmatrix} \mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix} = 0 \\ \nabla_p\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = 0 \\ \nabla_p\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \end{pmatrix}$$

$$\text{or} \begin{pmatrix} \partial_E\mathbf{E}_{(\mathbf{p},\mathrm{E})} = \nabla_p\times\mathbf{B}_{(\mathbf{p},\mathrm{E})} \\ \partial_t\mathbf{B}_{(\mathbf{p},\mathrm{E})} = -\nabla_p\times\mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ \nabla_p\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = 0 \\ \nabla_p\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \end{pmatrix} \tag{6.11}$$

If we calculate the determinant:

$$Det_s\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix} = t\cdot t - (-\mathbf{s}\cdot\mathbf{x})(-\mathbf{s}\cdot\mathbf{x}) \tag{6.12}$$

We obtain the following:

$$Det_s\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix} = (t^2 - \mathbf{x}^2)I_3 - \begin{pmatrix} x^2 & xy & xz \\ yz & y^2 & yz \\ zx & zy & z^2 \end{pmatrix} = (t^2 - \mathbf{x}^2)I_3 - M_T \tag{6.13}$$

The last term M_T in expression (6.13) makes fundamental relation $t^2 - \mathbf{x}^2 = 0$ not hold in the determinant view (6.12) unless the action of M_T on the external and internal components of the wave function produces null result, since equations (5.20) and (5.21) only hold in the source-free region of the dual momentum-energy universe.

At the location of a massive (i.e., intrinsic proper time is non-zero) charged particle such as an electron or proton, equations (5.20) and (5.21) are also violated by the photon. That is, the photon appears to have intrinsic proper time M_T at the source, thus in this model particle pairs may be created on collision of a photon with a massive charged particle. In the Maxwell-like equations, these violations are counter-balanced by adding source to the equations as discussed below. The Maxwell-like equations with source are, in turn, coupled to the Dirac-like Equation of the fermions such as electron or proton forming the Dirac-Maxwell-like system as further discussed in § 11.

Indeed, if source $j^{\mu} = \left(\rho_{(\mathbf{p},E)}, \mathbf{j}_{(\mathbf{p},E)}\right) \neq 0$ in the dual momentum-energy universe, we have instead:

$$\begin{pmatrix} \begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix} = \begin{pmatrix} i\mathbf{j}_{(\mathbf{p},\mathrm{E})} \\ 0 \end{pmatrix} \\ \mathbf{x}\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = i\rho_{(\mathbf{p},\mathrm{E})} \\ \mathbf{x}\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \end{pmatrix}, \begin{pmatrix} \begin{pmatrix} -i\partial_E & \nabla_p\times \\ \nabla_p\times & -i\partial_E \end{pmatrix}\begin{pmatrix} \mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix} = \begin{pmatrix} i\mathbf{j}_{(\mathbf{p},\mathrm{E})} \\ 0 \end{pmatrix} \\ \nabla_p\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = \rho_{(\mathbf{p},\mathrm{E})} \\ \nabla_p\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \end{pmatrix}$$

$$\text{or} \begin{pmatrix} \partial_E\mathbf{E}_{(\mathbf{p},\mathrm{E})} = \nabla_p\times\mathbf{B}_{(\mathbf{p},\mathrm{E})} - \mathbf{j}_{(\mathbf{p},\mathrm{E})} \\ \partial_t\mathbf{B}_{(\mathbf{p},\mathrm{E})} = -\nabla_p\times\mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ \nabla_p\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = \rho_{(\mathbf{p},\mathrm{E})} \\ \nabla_p\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \end{pmatrix} \tag{6.14}$$

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

$$\begin{pmatrix} t & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ i\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix} = 0 \tag{6.15}$$

which gives:

$$\begin{pmatrix} \begin{pmatrix} \partial_E & -\nabla_p\times \\ \nabla_p\times & \partial_E \end{pmatrix}\begin{pmatrix} \mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ \mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix} = 0 \\ \nabla_p\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} = 0 \\ \nabla_p\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \end{pmatrix} \tag{6.16}$$

If source $j^{\mu}=\left(\rho_{(\mathbf{p},E)},\mathbf{j}_{(\mathbf{p},E)}\right)\neq 0$, we have:

$$\begin{pmatrix} t & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ i\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})} \end{pmatrix}=\begin{pmatrix} i\boldsymbol{\sigma}\cdot\mathbf{j}_{(\mathbf{p},\mathrm{E})} \\ i\rho_{(\mathbf{p},\mathrm{E})} \end{pmatrix} \tag{6.17}$$

which gives:

$$\begin{pmatrix} \partial_E\mathbf{E}_{(\mathbf{p},\mathrm{E})}=\nabla_p\times\mathbf{B}_{(\mathbf{p},\mathrm{E})}-\mathbf{j}_{(\mathbf{p},\mathrm{E})} \\ \partial_t\mathbf{B}_{(\mathbf{p},\mathrm{E})}=-\nabla_p\times\mathbf{E}_{(\mathbf{p},\mathrm{E})} \\ \nabla_p\cdot\mathbf{E}_{(\mathbf{p},\mathrm{E})}=\rho_{(\mathbf{p},\mathrm{E})} \\ \nabla_p\cdot\mathbf{B}_{(\mathbf{p},\mathrm{E})}=0 \end{pmatrix} \tag{6.18}$$

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 $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and $i\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ to spin $\boldsymbol{\sigma}$.

Further, we point out here that for a linear photon its electric field $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ is the external wave function (external object) and its magnetic field $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ is the internal wave function (internal object) in this model. These two fields are always self-entangled and their entanglement is their self-gravity. Therefore, the relation between $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ in a propagating electromagnetic wave in the momentum-energy universe is not that change in $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ induces $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ *vice versa* but that change in $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ is always accompanied by change in $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ synchronously *vice versa* due to their entanglement (self-gravity). That is, the relationship between $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ are gravitational and instantaneous.

7. Strong Interaction in the Premomentumenergy Model

While weak and electromagnetic interactions are expressive processes involving fermionic and bosonic spinizations of spinless entities (the third state of matter) and their respective reverse processes, strong interaction in this model does not involve spinization, that is, strong force is a confining process. It may be assumed that spinless entities in general are unstable and decay through fermionic or bosonic spinization. In order to achieve confinement of a nucleon or stability of the nucleus, we suggest that strong interaction may involve imaginary position in the confinement zone in the dual momentum-energy universe as illustrated below. There are two types of strong interactions at play. One is the self-confinement of a nucleon such as a proton and the other is the interaction among nucleons such a proton and a neutron.

In the Standard Model, a proton is a composite entity comprised of three quarks confined by massless gluons and the interaction among the nucleons is mediated by mesons comprised of pairs of a quark and an antiquark which in turn interact through gluons. However, since no free quarks have been observed, there may be good reason to consider other options. We have suggested in § 3 that the proton may be considered as an elementary particle that accomplishes momentum self-confinement through downward self-reference (imaginary position).

Here, we will first derive the condition for producing momentum self-confinement of the nucleon in the dual momentum-energy universe and the Yukawa-like potential. The equation for a massive but spinless entity in Dirac-like Form is as follows:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & t+\tau \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \quad \text{or} \quad \begin{pmatrix} (t-\tau)\psi_e = |\mathbf{x}|\psi_i \\ (t+\tau)\psi_i = |\mathbf{x}|\psi_e \end{pmatrix} \tag{7.1}$$

Assuming that the wave function has time eigenstate -*t* (that is, the external and internal wave functions have time eigenstate -*t* and +*t* respectively in the determinant view), we can write:

$$(t-\tau)\psi_e = |\mathbf{x}|\psi_i \rightarrow (t-\tau)e^{-iEt}\phi_e(\mathbf{p}) = |\mathbf{x}|e^{-iEt}\phi_i(\mathbf{p}) \rightarrow (-t-\tau)\phi_e(\mathbf{p}) = |\mathbf{x}|\phi_i(\mathbf{p}) \tag{7.2}$$

$$(t+\tau)\psi_i = |\mathbf{x}|\psi_e \rightarrow (t+\tau)e^{-iEt}\phi_i(\mathbf{p}) = |\mathbf{x}|e^{-iEt}\phi_e(\mathbf{p}) \rightarrow \phi_i(\mathbf{p}) = \frac{|\mathbf{x}|}{-t+\tau}\phi_e(\mathbf{p}) \tag{7.3}$$

From expressions (7.2) and (7.3), we can derive the following:

$$(t^2-\tau^2-\mathbf{x}^2)\phi_i(\mathbf{p}) = 0 \quad \text{or} \quad (t^2-\tau^2+\nabla_p{}^2)\phi_i(\mathbf{p}) = 0 \tag{7.4}$$

Equation (7.4) has radial solution as follows:

$$\phi_i(p) = \frac{1}{4\pi p}e^{-ip\sqrt{t^2-\tau^2}} \tag{7.5}$$

Then, we have from expression (7.3):

$$\phi_e(p) = \frac{|\mathbf{x}|}{-t-\tau}\phi_i(p) = \frac{-|\mathbf{x}|}{t+\tau}\frac{1}{4\pi p}e^{-ip\sqrt{t^2-\tau^2}} \tag{7.6}$$

where we may utilize the following conjecture:

$$|\mathbf{x}|\phi_i(p) = \sqrt{-\nabla_p{}^2}\,\frac{1}{4\pi p}e^{-ip\sqrt{t^2-\tau^2}} \rightarrow \sqrt{t^2-\tau^2}\,\frac{1}{4\pi p}e^{-ip\sqrt{t^2-\tau^2}} \tag{7.7}$$

The complete radial solution of equation (7.1) for time eigenstate -*t* in Dirac-like form is:

$$\psi(E,p) = \begin{pmatrix} \psi_{e,-}(E,p) \\ \psi_{i,+}(E,p) \end{pmatrix} = N\begin{pmatrix} \frac{-|\mathbf{x}|}{t+\tau}\frac{1}{4\pi p}e^{-iEt-ip\sqrt{t^2-\tau^2}} \\ \frac{1}{4\pi p}e^{-iEt-ip\sqrt{t^2-\tau^2}} \end{pmatrix} = N\begin{pmatrix} \frac{-|\mathbf{x}|}{t+\tau} \\ 1 \end{pmatrix}\frac{1}{4\pi p}e^{-iEt-ip\sqrt{t^2-\tau^2}} \tag{7.8}$$

where N is a normalization factor.

When $\tau^2>t^2$, that is, when the position in $t^2-\tau^2=\boldsymbol{x}^2$ is imaginary, we have from (7.8):

$$\psi(E,p)=\begin{pmatrix}\psi_{e,-}(E,p)\\ \psi_{i,+}(E,p)\end{pmatrix}=N\begin{pmatrix}\frac{-|\mathbf{x}|}{t+\tau}\frac{1}{4\pi p}e^{-iEt-p\sqrt{\tau^2-t^2}}\\ \frac{1}{4\pi p}e^{-iEt-p\sqrt{\tau^2-t^2}}\end{pmatrix}=N\begin{pmatrix}\frac{-|\mathbf{x}|}{t+\tau}\\ 1\end{pmatrix}\frac{1}{4\pi p}e^{-iEt-p\alpha} \quad (7.9)$$

where $\alpha=\sqrt{\tau^2-t^2}$.

Now, if we consider the special case of an energy-less, spinless but massive entity in which *t=0*, we have from (7.9):

$$\psi(p)=\begin{pmatrix}\psi_e\\ \psi_i\end{pmatrix}=N\begin{pmatrix}\frac{-|\mathbf{x}|}{\tau}\frac{1}{4\pi p}e^{-p\tau}\\ \frac{1}{4\pi p}e^{-p\tau}\end{pmatrix}=N\begin{pmatrix}\frac{-|\mathbf{x}|}{\tau}\\ 1\end{pmatrix}\frac{1}{4\pi p}e^{-p\tau} \quad (7.10)$$

Thus, the internal and external wave functions in expression (7.10) have the form of Yukawa-like potential and its negative imaginary projection, respectively.

We suggest that the interior (confinement zone) of an unspinized nucleon is described by wave functions similar to expressions (7.9) or (7.10) in the dual momentum-energy universe and confinement is achieved through downward self-reference (imaginary position $\mathbf{x}_i$). Therefore, in this scenario, the three colors of the strong force are the three-dimensional imaginary position $\mathbf{x}_i$. Further, another implication of this scenario is that in the Machian quantum universe the energy-less edge or the outside of this dual momentum universe (which is embedded in premomentumenergy) is connected to or simply is the enegy-less inside of the nucleons.

If we assume that the internal wave function ψ_i (which is self-coupled to the external wave function ψ_e through expression (7.1)) also couples with the external wave function χ_e of another entity (which is also self-coupled to its internal wave function χ_i) as, for example:

$$-g^2\psi_i\chi_e=-g^2\frac{1}{4\pi p}e^{-\tau p}\chi_e=-\frac{g^2}{p}e^{-\tau p}\chi_e \quad (7.11)$$

where $-g^2$ is a coupling constant, we can write part of the nuclear potential of a nucleon as follows:

$$V=-\frac{g^2}{p}e^{-\tau p} \quad (7.12)$$

which is in the form of Yukawa-like Potential.

We now discuss the unspinized and spinized forms of proton. The spinized proton in the duel momentum-energy universe is the commonly known form of proton and we suggest that the unspinized proton may reside in the neutron comprised of the unspinized proton and a spinized electron as illustrated in § 3. The equations for a free unspinized and spinized proton in Dirac Form are respectively as follows:

$$\begin{pmatrix} t-\tau & -|\mathbf{x}_i| \\ -|\mathbf{x}_i| & t+\tau \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix}=0 \tag{7.13}$$

and

$$\begin{pmatrix} t-\tau & -\sigma\cdot\mathbf{X}_i \\ -\sigma\cdot\mathbf{X}_i & t+\tau \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix}=0 \tag{7.14}$$

where $\mathbf{x}_i$ is imaginary position. From the above derivation, we may write the wave function of an unspinized proton with external and internal time eigenstate $-t$ and $+t$ respectively as follows (by convention, electron has positive external time $+t$ and internal time $-t$):

$$\psi(E,p)=\begin{pmatrix} \psi_{e,-}(E,p) \\ \psi_{i,+}(E,p) \end{pmatrix}=N\begin{pmatrix} \dfrac{-|\mathbf{x}_i|}{t+\tau}\dfrac{1}{4\pi p}e^{-iEt-p\alpha} \\ \dfrac{1}{4\pi p}e^{-iEt-p\alpha} \end{pmatrix}=N\begin{pmatrix} -i\beta \\ 1 \end{pmatrix}e^{-iEt}\frac{1}{4\pi r}e^{-p\alpha} \tag{7.15}$$

In contrast, an unspinized antiproton with external and internal time eigenstate $+t$ and $-t$ respectively may have the following wave function:

$$\psi(E,p)=\begin{pmatrix} \psi_{e,+}(E,p) \\ \psi_{i,-}(E,p) \end{pmatrix}=N\begin{pmatrix} \dfrac{1}{4\pi p}e^{+iEt-p\alpha} \\ \dfrac{|\mathbf{x}_i|}{t+\tau}\dfrac{1}{4\pi p}e^{+iEt-p\alpha} \end{pmatrix}=N\begin{pmatrix} 1 \\ i\beta \end{pmatrix}e^{+iEt}\frac{1}{4\pi p}e^{-p\alpha} \tag{7.16}$$

According to this scenario, the nuclear spin of the neutron in the dual momentum-energy universe is solely due to the tightly bound spinized electron. Indeed, experimental data on charge distribution and *g*-factor of neutron supports this scenario. We further suggest that the nuclear potential causing tight binding of the spinized electron in the neutron may have the form of expression (7.12). Detailed consideration will be given elsewhere.

The wave function of spinized proton described by equation (7.14) can be obtained by spinizing the solution in expression (7.15) as follows:

$$|\mathbf{x}_i|=\sqrt{\mathbf{x}_i^2}=\sqrt{-Det\boldsymbol{\sigma}\cdot\mathbf{X}_i}\rightarrow\boldsymbol{\sigma}\cdot\mathbf{X}_i=i\boldsymbol{\sigma}\cdot\nabla \tag{7.17}$$

$$=i\left(\left(\frac{\partial}{\partial_p}+\frac{1}{p}\right)\pm i\frac{j+1/2}{p}\right)I_2=\left(i\left(\frac{\partial}{\partial_p}+\frac{1}{p}\right)\mp\frac{j+1/2}{p}\right)I_2$$

where j is the total angular momentum number. Choosing j=1/2, we obtain from expression

(7.15) two sets of solutions as follows:

$$\psi(E,p)=\begin{pmatrix}\psi_{e,-}(E,p)\\ \psi_{i,+}(E,p)\end{pmatrix}=N\begin{pmatrix}\frac{-(1/p+i\alpha)}{t+\tau}\frac{1}{4\pi p}e^{-iEt-r\alpha}\\ 0\\ \frac{1}{4\pi p}e^{-iEt-p\alpha}\\ 0\end{pmatrix}=N\begin{pmatrix}\frac{-(1/p+i\alpha)}{t+\tau}\\ 0\\ 1\\ 0\end{pmatrix}\frac{1}{4\pi p}e^{-iEt-p\alpha} \quad (7.18)$$

$$\psi(E,p)=\begin{pmatrix}\psi_{e,-}(E,p)\\ \psi_{i,+}(E,p)\end{pmatrix}=N\begin{pmatrix}0\\ \frac{-(-1/p+i\alpha)}{t+\tau}\frac{1}{4\pi p}e^{-iEt-p\alpha}\\ 0\\ \frac{1}{4\pi p}e^{-iEt-p\alpha}\end{pmatrix}=N\begin{pmatrix}0\\ \frac{-(-1/p+i\alpha)}{t+\tau}\\ 0\\ 1\end{pmatrix}\frac{1}{4\pi p}e^{-iEt-p\alpha} \quad (7.19)$$

where $\alpha=\sqrt{\tau^2-t^2}$. In the case of energy-less proton (that is, when t=0), we have from expressions (7.18) and (7.19) the following:

$$\psi(E,p)=\begin{pmatrix}\psi_{e,-}(E,p)\\ \psi_{i,+}(E,p)\end{pmatrix}=N\begin{pmatrix}-\left(\frac{1}{\tau p}+i\right)\frac{1}{4\pi p}e^{-\tau p}\\ 0\\ \frac{1}{4\pi p}e^{-\tau p}\\ 0\end{pmatrix}=N\begin{pmatrix}-\frac{1}{\tau p}-i\\ 0\\ 1\\ 0\end{pmatrix}\frac{1}{4\pi p}e^{-\tau p} \quad (7.18)$$

$$\psi(E,p)=\begin{pmatrix}\psi_{e,-}(E,p)\\ \psi_{i,+}(E,p)\end{pmatrix}=N\begin{pmatrix}0\\ \left(\frac{1}{\tau p}-i\right)\frac{1}{4\pi p}e^{-\tau p}\\ 0\\ \frac{1}{4\pi p}e^{-\tau p}\end{pmatrix}=N\begin{pmatrix}0\\ \frac{1}{\tau p}-i\\ 0\\ 1\end{pmatrix}\frac{1}{4\pi p}e^{-\tau p} \quad (7.19)$$

In this scenario, spinization of unspinized proton may cause loss of tight binding of spinized electron to unspinized proton the possible cause of which will be considered elsewhere.

8. Gravity (Quantum Entanglement) in the Premomentumenergy Model

Gravity in the dual momentum-energy universe is quantum entanglement (instantaneous interaction) across the dual momentum-energy world. 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. 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 in the dual momentum-energy universe may be strong quantum entanglement (strong gravity).

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

As shown below, energy-less quantum entanglement between two entities accounts for Newtonian-like gravity. Momentum-less and/or proper-timesless quantum entanglement between two entities may account for dark matter. Importantly, gravitational components related to spinization may account for dark energy.

When t=0, we have from fundamental relationship (3.4):

$$-\tau^2 - \mathbf{x}^2 = 0 \quad \text{or} \quad \tau^2 + \mathbf{x}^2 = 0 \tag{8.1}$$

We can regard expression (8.1) as a relationship governing the Machian-like quantum universe in which the total time is zero. This may be seen as: (1) the intrinsic proper time τ being comprised of imaginary position $\mathbf{x}=i\mathbf{x}_i$, or (2) position $\mathbf{x}$ being comprised of imaginary intrinsic proper time $\tau=i\tau_i$.

As shown in § 3, the energy-less matrix law in Dirac-like and Weyl-like form is respectively the following:

$$\begin{pmatrix} -\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & +\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{8.2}$$

$$\begin{pmatrix} -|\mathbf{x}| & -\tau \\ -\tau & +|\mathbf{x}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{8.3}$$

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

$$\begin{pmatrix} -\tau & -|\mathbf{x}| \\ -|\mathbf{x}| & +\tau \end{pmatrix} \begin{pmatrix} g_{D,e}e^{+iM} \\ g_{D,i}e^{+iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = L_M V_D = 0 \tag{8.4}$$

and

$$\begin{pmatrix} -|\mathbf{x}| & -\tau \\ -\tau & +|\mathbf{x}| \end{pmatrix} \begin{pmatrix} g_{W,e}e^{+iM} \\ g_{W,i}e^{+iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = L_M V_W = 0 \tag{8.5}$$

Equation (8.4) and (8.5) can be respectively rewritten as:

$$\begin{pmatrix} \tau V_{D,e} = -|\mathbf{x}| V_{D,i} \\ \tau V_{D,i} = |\mathbf{x}| V_{D,e} \end{pmatrix} \text{ or } \begin{pmatrix} V_{D,e} = -\frac{|\mathbf{x}|}{\tau} V_{D,i} \\ V_{D,i} = \frac{|\mathbf{x}|}{\tau} V_{D,e} \end{pmatrix} \tag{8.6}$$

and

$$\begin{pmatrix} \tau V_{W,e} = |\mathbf{x}| V_{W,i} \\ \tau V_{W,i} = -|\mathbf{x}| V_{W,e} \end{pmatrix} \text{ or } \begin{pmatrix} V_{W,e} = \frac{|\mathbf{x}|}{\tau} V_{W,i} \\ V_{W,i} = -\frac{|\mathbf{x}|}{\tau} V_{W,e} \end{pmatrix} \tag{8.7}$$

To see the coupling of external and internal wave functions (self-fields) in a different perspective we can rewrite (8.6) and (8.7) respectively as follows:

$$\begin{pmatrix} \tau\tau V_{D,e} V_{D,i} = \left(-|\mathbf{x}| V_{D,i}\right)\left(|\mathbf{x}| V_{D,e}\right) \\ \left(|\mathbf{x}| V_{D,e}\right)\left(\tau V_{D,e}\right) = \left(\tau V_{D,i}\right)\left(-|\mathbf{x}| V_{D,i}\right) \end{pmatrix} \tag{8.8}$$

and

$$\begin{pmatrix} \tau\tau V_{W,e} V_{W,i} = \left(|\mathbf{x}| V_{W,i}\right)\left(-|\mathbf{x}| V_{W,e}\right) \\ \left(-|\mathbf{x}| V_{W,e}\right)\left(\tau V_{W,e}\right) = \left(\tau V_{W,i}\right)\left(-|\mathbf{x}| V_{W,i}\right) \end{pmatrix} \tag{8.9}$$

From expression (8.6), we can derive the following:

$$\left(\tau^2 + \mathbf{x}^2\right) V_{D,e} = 0 \quad \text{or} \quad \left(\tau^2 - \nabla^2\right) V_{D,e} = 0 \tag{8.10}$$

Equation (8.10) has radial solution in the form of Yukawa potential:

$$V_{D,e}(p) = \frac{1}{4\pi p} e^{-\tau p} \tag{8.11}$$

So in expression (8.4), M=-$i\tau p$, that is, position is comprised of imaginary intrinsic proper time. The external energy-less self-field in expression (8.11) has the form of Newton-like gravitational or Coulomb-like electric potential at large momentum $p\to\infty$. We have from expression (8.6):

$$V_{D,i} = \frac{|\mathbf{x}|}{\tau} V_{D,e} = \frac{|\mathbf{x}|}{\tau} \frac{1}{4\pi p} e^{-\tau p} \to i \frac{1}{4\pi p} e^{-\tau p} \tag{8.12}$$

where we have utilized the following conjecture:

$$|\mathbf{x}| V_{D,e} = \sqrt{-\nabla_p^{\ 2}} \frac{1}{4\pi p} e^{-\tau p} \to i\tau \frac{1}{4\pi p} e^{-\tau p} \tag{8.13}$$

The complete radial solution of equation (8.4) is then:

$$V_D(p) = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N \begin{pmatrix} \frac{1}{4\pi p} e^{-\tau p} \\ i \frac{1}{4\pi p} e^{-\tau p} \end{pmatrix} = N \begin{pmatrix} 1 \\ i \end{pmatrix} \frac{1}{4\pi p} e^{-\tau p} \tag{8.14}$$

where N is a normalization factor. Indeed, expression (8.7) can have same radial solution as expression (8.6):

$$V_W(p) = \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = N \begin{pmatrix} \frac{1}{4\pi p} e^{-\tau p} \\ i \frac{1}{4\pi p} e^{-\tau p} \end{pmatrix} = N \begin{pmatrix} 1 \\ i \end{pmatrix} \frac{1}{4\pi p} e^{-\tau p} \tag{8.15}$$

If we assume that the internal self-field $V_{D,i}$ (which is self-coupled to its external self-field $V_{D,e}$ through expression (8.4) or (8.8)) also couples through energy-less quantum entanglement with the external wave function ψ_e of another entity of test intrinsic-proper-time τ_t (which is also self-coupled to its internal wave function ψ_i) as, for example:

$$i\kappa\tau V_{D,i} \tau_t \psi_e = i\kappa\tau i \frac{1}{4\pi r} e^{-\tau p} \tau_t \psi_e = -G \frac{\tau}{p} e^{-\tau p} \tau_t \psi_e \tag{8.16}$$

where $i\kappa$ is a coupling constant and $G=\kappa/4\pi$ is Newton-like Gravitational Constant, we have gravitational-like potential at large momentum $p\to\infty$ as:

$$V_g = -G \frac{\tau}{p} \tag{8.17}$$

When $|\mathbf{x}|=0$, we have from fundamental relationship (3.4):

$$t^2 - \tau^2 = 0 \tag{8.18}$$

We can regard expression (8.6) as a relationship governing a momemtum-less quantum universe. Classically, this may be seen as the intrinsic-proper-time τ being comprised of energy-position (time t). As shown in § 3, the momemtum-less Matrix Law in Dirac and Weyl form is respectively the following:

$$\begin{pmatrix} t-\tau & 0 \\ 0 & t+\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{8.19}$$

and

$$\begin{pmatrix} t & -\tau \\ -\tau & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{8.20}$$

and the equation of momemtum-less wave functions (self- fields) are respectively the follows:

$$\begin{pmatrix} t-\tau & 0 \\ 0 & t+\tau \end{pmatrix} \begin{pmatrix} g_{D,e} e^{+i\tau E} \\ g_{D,i} e^{+i\tau E} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = L_M V_D = 0 \tag{8.21}$$

and

$$\begin{pmatrix} t & -\tau \\ -\tau & t \end{pmatrix} \begin{pmatrix} g_{W,e} e^{+i\tau E} \\ g_{W,i} e^{+i\tau E} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = L_M V_W = 0 \tag{8.22}$$

The external and internal (momentum-less) wave functions $V_{D,e}$ and $V_{D,i}$ in equation (8.21) are decoupled from each other, but those in equation (8.22), $V_{W,e}$ and $V_{W,i}$, are coupled to each other:

$$\begin{pmatrix} tV_{D,e} = \tau V_{D,e} \\ tV_{D,i} = -\tau V_{D,i} \end{pmatrix} \text{ but } \begin{pmatrix} tV_{W,e} = \tau V_{W,i} \\ tV_{W,i} = \tau V_{W,e} \end{pmatrix} \tag{8.23}$$

It can be easily verified that the solutions to equation (8.21) are in forms of:

$$V_D = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N \begin{pmatrix} 1e^{+i\tau E} \\ 0e^{+i\tau E} \end{pmatrix} = N \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{+i\tau E} \tag{8.24}$$

or

$$V_D = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N \begin{pmatrix} 0e^{-i\tau E} \\ 1e^{-i\tau E} \end{pmatrix} = N \begin{pmatrix} 0 \\ 1 \end{pmatrix} e^{-i\tau E} \tag{8.25}$$

but the solutions to equation (8.22) are in the forms of:

$$V_W = \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = N \begin{pmatrix} 1e^{+i\tau E} \\ 1e^{+i\tau E} \end{pmatrix} = N \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{+i\tau E} \tag{8.26}$$

or

$$V_W = \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = N \begin{pmatrix} 1e^{-i\tau E} \\ 1e^{-i\tau E} \end{pmatrix} = N \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{-i\tau E} \tag{8.27}$$

We shall illustrate below momentum-less quantum entanglements (gravity) between two entities. For simplicity, we will consider two intrinsic-proper-times $\tau_1+\tau_p$ and τ_2 respectively located at momentum points 1 and 2. Their respective momentum-less wave functions may be be written in Weyl-like form as follows:

$$V_{1W+} = \begin{pmatrix} g_{1W+,e} e^{=i\left(\tau_1+\tau_p\right)E} \\ g_{1W+,i} e^{-i\left(\tau_1+\tau_p\right)E} \end{pmatrix} \quad \text{and} \quad V_{2W-} = \begin{pmatrix} g_{2W-,e} e^{+i\tau_2 E} \\ g_{2W-,i} e^{-i\tau_2 E} \end{pmatrix} \tag{8.28}$$

which form product state $V_{1W+}V_{2W-}$. After τ_p leaves V_{1W+} as an emitted particle and get absorbed by V_{2W-}, we may have the following two additional momentum-less wave functions in Weyl-like form:

$$V_{1W-} = \begin{pmatrix} g_{1W-,e} e^{+i\tau_1 E} \\ g_{1W-,i} e^{+i\tau_1 E} \end{pmatrix} \quad \text{and} \quad V_{2W+} = \begin{pmatrix} g_{2W+,e} e^{+i\left(\tau_2+\tau_p\right)t} \\ g_{2W+,i} e^{+i\left(\tau_2+\tau_p\right)t} \end{pmatrix} \tag{8.29}$$

which form product state $V_{1W-}V_{2W+}$. The final momentum-less quantum state may be written as follows:

$$V = \frac{1}{\sqrt{2}}\left(V_{1W+}V_{2W-} + V_{1W-}V_{2W+}\right) = \frac{1}{\sqrt{2}}\left(\left|1+\right\rangle\left|2-\right\rangle + \left|1-\right\rangle\left|2+\right\rangle\right) \tag{8.30}$$

In this joint momentum-less wavefunction, τ_1 and τ_2 are quantum entangled due to interaction with and through τ_p.

When τ=0, we have from fundamental relationship (3.4):

$$t^2 - \mathbf{x}^2 = 0 \tag{8.31}$$

We can regard expression (8.11) as a relationship governing the intrinsic-proper-time-less quantum universe in which the total intrinsic proper time (rest mass) is zero. Classically, this may be seen as time t being comprised of position $\mathbf{x}$. As shown in § 3, the intrinsic-proper-time-less matrix law in Dirac-like and Weyl-like form is respectively the following:

$$\begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{8.32}$$

and

$$\begin{pmatrix} t-|\mathbf{x}| & 0 \\ 0 & t+|\mathbf{x}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{8.33}$$

and the equations of intrinsic-proper-time-less wave functions (self-fields) are respectively the following:

$$\begin{pmatrix} t & -|\mathbf{x}| \\ -|\mathbf{x}| & t \end{pmatrix}\begin{pmatrix} g_{D,e}e^{+iM} \\ g_{D,i}e^{+iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = L_M V_D = 0 \tag{8.34}$$

and

$$\begin{pmatrix} t-|\mathbf{x}| & 0 \\ 0 & t+|\mathbf{x}| \end{pmatrix}\begin{pmatrix} g_{W,e}e^{+iM} \\ g_{W,i}e^{+iM} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = L_M V_W = 0 \tag{8.35}$$

Equations (8.34) and (8.35) have plane-wave solutions. The external and internal (masssless) wave functions $V_{D,e}$ and $V_{D,i}$ in equation (8.34) are coupled with each other, but those in equations (8.35), $V_{W,e}$ and $V_{W,i}$, are decoupled from each other:

$$\begin{pmatrix} tV_{D,e} = |\mathbf{x}|V_{D,i} \\ tV_{D,i} = |\mathbf{x}|V_{D,e} \end{pmatrix} \text{ but } \begin{pmatrix} tV_{W,e} = |\mathbf{x}|V_{W,e} \\ tV_{W,i} = -|\mathbf{x}|V_{W,i} \end{pmatrix} \tag{8.36}$$

For eigenstate of t and |**p**|, the solutions to equation (8.34) are in the forms of:

$$V_D = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N\begin{pmatrix} 1e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ \frac{|\mathbf{x}|}{t}e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = N\begin{pmatrix} 1 \\ 1 \end{pmatrix}e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \tag{8.37}$$

or

$$V_D = \begin{pmatrix} V_{D,e} \\ V_{D,i} \end{pmatrix} = N\begin{pmatrix} \frac{|\mathbf{x}|}{t}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ 1e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = N\begin{pmatrix} 1 \\ 1 \end{pmatrix}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \tag{8.38}$$

but the solutions to equation (8.35) are in the forms of:

$$V_W = \begin{pmatrix} V_{W,e} \\ V_{w,i} \end{pmatrix} = N\begin{pmatrix} 1e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ 0e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = N\begin{pmatrix} 1 \\ 0 \end{pmatrix}e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \tag{8.39}$$

or

$$V_W = \begin{pmatrix} V_{W,e} \\ V_{W,i} \end{pmatrix} = N\begin{pmatrix} 0e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ 1e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = N\begin{pmatrix} 0 \\ 1 \end{pmatrix}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \tag{8.40}$$

Equations (8.34) and (8.35) describe the self-interaction of external and internal intrinsic-proper-time-less and spinless wave functions (self-fields). We may build a quantum-entangled state of two intrinsic-proper-time-less and spinless entities similar to that of two momentum-less entities.

9. Human Consciousness in the Premomentumenergy Model

We now briefly discuss human consciousness in the premomentumenergy model. Detailed treatment will be given in forthcoming articles.

Our experimental results on quantum entanglement of the brain with external substances (See, e.g., Refs, in [1]) suggest that Consciousness is not located in the brain but associated with prespacetime/ premomentumenergy or simply is prespacetime/premomentumenergy. Thus, Consciousness as premomentumenergy has both transcendental and immanent properties. The transcendental aspect of Consciousness as premomentumenergy is the origin of primordial self-referential spin (including the self-referential matrix law) and it projects the external and internal objects (wavefunctions) in the dual universe through spin and, in turn, the immanent aspect of Consciousness as premomentumenergy observes the external object (wavefunction) in the external momentum-energy space through the internal object (wavefunction) in the internal momentum-energy space.

Human consciousness in the dual momentum-energy universe is a limited and particular version of this dual-aspect Consciousness as premomentumenergy such that we have limited free will and limited observation.

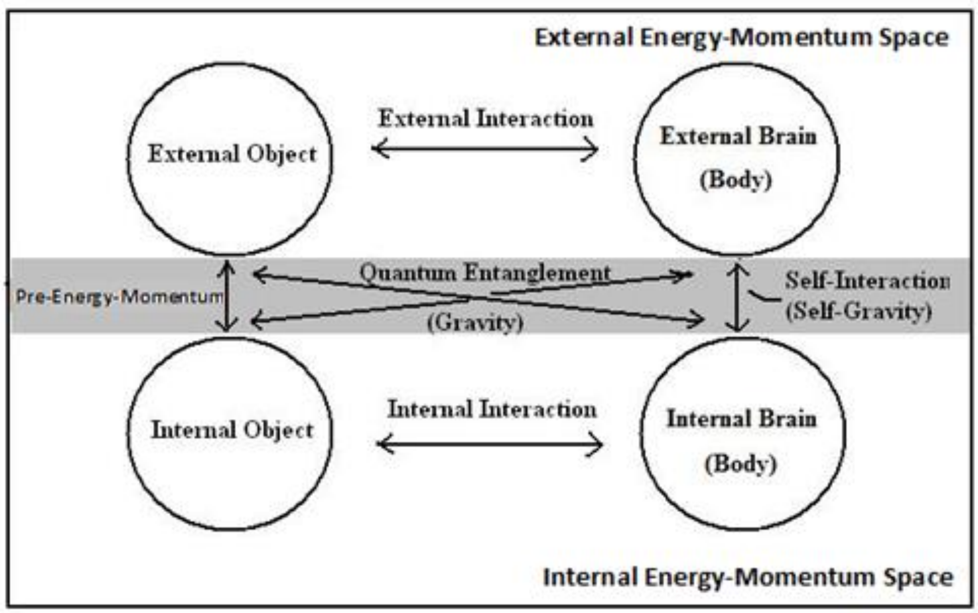

Figure 9.1 Interaction between an object and the brain (body) in the dual universe comprised of the external momentum-energy space and the internal momentum-energy space

As illustrated in Figure 9.1, there are two kinds of interactions between an object (entity) outside the brain (body) and the brain (body) in the premomentumenergy model. The first 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 universe 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.

In the premomentumenergy model, we may write the following Hodgkin-Huxley-like equation in the external/internal momentum-energy space:

$$\partial_E V_{m(\mathbf{p}.E)} = -\frac{1}{C_{m(\mathbf{p}.E)}}\left(\sum_i \left(V_{m(\mathbf{p}.E)} - E_{i(\mathbf{p}.E)}\right) g_{i(\mathbf{p}.E)}\right) \tag{9.1}$$

where $V_{m(\mathbf{p},E)}$ is the electric potential across the neural membranes, $C_{m(\mathbf{p},E)}$ is the capacitance of the membranes, $g_{i(\mathbf{p},E)}$ is the *i*th voltage-gated or constant-leak ion channel.

Microscopically, in the dual universe comprised of the external momentum-energy space and the internal momentum-energy space, electromagnetic fields $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ or their four-potential $A^{\mu}{}_{(\mathbf{p},E)} = \left(\phi_{(\mathbf{p},E)}, \mathbf{A}_{(\mathbf{p},E)}\right)$:

$$\begin{pmatrix} \mathbf{E}_{(\mathbf{p},E)} = -\nabla\phi_{(\mathbf{p},E)} - \partial_E \mathbf{A}_{(\mathbf{p},E)} \\ \mathbf{B}_{(\mathbf{p},E)} = \nabla\times\mathbf{A}_{(\mathbf{p},E)} \end{pmatrix} \tag{9.2}$$

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

$$\left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot\left(\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}\right) \\ -\boldsymbol{\sigma}\cdot\left(\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}\right) & t-e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix}\psi_{e,-}\\ \psi_{i,+}\end{pmatrix}=0\right)_p \tag{9.3}$$

$$\begin{pmatrix} t & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E}_{(\mathbf{p},E)} \\ i\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},E)} \end{pmatrix} = \begin{pmatrix} i\boldsymbol{\sigma}\cdot(\psi^{\dagger}\beta\boldsymbol{\alpha}\psi) + i\boldsymbol{\sigma}\cdot\mathbf{j}_{(\mathbf{p},E)} \\ i(\psi^{\dagger}\beta\beta\psi) + i\rho_{(\mathbf{p},E)} \end{pmatrix}_p \tag{9.4}$$

and

$$\left(\begin{pmatrix} t+e\phi_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot\left(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}\right) \\ -\boldsymbol{\sigma}\cdot\left(\mathbf{x}+e\mathbf{A}_{(\mathbf{p},E)}\right) & t+e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix}\psi_{e,+}\\ \psi_{i,-}\end{pmatrix}=0\right)_e \tag{9.5}$$

$$\begin{pmatrix} t & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & t \end{pmatrix}\begin{pmatrix} \boldsymbol{\sigma}\cdot\mathbf{E}_{(\mathbf{p},E)} \\ i\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},E)} \end{pmatrix}=\begin{pmatrix} i\boldsymbol{\sigma}\cdot(\psi^{\dagger}\beta\boldsymbol{\alpha}\psi)+i\boldsymbol{\sigma}\cdot\mathbf{j}_{(\mathbf{p},E)} \\ i(\psi^{\dagger}\beta\beta\psi)\ +i\rho_{(\mathbf{p},E)} \end{pmatrix}_e \tag{9.6}$$

where β and $\boldsymbol{\alpha}$ are Dirac matrices and $j^{\mu}=\left(\rho_{(\mathbf{p},E)},\mathbf{j}_{(\mathbf{p},E)}\right)$ is four-current in external/internal momentum-energy space.

In equations (9.3) and (9.5), the interactions (couplings) of $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and/or $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ with proton and/or electron spin operator $(\boldsymbol{\sigma})_p$ and $(\boldsymbol{\sigma})_e$ are hidden. The said interactions 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-like form, we have:

$$\left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\tau & -\boldsymbol{\sigma}\cdot\left(\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}\right) \\ -\boldsymbol{\sigma}\cdot\left(\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}\right) & t-e\phi_{(\mathbf{p},E)}+\tau \end{pmatrix}\begin{pmatrix}\psi_{e,-}\\ \psi_{i,+}\end{pmatrix}=L_M\psi=0\right)_p \tag{9.7}$$

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

$$\rightarrow\left(\left(\left(t-e\phi_{(\mathbf{p},E)}\right)^2-\tau^2-\left(\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}\right)^2+e\boldsymbol{\sigma}\cdot\mathbf{B}_{(\mathbf{p},E)}\right)I_2\psi_{e,-}\psi_{i,+}^{*}=0\right)_p$$

For Weyl-like (chiral-like) form, we have:

$$\left(\begin{pmatrix} t-e\phi_{(\mathbf{p},E)}-\boldsymbol{\sigma}\cdot\left(\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}\right) & -\tau \\ -\tau & t-e\phi_{(\mathbf{p},E)}+\boldsymbol{\sigma}\cdot\left(\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}\right) \end{pmatrix}\begin{pmatrix}\psi_{e,r}\\ \psi_{i,l}\end{pmatrix}=0\right)_p \tag{9.8}$$

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

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

These two couplings will also be explicitly shown during the process of non-relativistic approximation of the Dirac-like 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 $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$.

One effect of the couplings is that the action potentials through $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ (or $A^{\mu}_{(\mathbf{p},\mathrm{E})}$) input information into the mind-pixels in the brain. 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 $\mathbf{E}_{(\mathbf{p},\mathrm{E})}$ and $\mathbf{B}_{(\mathbf{p},\mathrm{E})}$ (or $A^{\mu}_{(\mathbf{p},\mathrm{E})}$) which in turn back-react on the action potentials through the Hodgkin-Huxley-like neural circuits in the brain.

10. Some Questions & Answers

1. Do the uncertainty principle and commutation relations among energy, momentum, time and position hold in the premomentumenergy model? Yes. However, in this model, time and position of an elementary particle are quantized dynamical variables and energy and momentum are continuous parameters. In contrast, in the prespacetime model [1-4], time and position are continuous parameters and energy and momentum are quantized dynamical variables.

2. How are prespacetime model and premomentumenergy model connected to each other? The elementary particle in prespacetime model is transformed into that in premomentumenergy model through quantum jump, *vice visa*, as demonstrated in forth coming articles.

3. What is the foundation of the dual momentum-energy universe? The foundation is premomentumenergy which is omnipotent, omniscient and omnipresent.

4. Was there something before the dual momentum-energy universe was born (if there was such birth)? Yes, premomentumenergy alone ($1=e^{i0}$) without differentiation or dualization. So, it may be said that $1= e^{i0}$ is the primordial particle.

5. How does premomentumenergy create, sustain and cause evolution of the dual momentum-energy universe and all entities in it? Premomentumenergy does these things by hierarchical self-referential spin of itself at its free will.

6. Why is there materially something instead of nothing? Premomentumenergy is restless and tends to create, sustain and make evolutions of different entities.

7. How does premomentumenergy govern the dual momentum-energy universe? Premomentumenergy governs through metamorphous self-referential matrix law.

8. What is matter in the premomentumenergy model? Matter is a dualized entity (created through hierarchical self-referential spin of premomentumenergy) comprised of an external wave function (external object) having positive time by convention and an internal wave function (internal object) having negative time by convention.

9. What is antimatter in the premomentumenergy model? Antimatter is a dualized entity (created through hierarchical self-referential spin of premomentumenergy) comprised of an external wave function (external object) having negative time by convention and an internal wave function (internal object) having positive time by convention.

10. Is time conserved in the premomentumenergy model? Yes, time is conserved to zero according to the accounting principle of zero.

11. Is time conserved in the external (internal) momentum-energy space? The answer depends on the context. In most natural processes, external (internal) time is conserved and transformed into different forms without loss due to cancellation between the external and internal spaces. However, in some processes, especially those involving human consciousness and/or intention (free will), time conservation in the external (internal) momentum-energy space may be slightly violated so that the free will may function.

12. What is quantum entanglement in the premomentumenergy model? It is the interaction and/or connections between the external and internal wave functions (objects) of a single dualized entity or among different dualized entities through premomentumenergy which is outside momentum-energy.

13. What is self-interaction, self-gravity or self-quantum entanglement in the premomentumenergy model? Self-interaction is the interaction between the external and internal wave functions (objects) according to the premomentumenergy equation governed by the self-referential matrix law.

14. What is strong force in the premomentumenergy model? It is downward self-reference through imaginary position. It is strong gravity (strong quantum entanglement).

15. What is weak force in the premomentumenergy model? It is fermionic spinization and unspinization of spinless entities with or without bosonic intermediary spinization.

16. What is electromagnetic force in the premomentumenergy model? It is bosonic spinization and unspinization of intrinsic-proper-time-less (massless) and spinless entity.

17. What is gravity in the premomentumenergy model? It is quantum entanglement across the dual momentum-energy universe which includes self-gravity or self-quantum-entanglement between the external and internal wave functions (objects) of a single dualized entity and gravity or quantum entanglement among different entities.

18. What is the origin of the quantum effect in the premomentumenergy model? The origin is primordial hierarchical self-referential spin of premomentumenergy.

19. What is information in the premomentumenergy model? It is a distinction (either quantitative or qualitative) experienced or perceived by a particular consciousness.

20. What is quantum information in the premomentumenergy model? It is a distinction or a state of distinction (either quantitative or qualitative) experienced or perceived by a particular consciousness which is due to a quantum effect such as quantum entanglement.

21. What is the meaning of imaginary unit *i* in the premomentumenergy model? It is the most elementary self-referential process. As imagination of premomentumenergy, it makes phase distinction of an elementary entity and, as an element in the matrix law, it plays a crucial role in self-referential matrixing creation of premomentumenergy.

22. What is Consciousness? Consciousness is premomentumenergy which is omnipotent, omniscient and omnipresent.

23. What is human consciousness? It is a limited or individualized Consciousness associated with a particular human brain/body.

24. Does human consciousness reside in human brain? No, the human brain is the interface for human consciousness to experience and interact with the external universe.

25. What are spirit, soul and/or mind? They are different aspects or properties of premomentumenergy which is transcendent, immanent and eternal.

26. Where did we come from? Physically/biologically, we came from premomentumenergy as its creation. Spiritually, we are an inseparable part of premomentumenergy and our consciousness is limited and/or individualized version of unlimited Consciousness.

27. Where are we going? Physically/biologically, we disintegrate or die unless we advance our science to the point where death of our biological body becomes a choice, not unavoidability. Also, we are of the opinion that advancement in science will eventually enable us to transfer or preserve our individual consciousness associated with our ailing or diseased bodies to another biological or artificial host. Spiritually, we may go back to premomentumenergy or reincarnate into a different form of individual consciousness that may be able to recall its past.

28. How does the mind influence the brain? Mind influences the brain through free will which acts on subjective entities (internal objects), which in turn effect objective entities (external objects) through the premomentumenergy equation.

29. What is the origin of the uncertainty principle? The origin is self-referential spin or zitterbewegung.

30. What is the origin of quantum jump or wave collapse? The free will of premomentumenergy or unlimited transcendental Consciousness. Remember that our limited free will is part of the unlimted free will of premomentumenergy since we are part of premomentumenergy.

31. Is information conserved? It is our opinion that information is conserved to zero in the dual universe since each distinction in the external space is accompanied by its negation in the internal space. However, information is not conserved in each space alone.

32. What is a graviton? There is no graviton in the sense of a quantum (particle) which mediated gravitational interaction at the speed of light. However, since gravity is quantum entanglement, the wave function of each entity may be treated as a graviton.

33. Is there an absolute reference frame? Yes, it is simply prespacetime/ premomentumenergy.

11. Conclusion

This article is a continuation of the Principle of Existence. A premomentumenergy model of elementary particles, four forces and human consciousness is formulated, which illustrates how the self-referential hierarchical spin structure of the premomentumenergy provides a foundation for creating, sustaining and causing evolution of elementary particles through matrixing processes embedded in said premomentumenergy. This model generates elementary particles and their governing matrix laws for a dual universe (quantum frame) comprised of an external momentum-energy space and an internal momentum-energy space. In contrast, the prespacetime model described previously generates elementary particles and their governing matrix laws for a dual universe (quantum frame) comprised of an external spacetime and an internal spacetime. These quantum frames and their metamorphoses are interconnected through quantum jumps as demonstrated in forthcoming articles.

The premomentumenergy model reveals the creation, sustenance and evolution of fermions, bosons and spinless entities each of which is comprised of an external wave function or external object in the external momentum-energy space and an internal wave function or internal object in the internal momentum-energy space. The model provides a unified causal structure in said dual universe (quantum frame) for weak interaction, strong interaction, electromagnetic interaction, gravitational interaction, quantum entanglement, human consciousness. Further, the model provides a unique tool for teaching, demonstration, rendering, and experimentation related to subatomic and atomic structures and interactions, quantum entanglement generation, gravitational mechanisms in cosmology, structures and mechanisms of human consciousness.

One of the key features of the Principle of Existence illustrated in this work is the use of hierarchical self-referential mathematics in order to accommodate both the transcendental and immanent qualities/properties of premomentumenergy.

In the beginning there was premomentumenergy e^{i0} materially empty but spiritually restless. And it began to imagine through primordial self-referential spin $1=e^{i0}=e^{iM-iM}=e^{iM}e^{-iM}=e^{-iM}/e^{-iM} = e^{iM}/e^{iM}$...such that it created the external object to be observed and internal object as observed, separated them into external momentum-energy space and internal momentum-energy space, caused them to interact through self-referential matrix law and thus gave birth to the dual momentum-energy universe which it has since sustained and made to evolve.

In this universe, premomentumenergy (ether), represented by Euler's Number *e*, is the ground of existence and can form external and internal wave functions as external and internal momentum-energy objects (each pair forms an elementary entity in the dual momentum-energy universe) and interaction fields between elementary entities which accompany the imaginations of the premomentumenergy.

Premomentumenergy can be self-acted on by self-referential matrix law L_M. Premomentumenergy has imagining power *i* to project external and internal objects by projecting, e.g., external and internal phase $\underline{+}M = \underline{+}(Et-\boldsymbol{p}\cdot\boldsymbol{x})/\hbar$ at the power level of premomentumenergy. The universe so created is a dual momentum-energy universe comprising of the external momentum-energy space to be observed and internal momentum-energy space as observed under each relativistic frame $p^\mu=(E/c, \boldsymbol{p})$. In one perspective of premomentumenergy view, the internal momentum-energy space (which by convention has negative time) is the negation/image of the external momentum-energy space (which by convention has positive time). The absolute frame of reference is the premomentumenergy itself. Thus, if premomentumenergy stops imagining ($i0=0$), the dual momentum-energy universe would disappear into materially nothingness $e^{i0}=e^0=1$.

The accounting principle of the dual momentum-energy universe is conservation of zero. For example, the total time of an external object and its counterpart, the internal object, is zero. Also in this dual momentum-energy universe, self-gravity is the nonlocal-momentum-energy self-interaction (wave mixing) between an external object in the external momentum-energy space and its negation/image in the internal momentum-energy space, *vice versa*. Gravity in external momentum-energy space is the nonlocal-momentum-energy interaction (quantum entanglement) between an external object with the internal momentum-energy space as a whole.

Some other most basic conclusions are: (1) the two spinors of the Dirac electron or positron in the dual momentum-energy universe are respectively the external and internal objects of the electron or positron; and (2) the electric and magnetic fields of a linear photon in the dual momentum-energy universe are respectively the external and internal objects of a photon which are always self-entangled.

In this dual momentum-energy universe, premomentumenergy has both transcendental and immanent properties. The transcendental aspect of premomentumenergy is the origin of primordial self-referential spin (including the self-referential matrix law) and it projects the external and internal objects (wavefunctions) in the dual universe through spin and, in turn, the immanent aspect of premomentumenergy observes the external object (wavefunction) in the external momentum-energy space through the internal object (wavefunction) in the internal momentum-energy space. Human consciousness in the dual momentum-energy universe is a limited and particular version of this dual-aspect premomentumenergy such that we have limited free will and limited observation.

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