Article

Prespacetime-Premomentumenergy Model I: Quantum Theory for a Dual Universe Comprised of Spacetime & Momentumenergy Space

Huping Hu* & Maoxin Wu

ABSTRACT

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

The prespacetime-premomentumenergy model may reveal 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 spacetime and an internal wave function or internal object in the internal momentum-energy space. The model may provide a unified causal structure in said dual universe (quantum frame) for weak interaction, strong interaction, electromagnetic interaction, gravitational interaction, quantum entanglement, human consciousness. The model may also provide 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: prespacetime, premomentumenergy, four forces, consciousness, spin, existence.

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1. Introduction

In prespacetime-premomentumenergy we contemplate

As a continuation of the Principle of Existence, the beauty and awe of the possible manifestations of prespacetime-premomentumenergy are described in this article. The prespacetime-premomentumenergy model generates elementary particles and their governing matrix laws for a dual universe (quantum frame) comprised of an external spacetime and an internal momentum-energy space, *vice visa*. This model generates a quantum theory for said dual 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. Then, the premomentumenergy model described recently [5-7] 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. These quantum frames and their metamorphoses may be interconnected through quantum jumps as illustrated below and demonstrated in forthcoming articles.

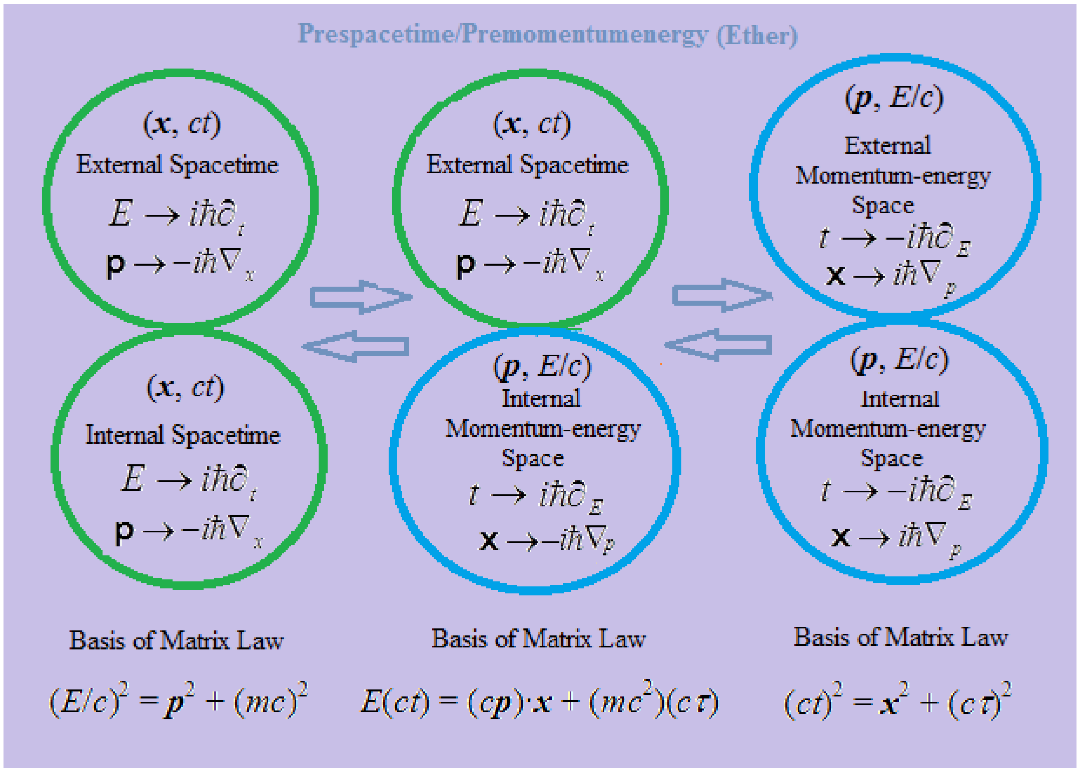

Figure 1.1 Illustration of prespacetime model, premomentumenergy model & prespacetime-premomentum model

This work is organized as follows. In § 2, we shall use words and drawings to lay out the ontology of the prespacetime-premomentumenergy model. In § 3, we shall express in mathematics the prespacetime-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 prespacetime-premomentumenergy model: (1) metamorphoses & the essence of spin; (2) the determinant view & the meaning of Klein-Gordon-like equation; (3) the Schrodinger-like equation; and (4) the third state of matter. In § 5 through § 8, we shall discuss, within the context of prespacetime-premomentumenergy model, weak, electromagnetic, strong and gravitational interactions respectively. In § 9, we shall discuss human consciousness within the context of prespacetime-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 prespacetime-premomentumenergy e^{i0} materially empty but 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 spacetime and internal momentum-energy space, caused them to interact through self-referential matrix law and thus gave birth to the dual universe (quantum frame) comprised of said external spacetime and internal momentum-energy space which it has since sustained and made to evolve.

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

The prespacetime-premomentumenergy can be self-acted on by self-referential matrix law L_M. The prespacetime-premomentumenergy has imagining power i to project external and internal objects by projecting, e.g., external and internal phase $\pm M=\pm(Et-\boldsymbol{p}\cdot\boldsymbol{x})/\hbar$ at the power level of prespacetime-premomentumenergy. The universe so created is a dual universe (quantum frame) comprising of the external spacetime with a relativistic frame $x^{\mu}=(t, \boldsymbol{x})$ and internal momentum-energy space with a relativistic frame $p^{\mu}=(E/c, \boldsymbol{p})$. The absolute frame of reference is the prespacetime-premomentumenergy itself. Thus, if prespacetime-premomentumenergy stops imagining ($i0=0$), the dual universe (quantum frame) would disappear into materially nothingness $e^{i0}=e^{0}=1$.

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

Some other basic conclusions are: (1) the two spinors of the Dirac electron or positron in this dual universe (quantum frame) 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 universe are respectively the external and internal objects of a photon which are always self-entangled.

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

Before mathematical presentations, we draw below several diagrams to illustrate how prespacetime-premomentumenergy creates the dual universe (quantum frame) comprising of the external spacetime and the internal momentum-energy space and how the external object in the external spacetime and internal object in the internal momentum-energy space interact.

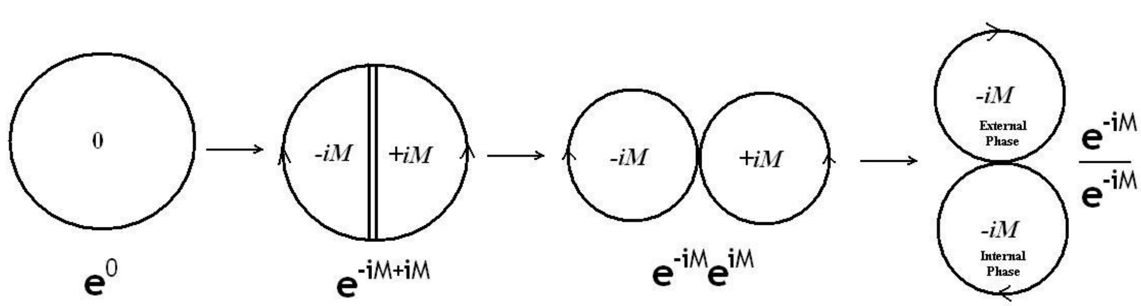

Figure2.1. Illustration of primordial phase distinction

As shown in Figure 2.1, a primordial phase distinction (dualization), e.g., $\pm M=\pm(Et-\boldsymbol{p}\cdot\boldsymbol{x})/\hbar$, was made at the power level of prespacetime-premomentumenergy through imagination i. At the ground level of prespacetime-premomentumenergy, this is $e^{i0}=e^{+iM-iM}=e^{+iM}e^{-iM} = e^{+iM}/e^{+iM}$....

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 prespacetime-premomentumenergy at the power level so as to enforce (maintain) the accounting principle of conservation of total phase to zero, as illustrated in Figure 2.2.

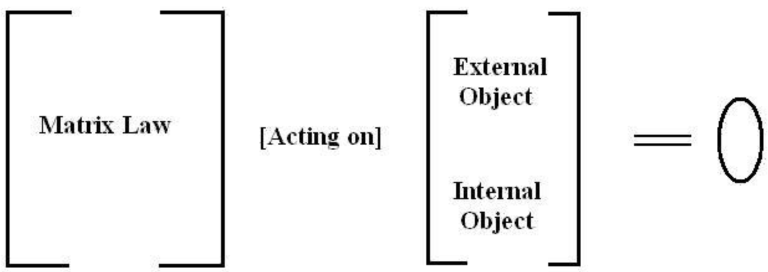

Figure 2.2 Prespacetime-premomentumenergy Equation

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

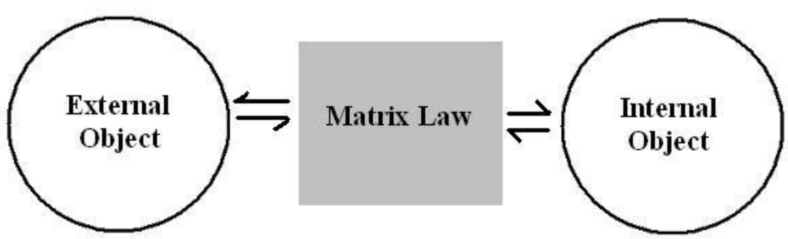

Figure 2.3 Self-interaction between external and internal objects of a quantum entity in a dual universe comprised of an external spacetime and an internal energy-momentum space, *vice versa*.

As shown in Figure 2.4, the external object in the spacetime and the internal object in the internal energy-momentum space 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 prespacetime-premomentumenergy is shown as a strip, both the dualized external spacetime and internal energy-momentum space are embedded in prespacetime-premomentumenergy.

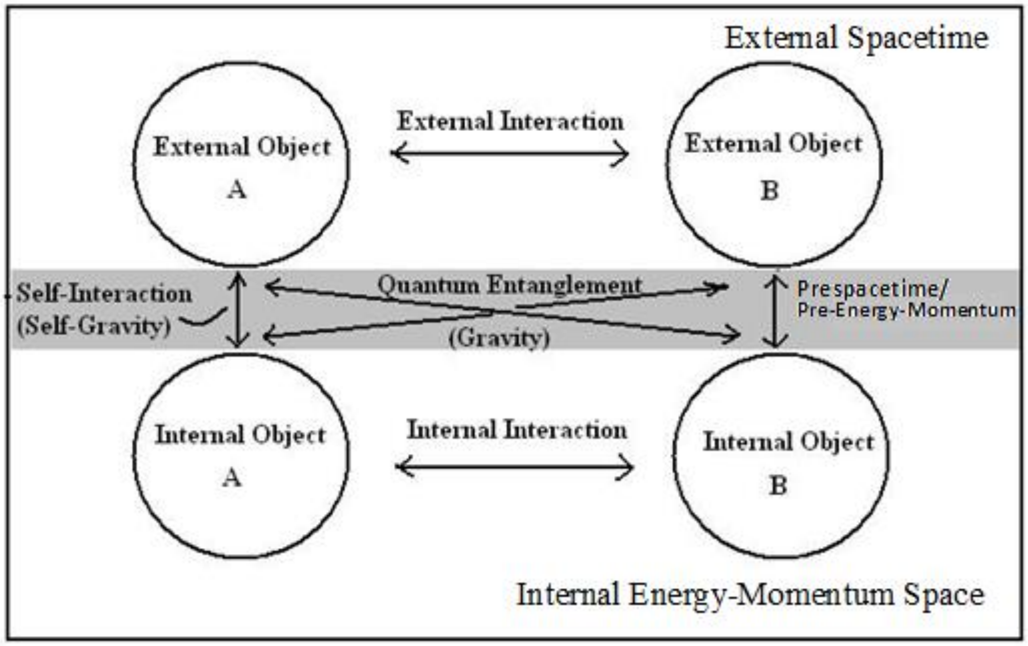

Figure2.4 Interactions in the dual universe comprised of the external spacetime and internal energy-momentum space, *vice versa.*

3. Mathematics of the Prespacetime-premomentumenergy Model

In mathematics we express

3.1 Scientific Genesis in a Nutshell

It is our comprehension that:

Prespacetime-premomentumenergy

=Omnipotent, Omnipresent & Omniscient Being/State = ONE (3.1)

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

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

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

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

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 universe as a whole).

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

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = \left(\left(DetM_{Et} + DetM_{m\tau} + DetM_{px}\right)\right)\left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow$$
$$\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} A_e e^{-iM} \\ A_i e^{-iM} \end{pmatrix} = L_M \begin{pmatrix} A_e \\ A_i \end{pmatrix} e^{-iM} = L_M \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0 \qquad (3.3)$$

where L_0 is the Law of Zero of the prespacetime-premomentumenergy as defined by fundamental relation (3.4) below, *Det* means determinant and M_{Et}, $M_{m\tau}$ and M_{px} are respectively matrices with $\pm E$ & $\pm t$ (or $\pm iE$ & $\pm it$), $\pm m$ & $\pm\tau$ (or $\pm im$ & $\pm i\tau$) and $\pm|\mathbf{p}|$ & $\pm|\mathbf{x}|$ (or $\pm i|\mathbf{p}|$ & $\pm i|\mathbf{x}|$) as elements respectively, and Et, $-m\tau$ and $-\boldsymbol{p}.\boldsymbol{x}$ as determinant respectively.

Prespacetime-premomentumenergy spins as $e^{i0}=e^{+iM-iM}=e^{+iM}e^{-iM} = e^{+iM}/ e^{+iM}$....before matrixization. Prespacetime-premomentumenergy 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 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 prespacetime-premomentumenergy is derived from the following fundamental relation through self-reference within this relation which accompanies the imagination (spin i) in prespacetime-premomentumenergy:

$$(E/c)(ct) - \mathbf{p}\cdot\mathbf{x} - (mc)(c\tau) = L_0 = 0$$

where time t and space $\boldsymbol{x}$ are continuous parameters in external spacetime but quantized dynamical variables of an elementary particle in the internal energy-momentum space; energy E and momentum $\boldsymbol{p}$ are quantized dynamical variables of said elementary particle in the external spacetime but continuous parameters in internal energy-momentum space; and τ is the intrinsic proper time of the elementary particle (e.g., defined as Compton wavelength divided by speed of light $\tau=\lambda/c$) and m is the mass of the elementary particle. For simplicity, we will set $c=\hbar=1$ throughout this work unless indicated otherwise, so that we have from above equation:

$$Et - \mathbf{p}\cdot\mathbf{x} - m\tau = L_0 = 0 \tag{3.4}$$

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

$$(E/c)(ct) = \mathbf{p}\cdot\mathbf{x} - (mc)(c\tau)$$

In the presence of an interacting field such as an electromagnetic potential ($\boldsymbol{A}_{(x,t)}, \phi_{(x,t)}$) in spacetime and its dual ($\boldsymbol{A}_{(\boldsymbol{p},E)}, \phi_{(\boldsymbol{p},E)}$) in momentum-energy space, equation (3.4) may be modified as follows for an elementary entity with charge e:

$$\left(E - e\phi_{(\mathbf{x},t)}\right)\left(t - e\phi_{(\mathbf{p},E)}\right) = m\tau + \left(\mathbf{p} - e\mathbf{A}_{(\mathbf{x},t)}\right)\cdot\left(\mathbf{x} - e\mathbf{A}_{(\mathbf{p},E)}\right) \tag{3.5}$$

One form of the matrix law in prespacetime-premomentumenergy is derived through self-reference from (3.4) as follows when $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$ and **p** parallels to **x**:

$$\begin{aligned} L = 1 = \frac{Et - m\tau}{|\mathbf{p}||\mathbf{x}|} = \left(\frac{E-m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{x}|}{t+\tau}\right)^{-1} \\ \rightarrow \frac{E-m}{-|\mathbf{p}|} = \frac{-|\mathbf{x}|}{t+\tau} \rightarrow \frac{E-m}{-|\mathbf{p}|} - \frac{-|\mathbf{x}|}{t+\tau} = 0 \end{aligned} \tag{3.6}$$

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

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

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

$$0 = Et - \mathbf{p}\cdot\mathbf{x} - m\tau = Det\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} -m & 0 \\ 0 & \tau \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{p}| & 0 \end{pmatrix} \tag{3.8}$$

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

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

After fermionic spinization:

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

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

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

expression (3.7) becomes:

$$\begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & t+\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \qquad (3.12)$$

Expression (3.12) governs fermions in Dirac-like form such as Dirac electron and positron in a dual universe (quantum frame) comprised of an external spacetime and an internal energy-momentum space, and expression (3.7) governs unspinized or spinless entity/particle with charge *e* and mass *m* (intrinsic proper time τ) such as a meson or a meson-like particle in said dual universe. Bosonic spinization of expression (3.7) $|\mathbf{p}| = \sqrt{\mathbf{p}^2} \longrightarrow \mathbf{s}\cdot\mathbf{p}$ and $|\mathbf{x}| = \sqrt{\mathbf{x}^2} \longrightarrow \mathbf{s}\cdot\mathbf{x}$ shall be discussed later.

If we define:

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

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$ and **p** parallels to **x**,

We get:

$$Det_\sigma \begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & t+\tau \end{pmatrix} = (Et - m\tau - \mathbf{x}\cdot\mathbf{p}) I_2 = 0 \qquad (3.14)$$

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

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

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$ and **p** parallels to **x**.

One kind of metamorphoses of (3.4)-(3.9) & (3.12-15) is respectively as follows when $\frac{t}{E} = \frac{\tau}{m} = \frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**:

$$tE - \mathbf{x}\cdot\mathbf{p} - \tau m = L_0 = 0 \tag{3.4a}$$

$$\left(t - e\phi_{(\mathbf{p},E)}\right)\left(E - e\phi_{(\mathbf{x},t)}\right) = \tau m + \left(\mathbf{x} - e\mathbf{A}_{(\mathbf{p},E)}\right)\cdot\left(\mathbf{p} - e\mathbf{A}_{(\mathbf{x},t)}\right) \tag{3.5a}$$

$$\begin{aligned} L = 1 = \frac{tE - \tau m}{|\mathbf{x}||\mathbf{p}|} = \left(\frac{t-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{p}|}{E+m}\right)^{-1} \\ \rightarrow \frac{t-\tau}{-|\mathbf{x}|} = \frac{-|\mathbf{p}|}{E+m} \rightarrow \frac{t-\tau}{-|\mathbf{x}|} - \frac{-|\mathbf{p}|}{E+m} = 0 \end{aligned} \tag{3.6a}$$

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

$$0 = tE - \mathbf{x}\cdot\mathbf{p} - \tau m = Det\begin{pmatrix} t & 0 \\ 0 & E \end{pmatrix} + Det\begin{pmatrix} -\tau & 0 \\ 0 & m \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{p}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \tag{3.8a}$$

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

$$\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & E+m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.12a}$$

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

$$Det_{\sigma}\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & E+m \end{pmatrix} = (tE-\tau m-\mathbf{p}\cdot\mathbf{x})I_2 = 0 \qquad (3.14a)$$

$$Det\begin{pmatrix} t-\tau & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & E+m \end{pmatrix} = (tE-\tau m-\mathbf{p}\cdot\mathbf{x})^2 = 0 \qquad (3.15a)$$

Another kind of metamorphoses of expressions (3.6) – (3.14) is respectively as follows when $\frac{E}{t}=\frac{m}{\tau}=\frac{|\mathbf{p}|}{|\mathbf{x}|}$ and **p** parallels to **x**:

$$L=1=\frac{Et-\mathbf{p}\cdot\mathbf{x}}{m\tau}=\left(\frac{E-|\mathbf{p}|}{-m}\right)\left(\frac{-\tau}{t+|\mathbf{x}|}\right)^{-1}$$
$$\rightarrow\frac{E-|\mathbf{p}|}{-m}=\frac{-\tau}{t+|\mathbf{x}|}\rightarrow\frac{E-|\mathbf{p}|}{-m}-\frac{-\tau}{t+|\mathbf{x}|}=0 \qquad (3.16)$$

$$\begin{pmatrix} E-|\mathbf{p}| & -\tau \\ -m & t+|\mathbf{x}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \qquad (3.17)$$

$$0 = Et-m\tau-\mathbf{x}\cdot\mathbf{p} = Det\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -m & 0 \end{pmatrix} + Det\begin{pmatrix} -|\mathbf{p}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} \qquad (3.18)$$

$$\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -\tau \\ -m & 0 \end{pmatrix} + \begin{pmatrix} -|\mathbf{p}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} = \begin{pmatrix} E-|\mathbf{p}| & -\tau \\ -m & t+|\mathbf{x}| \end{pmatrix} \qquad (3.19)$$

$$\begin{pmatrix} E-\boldsymbol{\sigma}\cdot\mathbf{p} & -\tau \\ -m & t+\boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L \qquad (3.20)$$

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

$$Det_{\sigma}\begin{pmatrix} E-\boldsymbol{\sigma}\cdot\mathbf{p} & -\tau \\ -m & t+\boldsymbol{\sigma}\cdot\mathbf{x} \end{pmatrix} = (Et-\mathbf{p}\cdot\mathbf{x}-\tau m)I_2 = 0 \qquad (3.22)$$

Expressions (3.16) – (3.22) have the following metamorphoses when $\frac{t}{E}=\frac{\tau}{m}=\frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**:

$$L=1=\frac{tE-\mathbf{x}\cdot\mathbf{p}}{\tau m}=\left(\frac{t-|\mathbf{x}|}{-\tau}\right)\left(\frac{-m}{E+|\mathbf{p}|}\right)^{-1} \to \frac{t-|\mathbf{x}|}{-\tau}=\frac{-m}{E+|\mathbf{p}|}\to\frac{t-|\mathbf{x}|}{-\tau}-\frac{-m}{E+|\mathbf{p}|}=0 \tag{3.16a}$$

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

$$0=tE-\tau m-\mathbf{x}\cdot\mathbf{p}=Det\begin{pmatrix} t & 0 \\ 0 & E \end{pmatrix}+Det\begin{pmatrix} 0 & -m \\ -\tau & 0 \end{pmatrix}+Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{p}| \end{pmatrix} \tag{3.18a}$$

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

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

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

$$Det_\sigma\begin{pmatrix} t-\boldsymbol{\sigma}\cdot\mathbf{x} & -m \\ -\tau & E+\boldsymbol{\sigma}\cdot\mathbf{p} \end{pmatrix}=(tE-\mathbf{x}\cdot\mathbf{p}-m\tau)I_2=0 \tag{3.22a}$$

Another kind of metamorphoses of expressions (3.6) - (3.14) is respectively as follows when $\frac{E}{t}=\frac{m}{\tau}=\frac{|\mathbf{p}|}{|\mathbf{x}|}$ and **p** parallels to **x**:

$$L=1=\frac{Et}{m\tau+\mathbf{p}\cdot\mathbf{x}}=\left(\frac{E}{-m+i|\mathbf{p}|}\right)\left(\frac{-\tau-i|\mathbf{x}|}{t}\right)^{-1} \to\frac{E}{-m+i|\mathbf{p}|}=\frac{-\tau-i|\mathbf{x}|}{t}\to\frac{E}{-m+i|\mathbf{p}|}-\frac{-\tau-i|\mathbf{x}|}{t}=0 \tag{3.25}$$

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

$$0 = Et - m\tau - \mathbf{p}\cdot\mathbf{x} = Det\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -m & 0 \end{pmatrix} + Det\begin{pmatrix} 0 & -i|\mathbf{x}| \\ i|\mathbf{p}| & 0 \end{pmatrix} \tag{3.27}$$

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

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

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

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

We can rewrite expression (3.29) as:

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

where $Q_p = \tau + i\boldsymbol{\sigma}\cdot\mathbf{x}$ is a quaternion and $Q_x{}^* = m - i\boldsymbol{\sigma}\cdot\mathbf{p}$ is also a quaternion.

Expressions (3.25) – (3.31) have the following metamorphoses when $\frac{t}{E} = \frac{\tau}{m} = \frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**:

$$L = 1 = \frac{tE}{\tau m + \mathbf{x}\cdot\mathbf{p}} = \left(\frac{t}{-\tau + i|\mathbf{x}|}\right)\left(\frac{-m - i|\mathbf{p}|}{E}\right)^{-1}$$
$$\rightarrow \frac{t}{-\tau + i|\mathbf{x}|} = \frac{-m - i|\mathbf{p}|}{E} \rightarrow \frac{t}{-\tau + i|\mathbf{x}|} - \frac{-m - i|\mathbf{p}|}{E} = 0 \tag{3.25a}$$

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

$$0 = tE - \tau m - \mathbf{x}\cdot\mathbf{p} = Det\begin{pmatrix} t & 0 \\ 0 & E \end{pmatrix} + Det\begin{pmatrix} 0 & -m \\ -\tau & 0 \end{pmatrix} + Det\begin{pmatrix} 0 & -i|\mathbf{p}| \\ i|\mathbf{x}| & 0 \end{pmatrix} \tag{3.27a}$$

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

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

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

$$Det_{\sigma}\begin{pmatrix} t & -m-i\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\tau+i\boldsymbol{\sigma}\cdot\mathbf{x} & E \end{pmatrix} = (tE - m\tau - \mathbf{p}\cdot\mathbf{x})I_2 = 0 \tag{3.31a}$$

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

$$\begin{gathered} L = 1 = \frac{Et - m\tau}{\mathbf{p}\cdot\mathbf{x}} = \left(\frac{E+m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{x}|}{t-\tau}\right)^{-1} \\ \rightarrow \frac{E+m}{-|\mathbf{p}|} = \frac{-|\mathbf{x}|}{t-\tau} \rightarrow \frac{E+m}{-|\mathbf{p}|} - \frac{-|\mathbf{x}|}{t-\tau} = 0 \end{gathered} \tag{3.35}$$

$$\begin{pmatrix} E+m & -|\mathbf{x}| \\ -|\mathbf{p}| & t-\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.36}$$

$$\begin{pmatrix} E+m & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & t-\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.37}$$

If $m=\tau=0$, we have from expressions (3.6) - (3.14):

$$L=1=\frac{Et}{\mathbf{p}\cdot\mathbf{x}}=\left(\frac{E}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{x}|}{t}\right)^{-1}$$
$$\rightarrow\frac{E}{-|\mathbf{p}|}=\frac{-|\mathbf{x}|}{t}\rightarrow\frac{E}{-|\mathbf{p}|}-\frac{-|\mathbf{x}|}{t}=0 \tag{3.38}$$

$$\begin{pmatrix} E & -|\mathbf{x}| \\ -|\mathbf{p}| & t \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}=L_M \tag{3.39}$$

$$0=Et-\mathbf{p}\cdot\mathbf{x}=Det\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix}+Det\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{p}| & 0 \end{pmatrix} \tag{3.40}$$

$$\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix}+\begin{pmatrix} 0 & -|\mathbf{x}| \\ -|\mathbf{p}| & 0 \end{pmatrix}=\begin{pmatrix} E & -|\mathbf{x}| \\ -|\mathbf{p}| & t \end{pmatrix} \tag{3.41}$$

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

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

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

After bosonic spinization:

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

expression (3.39) becomes:

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

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:

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

We get:

$$Det_s \begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{p} & t \end{pmatrix} = (Et - \mathbf{x}\cdot\mathbf{p})I_3 - \begin{pmatrix} xp_x & xp_y & xp_z \\ yp_z & yp_y & yp_z \\ zp_x & zp_y & zp_z \end{pmatrix} \tag{3.47}$$

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 (intrinsic-proper-time-less) particle with unobservable spin (spinless). After bosonic spinization, the spinless and massless particle gains its spin 1.

Expressions (3.35) – (3.47) have the following metamorphoses when $\frac{t}{E} = \frac{|\mathbf{x}|}{|\mathbf{p}|}$ & **x** parallels to **p**:

$$L = 1 = \frac{tE}{\mathbf{x}\cdot\mathbf{p}} = \left(\frac{t}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{p}|}{E}\right)^{-1} \\ \rightarrow \frac{t}{-|\mathbf{x}|} = \frac{-|\mathbf{p}|}{E} \rightarrow \frac{t}{-|\mathbf{x}|} - \frac{-|\mathbf{p}|}{E} = 0 \tag{3.38a}$$

$$\begin{pmatrix} t & -|\mathbf{p}| \\ -|\mathbf{x}| & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.39a}$$

$$0 = tE - \mathbf{x}\cdot\mathbf{p} = Det\begin{pmatrix} t & 0 \\ 0 & E \end{pmatrix} + Det\begin{pmatrix} 0 & -|\mathbf{p}| \\ -|\mathbf{x}| & 0 \end{pmatrix} \quad (3.40a)$$

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

$$\begin{pmatrix} t & -\boldsymbol{\sigma}\cdot\mathbf{p} \\ -\boldsymbol{\sigma}\cdot\mathbf{x} & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.42a)$$

$$\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{x} & E \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.44a)$$

$$Det_s\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{x} & E \end{pmatrix} = tE - (-\mathbf{s}\cdot\mathbf{p})(-\mathbf{s}\cdot\mathbf{x}) \quad (3.46a)$$

$$Det_s\begin{pmatrix} t & -\mathbf{s}\cdot\mathbf{p} \\ -\mathbf{s}\cdot\mathbf{x} & E \end{pmatrix} = (tE - \mathbf{p}\cdot\mathbf{x})I_3 - \begin{pmatrix} p_x x & p_y x & p_z x \\ p_z y & p_y y & p_z y \\ p_x z & z p_y & p_z z \end{pmatrix} \quad (3.47a)$$

Another kind of metamorphosis of expressions (3.18) - (3.22) when $m = \tau = 0$ is respectively as follows:

$$0 = Et - \mathbf{p}\cdot\mathbf{x} = Det\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} -|\mathbf{p}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} \quad (3.48)$$

$$\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} -|\mathbf{p}| & 0 \\ 0 & |\mathbf{x}| \end{pmatrix} = \begin{pmatrix} E - |\mathbf{p}| & 0 \\ 0 & t + |\mathbf{x}| \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \quad (3.49)$$

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

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

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

$$Det_s\begin{pmatrix} E-\mathbf{s}\cdot\mathbf{p} & 0 \\ 0 & t+\mathbf{s}\cdot\mathbf{x} \end{pmatrix} = (Et-\mathbf{p}\cdot\mathbf{x})I_3 - \begin{pmatrix} p_x x & p_y x & p_z x \\ p_z y & p_y y & p_z y \\ p_x z & p_y z & p_z z \end{pmatrix} \tag{3.53}$$

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.

Expressions (3.48)–(3.53) have the following metamorphoses when $\frac{t}{E}=\frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**:

$$0 = tE - \mathbf{x}\cdot\mathbf{p} = Det\begin{pmatrix} t & 0 \\ 0 & E \end{pmatrix} + Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{p}| \end{pmatrix} \tag{3.48a}$$

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

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

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

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

$$Det_s\begin{pmatrix} t-\mathbf{s}\cdot\mathbf{x} & 0 \\ 0 & E+\mathbf{s}\cdot\mathbf{p} \end{pmatrix} = (tE-\mathbf{x}\cdot\mathbf{p})I_3 - \begin{pmatrix} xp_x & xp_y & xp_z \\ yp_z & yp_y & yp_z \\ zp_x & zp_y & zp_z \end{pmatrix} \tag{3.53a}$$

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

$$-m\tau-\mathbf{p}\cdot\mathbf{x}=0 \tag{3.54}$$

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

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

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

Further, if |**p**| = |**x**| = 0, we have from expression (3.4):

$$Et-m\tau=0 \tag{3.57}$$

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

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

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

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

The above metamorphoses of the self-referential matrix law of prespacetime-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 (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 spin structure if it exists.

3.3 Additional Forms of Matrix Law

If prespacetime-premomentumenergy allows partial distinction within first-tier self-referential matrixization, we obtain, for example, the following additional forms of matrix law $\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M$, when $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$ and **p** parallels to **x**:

$$\begin{pmatrix} \sqrt{Et - m\tau} & -|\mathbf{x}| \\ -|\mathbf{p}| & \sqrt{Et - m\tau} \end{pmatrix} \quad (3.60) \qquad \begin{pmatrix} \sqrt{Et - m\tau} & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & \sqrt{Et - m\tau} \end{pmatrix} \quad (3.61)$$

$$\begin{pmatrix} \sqrt{Et - m\tau} - |\mathbf{p}| & 0 \\ 0 & \sqrt{Et - m\tau} + |\mathbf{x}| \end{pmatrix} \quad (3.62) \qquad \begin{pmatrix} \sqrt{Et - m\tau} - \boldsymbol{\sigma}\cdot\mathbf{p} & 0 \\ 0 & \sqrt{Et - m\tau} + \boldsymbol{\sigma}\cdot\tau \end{pmatrix} \quad (3.63)$$

$$\begin{pmatrix} \sqrt{Et - \mathbf{p}\cdot\mathbf{x}} & -\tau \\ -m & \sqrt{Et - \mathbf{p}\cdot\mathbf{x}} \end{pmatrix} \quad (3.64) \qquad \begin{pmatrix} \sqrt{Et - \mathbf{p}\cdot\mathbf{x}} - m & 0 \\ 0 & \sqrt{Et - \mathbf{p}\cdot\mathbf{x}} + \tau \end{pmatrix} \quad (3.65)$$

$$\begin{pmatrix} E & -\sqrt{m\tau + \mathbf{p}\cdot\mathbf{x}} \\ \sqrt{m\tau + \mathbf{p}\cdot\mathbf{x}} & t \end{pmatrix} \quad (3.66) \qquad \begin{pmatrix} E - \sqrt{m\tau + \mathbf{p}\cdot\mathbf{x}} & 0 \\ 0 & t + \sqrt{m\tau + \mathbf{p}\cdot\mathbf{x}} \end{pmatrix} \quad (3.67)$$

$$\begin{pmatrix} \sqrt{Et - m\tau - \mathbf{p}\cdot\mathbf{x}} & 0 \\ 0 & \sqrt{Et - m\tau - \mathbf{p}\cdot\mathbf{x}} \end{pmatrix} \quad (3.68)$$

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

Prespacetime-premomentumenergy may create momentum-position self-confinement of an elementary entity through imaginary momentum $\mathbf{p}_i$ and imaginary position $\mathbf{x}_i$ (downward self-reference such that $m\tau > Et$). We may write:

$$m\tau - Et = -\mathbf{p}_i \cdot \mathbf{x}_i = -p_{i,x}x_i - p_{i,y}y_i - p_{i,z}z_i = (i\mathbf{p}_i)\cdot(i\mathbf{x}_i) \quad (3.69)$$

that is:

$$Et - m\tau - \mathbf{p}_i \cdot \mathbf{x}_i = 0 \quad (3.70)$$

Therefore, allowing imaginary momentum and imaginary position (downward self-reference) for an elementary entity, we can derive the following matrix law in Dirac-like form when $\frac{E}{t}=\frac{m}{\tau}=\frac{|\mathbf{p_i}|}{|\mathbf{x_i}|}$ and $\mathbf{p}_i$ parallels to $\mathbf{x}_i$:

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

$$\begin{pmatrix} -m & -\boldsymbol{\sigma}\cdot\mathbf{x}_i \\ -\boldsymbol{\sigma}\cdot\mathbf{p}_i & +\tau \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.72}$$

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

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

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

Bosonic versions of expressions (3.72) and (3.74) are obtained by replacing **σ** with **s**.

It is possible that the above additional forms of self-referential matrix law govern different particles in the particle zoo as discussed later.

Expressions (3.70) can also be written as follows:

$$tE-\tau m-\mathbf{p}_\mathrm{i}\cdot\mathbf{x}_\mathrm{i}=0 \tag{3.70a}$$

Expressions (3.71) – (3.74) have the following metamorphoses when $\frac{t}{E}=\frac{\tau}{m}=\frac{|\mathbf{x_i}|}{|\mathbf{p_i}|}$ and $\mathbf{x}_i$ parallels to $\mathbf{p}_i$:

$$\begin{pmatrix} t-\tau & -|\mathbf{p}_i| \\ -|\mathbf{x}_i| & E+m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.71a}$$

$$\begin{pmatrix} -\tau & -\boldsymbol{\sigma}\cdot\mathbf{p}_i \\ -\boldsymbol{\sigma}\cdot\mathbf{x}_i & +m \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} = L_M \tag{3.72a}$$

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

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

3.4 Scientific Genesis of Primordial Entities in the Prespacetime-Premomentumenergy Model

Prespacetime-premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion such as an electron in Dirac-like form in a dual universe comprised of an external spacetime and internal momentum-energy space as follows:

$$\begin{gathered} 1 = e^{i0} = 1e^{i0} = Le^{+M-iM} = \frac{Et-m\tau}{\mathbf{p}\cdot\mathbf{x}} e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} = \\ \left(\frac{E-m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{x}|}{t+\tau}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow \\ \frac{E-m}{-|\mathbf{p}|}e^{-ip^{\mu}x_{\mu}} = \frac{-|\mathbf{x}|}{t+\tau}e^{-ip^{\mu}x_{\mu}} \rightarrow \frac{E-m}{-|\mathbf{p}|}e^{-ip^{\mu}x_{\mu}} - \frac{-|\mathbf{x}|}{t+\tau}e^{-ip^{\mu}x_{\mu}} = 0 \\ \rightarrow \begin{pmatrix} E-m & -|\mathbf{x}| \\ -|\mathbf{p}| & t+\tau \end{pmatrix} \begin{pmatrix} a_{e,+}e^{-ip^{\mu}x_{\mu}} \\ a_{i,-}e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M\psi = 0 \\ \rightarrow \begin{pmatrix} E-m & -\boldsymbol{\sigma}\cdot\mathbf{x} \\ -\boldsymbol{\sigma}\cdot\mathbf{p} & t+\tau \end{pmatrix} \begin{pmatrix} A_{e,+}e^{-ip^{\mu}x_{\mu}} \\ A_{i,-}e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix} \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M\psi = 0 \end{gathered} \tag{3.75}$$

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$; **p** parallels to **x**; E and **p** are only operators in spacetime acting on external wave function (they are continuous parameters in momentum-energy space); and t and **x** are only operators in momentum-energy space acting on internal wave function (they are continuous parameters in spacetime), that is:

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

where substitutions $E \to i\partial_t, \mathbf{p} \to -i\nabla_x$ in the external spacetime and $t \to i\partial_E$ and $\mathbf{x} \to -i\nabla_p$ in the internal momentum-energy space have been made so that components of L_M can act on external and internal wave functions. Equation (3.76) may have free spherical wave solution in the dual 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, prespacetime-premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion such as the electron in Dirac-like form in the dual universe as follows:

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = (Et - m\tau - \mathbf{p}\cdot\mathbf{x})e^{-ip^\mu x_\mu + ip^\mu x_\mu} = \tag{3.78}$$

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

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

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

Expressions (3.75), (3.76) & (3.78) have the following metamorphoses, when $\frac{t}{E} = \frac{\tau}{m} = \frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**, for a dual universe comprised of an external momentum-energy space and an internal spacetime:

$$1 = e^{i0} = 1e^{i0} = Le^{+M-iM} = \frac{tE - \tau m}{\mathbf{x}\cdot\mathbf{p}} e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} =$$

$$\left(\frac{t-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{p}|}{E+m}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow \quad (3.75a)$$

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

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

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

$$\begin{pmatrix} (t-\tau)\psi_{e,+} = \boldsymbol{\sigma}\cdot\mathbf{p}\,\psi_{i,-} \\ (E+m)\psi_{i,-} = \boldsymbol{\sigma}\cdot\mathbf{x}\,\psi_{e,+} \end{pmatrix} \text{ or } \begin{pmatrix} i\partial_E\psi_{e,+} - \tau\psi_{e,+} = -i\boldsymbol{\sigma}\cdot\nabla_x\psi_{i,-} \\ i\partial_t\psi_{i,-} + m\psi_{i,-} = -i\boldsymbol{\sigma}\cdot\nabla_p\psi_{e,+} \end{pmatrix} \quad (3.76a)$$

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = (tE - \tau m - \mathbf{x}\cdot\mathbf{p})e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} = \quad (3.78a)$$

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

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

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

Prespacetime-premomentumenergy creates, sustains and causes evolution of a free plane-wave antifermion such as a positron in Dirac-like form in the dual universe comprised of the external spacetime and the internal momentum-energy space as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{Et - m\tau}{\mathbf{p}\cdot\mathbf{x}} e^{+ip^{\mu}x_{\mu} - ip^{\mu}x_{\mu}} =$$

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

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

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

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

or

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

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

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

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

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$; **p** parallels to **x**; E and **p** are only operators in spacetime acting on external wave function (they are continuous parameters in momentum-energy space); and t and **x** are operators only in momentum-energy space only acting on internal wave function (they are continuous parameters in spacetime).

Expressions (3.79) & (3.80) have the following metamorphoses, when $\frac{t}{E} = \frac{\tau}{m} = \frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**, for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{tE - \tau m}{\mathbf{x}\cdot\mathbf{p}} e^{+ip^\mu x_\mu - ip^\mu x_\mu} = \left(\frac{t-\tau}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{p}|}{E+m}\right)^{-1}\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1} \rightarrow \tag{3.79a}$$

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

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

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

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(tE - \tau m - \mathbf{x}\cdot\mathbf{p}\right)e^{+ip^\mu x_\mu - ip^\mu x_\mu} = \tag{3.80a}$$

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

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

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

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

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{Et - \mathbf{p}\cdot\mathbf{x}}{m\tau} e^{-ip^\mu x_\mu + ip^\mu x_\mu} = \left(\frac{E-|\mathbf{p}|}{-m}\right)\left(\frac{-\tau}{t+|\mathbf{x}|}\right)^{-1}\left(e^{-ip^\mu x_\mu}\right)\left(e^{-ip^\mu x_\mu}\right)^{-1} \rightarrow \tag{3.81}$$

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

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

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

where $\frac{E}{t}=\frac{m}{\tau}=\frac{|\mathbf{p}|}{|\mathbf{x}|}$; **p** parallels to **x**; E and **p** are operators only in spacetime only acting on external wave function (they are continuous parameters in momentum-energy space); and t and **x** are operators only in momentum-energy space only acting on internal wave function (they are continuous parameters in spacetime),

that is:

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

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

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

where $\frac{E}{t}=\frac{m}{\tau}=\frac{|\mathbf{p}|}{|\mathbf{x}|}$, **p** parallels to **x.**

Expressions (3.81) - (3.83) have the following metamorphoses, when $\frac{t}{E}=\frac{\tau}{m}=\frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**, for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{tE - \mathbf{x}\cdot\mathbf{p}}{\tau m} e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} = \left(\frac{t-|\mathbf{x}|}{-\tau}\right)\left(\frac{-m}{E+|\mathbf{p}|}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow \tag{3.81a}$$

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

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

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

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

$$0 = 0e^{i0} = L_0e^{-iM+iM} = (tE - \tau m - \mathbf{x}\cdot\mathbf{p})e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} = \left(Det\begin{pmatrix} t & 0 \\ 0 & E \end{pmatrix} + Det\begin{pmatrix} 0 & -m \\ -\tau & 0 \end{pmatrix} + Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & |\mathbf{p}| \end{pmatrix}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow \tag{3.83a}$$

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

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

Prespacetime-premomentumenergy creates, sustains and causes evolution of a free plane-wave fermion in another form in the dual universe comprised of the external spacetime and the internal momentum-energy space as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{Et}{m\tau + \mathbf{p}\cdot\mathbf{x}} e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} =$$
$$\left(\frac{E}{-m+i|\mathbf{p}|}\right)\left(\frac{-\tau - i|\mathbf{x}|}{t}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \to \frac{E}{-m+i|\mathbf{p}|}e^{-ip^{\mu}x_{\mu}} = \tag{3.84}$$
$$\frac{-\tau - i|\mathbf{x}|}{t}e^{-ip^{\mu}x_{\mu}} \to \frac{E}{-m+i|\mathbf{p}|}e^{-ip^{\mu}x_{\mu}} - \frac{-\tau - i|\mathbf{p}|}{t}e^{-ip^{\mu}x_{\mu}} = 0$$
$$\to \begin{pmatrix} E & -\tau - i\boldsymbol{\sigma}\cdot\mathbf{x} \\ -m + i\boldsymbol{\sigma}\cdot\mathbf{p} & t \end{pmatrix}\begin{pmatrix} A_e e^{-ip^{\mu}x_{\mu}} \\ A_i e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0$$
$$\to \begin{pmatrix} t & -Q_p \\ -Q_x{}^* & t \end{pmatrix}\begin{pmatrix} A_e e^{-ip^{\mu}x_{\mu}} \\ A_i e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = L_M \psi = 0$$

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$; **p** parallels to **x**; E and **p** are operators only in spacetime only acting on external wave function (they are continuous parameters in momentum-energy space); and t and **x** are operators only in momentum-energy space acting on internal wave function (they are continuous parameters in spacetime); $Q_p = \tau + i\boldsymbol{\sigma}\cdot\mathbf{x}$; and $Q_x{}^* = m - i\boldsymbol{\sigma}\cdot\mathbf{p}$, that is:

$$\begin{pmatrix} E\psi_e = (\tau + i\boldsymbol{\sigma}\cdot\mathbf{x})\psi_i \\ t\psi_i = (m - i\boldsymbol{\sigma}\cdot\mathbf{p})\psi_e \end{pmatrix} \text{ or } \begin{pmatrix} i\partial_t\psi_e = \tau\psi_i + \boldsymbol{\sigma}\cdot\nabla_p\psi_i \\ i\partial_E\psi_i = m\psi_e - \boldsymbol{\sigma}\cdot\nabla_x\psi_i \end{pmatrix} \tag{3.85}$$

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

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = \left(Et - m\tau - \mathbf{x}\cdot\mathbf{p}\right)e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} =$$
$$\left(Det\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + Det\begin{pmatrix} 0 & -\tau \\ -m & 0 \end{pmatrix} + Det\begin{pmatrix} 0 & -i|\mathbf{x}| \\ i|\mathbf{p}| & 0 \end{pmatrix}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \to$$
$$\left(\begin{pmatrix} E & 0 \\ 0 & t \end{pmatrix} + \begin{pmatrix} 0 & -\tau \\ -m & 0 \end{pmatrix} + \begin{pmatrix} 0 & -i|\mathbf{x}| \\ i|\mathbf{p}| & 0 \end{pmatrix}\right)\begin{pmatrix} a_e e^{-ip^{\mu}x_{\mu}} \\ a_i e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} E & -\tau - i|\mathbf{x}| \\ -m + i|\mathbf{p}| & t \end{pmatrix}\begin{pmatrix} a_e e^{-ip^{\mu}x_{\mu}} \\ a_i e^{-ip^{\mu}x_{\mu}} \end{pmatrix} = 0$$

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

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

where $\frac{E}{t}=\frac{m}{\tau}=\frac{|\mathbf{p}|}{|\mathbf{x}|}$, **p** parallels to **x**.

Expressions (3.84) - (3.86) have the following metamorphoses, when $\frac{t}{E}=\frac{\tau}{m}=\frac{|\mathbf{x}|}{|\mathbf{p}|}$ and **x** parallels to **p**, for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$1=e^{i0}=1e^{i0}=Le^{-iM+iM}=\frac{tE}{\tau m+\mathbf{x}\cdot\mathbf{p}}e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}=$$
$$\left(\frac{t}{-\tau+i|\mathbf{x}|}\right)\left(\frac{-m-i|\mathbf{p}|}{E}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1}\rightarrow\frac{t}{-\tau+i|\mathbf{x}|}e^{-ip^{\mu}x_{\mu}}= \qquad (3.84a)$$
$$\frac{-m-i|\mathbf{p}|}{E}e^{-ip^{\mu}x_{\mu}}\rightarrow\frac{t}{-\tau+i|\mathbf{x}|}e^{-ip^{\mu}x_{\mu}}-\frac{-m-i|\mathbf{p}|}{E}e^{-ip^{\mu}x_{\mu}}=0$$

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

$$\rightarrow\begin{pmatrix} E & -Q_x \\ -Q_p^* & t \end{pmatrix}\begin{pmatrix} A_e e^{-ip^{\mu}x_{\mu}} \\ A_i e^{-ip^{\mu}x_{\mu}} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix}=L_M\psi=0$$

where $\frac{E}{t}=\frac{m}{\tau}=\frac{|\mathbf{p}|}{|\mathbf{x}|}$, **p** parallels to **x**, $Q_x=\tau+i\boldsymbol{\sigma}\cdot\mathbf{x}$, and $Q_x^*=\tau-i\boldsymbol{\sigma}\cdot\mathbf{x}$,

$$\begin{pmatrix} t\psi_e=(m+i\boldsymbol{\sigma}\cdot\mathbf{p})\psi_i \\ E\psi_i=(\tau-i\boldsymbol{\sigma}\cdot\mathbf{x})\psi_e \end{pmatrix} \text{ or } \begin{pmatrix} i\partial_E\psi_e=m\psi_i+\boldsymbol{\sigma}\cdot\nabla_x\psi_i \\ i\partial_E\psi_i=\tau\psi_e-\boldsymbol{\sigma}\cdot\nabla_p\psi_i \end{pmatrix} \qquad (3.85a)$$

$$0=0e^{i0}=L_0e^{-iM+iM}=\left(tE-\tau m-\mathbf{p}\cdot\mathbf{x}\right)e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}=$$

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

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

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

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

Prespacetime-premomentumenergy creates, sustains and causes evolution of a linear plane-wave photon in the dual universe comprised of the external spacetime and the internal momentum-energy space as follows:

$$1=e^{i0}=1e^{i0}=Le^{-iM+iM}=\frac{Et}{\mathbf{p}\cdot\mathbf{x}}e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}=$$

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

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

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

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

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

$$0=0e^{i0}=L_0e^{-iM+iM}=\left(Et-\mathbf{x}\cdot\mathbf{p}\right)e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}= \quad (3.88)$$

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

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

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

This photon wave function in the dual universe may be written as:

$$\psi_{photon}=\begin{pmatrix}\psi_{e,+}\\ \psi_{i,-}\end{pmatrix}=\begin{pmatrix}\mathbf{E}_{(\mathbf{x},\ t)}\\ i\mathbf{B}_{(\mathbf{p},\ E)}\end{pmatrix}=\begin{pmatrix}\mathbf{E}_{\mathbf{0}}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})}\\ i\mathbf{B}_{\mathbf{0}}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})}\end{pmatrix}=\begin{pmatrix}\mathbf{E}_{\mathbf{0}}\\ i\mathbf{B}_{\mathbf{0}}\end{pmatrix}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \quad (3.89)$$

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

$$\begin{pmatrix}i\partial_t & i\mathbf{S}\cdot\nabla_p\\ i\mathbf{S}\cdot\nabla_x & i\partial_E\end{pmatrix}\begin{pmatrix}\mathbf{E}_{(\mathbf{x},\ t)}\\ i\mathbf{B}_{(\mathbf{p},\ E)}\end{pmatrix}=0\rightarrow\begin{pmatrix}\partial_t\mathbf{E}_{(\mathbf{x},\ t)}=-\nabla_p\times\mathbf{B}_{(\mathbf{p},\ E)}\\ \partial_E\mathbf{B}_{(\mathbf{p},\ E)}=\nabla_x\times\mathbf{E}_{(\mathbf{x},\ t)}\end{pmatrix} \quad (3.90)$$

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 $\nabla_x\cdot\mathbf{E}_{(\mathbf{x},\ t)}=0$ and $\nabla_p\cdot\mathbf{B}_{(\mathbf{p},\ E)}=0$ are the Maxwell-like equations in the source-free vacuum in the dual universe comprised of the external spacetime and internal momentum-energy space.

Prespacetime-premomentumenergy creates a neutrino in Dirac-like form in the dual universe comprised of the external spacetime and the internal momentum-energy space by replacing the last step of expression (3.87) with the following:

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

Expressions (3.87) - (3.91) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$1=e^{i0}=1e^{i0}=Le^{-iM+iM}=\frac{tE}{\mathbf{x}\cdot\mathbf{p}}e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}=$$
$$\left(\frac{t}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{p}|}{E}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1}\rightarrow \quad (3.87a)$$
$$\frac{t}{-|\mathbf{x}|}e^{-ip^{\mu}x_{\mu}}=\frac{-|\mathbf{p}|}{E}e^{-ip^{\mu}x_{\mu}}\rightarrow\frac{t}{-|\mathbf{x}|}e^{-ip^{\mu}x_{\mu}}-\frac{-|\mathbf{p}|}{E}e^{-ip^{\mu}x_{\mu}}=0$$

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

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

$$0=0e^{i0}=L_0e^{-iM+iM}=(tE-\mathbf{p}\cdot\mathbf{x})e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}}=$$
$$\left(Det\begin{pmatrix} t & 0 \\ 0 & E\end{pmatrix}+Det\begin{pmatrix} 0 & -|\mathbf{p}| \\ -|\mathbf{x}| & 0\end{pmatrix}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1}\rightarrow \quad (3.88a)$$
$$\left(\begin{pmatrix} t & 0 \\ 0 & E\end{pmatrix}+\begin{pmatrix} 0 & -|\mathbf{p}| \\ -|\mathbf{x}| & 0\end{pmatrix}\right)\begin{pmatrix} a_{e,+}e^{-ip^{\mu}x_{\mu}} \\ a_{i,-}e^{-ip^{\mu}x_{\mu}}\end{pmatrix}=\begin{pmatrix} t & -|\mathbf{p}| \\ -|\mathbf{x}| & E\end{pmatrix}\begin{pmatrix} a_{e,+}e^{-ip^{\mu}x_{\mu}} \\ a_{i,-}e^{-ip^{\mu}x_{\mu}}\end{pmatrix}=0$$

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

$$\psi_{photon}=\begin{pmatrix}\psi_{e,+}\\ \psi_{i,-}\end{pmatrix}=\begin{pmatrix}\mathbf{E}_{(\mathbf{p},\,\mathrm{E})}\\ i\mathbf{B}_{(\mathbf{x},\,\mathrm{t})}\end{pmatrix}=\begin{pmatrix}\mathbf{E}_0e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})}\\ i\mathbf{B}_0e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})}\end{pmatrix}=\begin{pmatrix}\mathbf{E}_0\\ i\mathbf{B}_0\end{pmatrix}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \quad (3.89a)$$

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

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

Prespacetime-premomentumenergy creates, sustains and causes evolution of a linear plane-wave antiphoton in the dual universe comprised of the external spacetime and the internal momentum-energy space as follows:

$$1=e^{i0}=1e^{i0}=Le^{+iM-iM}=\frac{Et}{\mathbf{p}\cdot\mathbf{x}}e^{+ip^{\mu}x_{\mu}-ip^{\mu}x_{\mu}}=$$

$$\left(\frac{E}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{x}|}{t}\right)^{-1}\left(e^{+ip^{\mu}x_{\mu}}\right)\left(e^{+ip^{\mu}x_{\mu}}\right)^{-1}\rightarrow \quad (3.92)$$

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

$$\rightarrow\begin{pmatrix} E & -|\mathbf{x}| \\ -|\mathbf{p}| & t \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=L_M\psi=0$$

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

This antiphoton wave function can also be written as:

$$\psi_{antiphoton}=\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=\begin{pmatrix} i\mathbf{B}_{(\mathbf{x},\,t)} \\ \mathbf{E}_{(\mathbf{p},\,E)} \end{pmatrix}=\begin{pmatrix} i\mathbf{B}_{\mathbf{0}(\mathbf{x},\,t)}e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ \mathbf{E}_{\mathbf{0}(\mathbf{p},\,E)}e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix}=\begin{pmatrix} i\mathbf{B}_{\mathbf{0}(\mathbf{x},\,t)} \\ \mathbf{E}_{\mathbf{0}(\mathbf{p},\,E)} \end{pmatrix}e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \quad (3.93)$$

Prespacetime-premomentumenergy creates an antineutrino in Dirac-like in the dual universe comprised of the external spacetime and the internal momentum-energy space form by replacing the last step of expression (3.93) with the following:

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

Expressions (3.92) - (3.94) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{tE}{\mathbf{x}\cdot\mathbf{p}} e^{+ip^{\mu}x_{\mu}-ip^{\mu}x_{\mu}} =$$

$$\left(\frac{t}{-|\mathbf{x}|}\right)\left(\frac{-|\mathbf{p}|}{E}\right)^{-1}\left(e^{+ip^{\mu}x_{\mu}}\right)\left(e^{+ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow \tag{3.92a}$$

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

$$\rightarrow \begin{pmatrix} t & -|\mathbf{p}| \\ -|\mathbf{x}| & E \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = L_M \psi = 0$$

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

$$\psi_{antiphoton} = \begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix} = \begin{pmatrix} i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \\ \mathbf{E}_{(\mathbf{x},\mathrm{t})} \end{pmatrix} = \begin{pmatrix} i\mathbf{B}_{\mathbf{0}(\mathbf{p},\mathrm{E})} e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \\ \mathbf{E}_{\mathbf{0}(\mathbf{x},\mathrm{t})} e^{+i(\omega t-\mathbf{k}\cdot\mathbf{x})} \end{pmatrix} = \begin{pmatrix} i\mathbf{B}_{\mathbf{0}(\mathbf{p},\mathrm{E})} \\ \mathbf{E}_{\mathbf{0}(\mathbf{x},\mathrm{t})} \end{pmatrix} e^{-i(\omega t-\mathbf{k}\cdot\mathbf{x})} \tag{3.93a}$$

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

Prespacetime-premomentumenergy creates, sustains and causes evolution of chiral plane-wave photons in the dual universe comprised of the external spacetime and the internal momentum-energy space as follows:

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = \left(Et - \mathbf{p}\cdot\mathbf{x}\right) e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} = \tag{3.95}$$

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

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

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

where $\frac{E}{t}=\frac{|\mathbf{p}|}{|\mathbf{x}|}$ and **p** parallels to **x**, that is, $\psi_{e,l}$ and $\psi_{i,r}$ are decoupled from each other and satisfy the following equations respectively:

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

which have the following respective solutions:

$$\psi=\begin{pmatrix}\psi_{e,l}\\ \psi_{i,r}\end{pmatrix}=\begin{pmatrix}\mathbf{E}_{(\mathbf{x},\,t)}+i\mathbf{B}_{(\mathbf{x},\,t)}\\ \mathbf{E}_{(\mathbf{p},\,E)}-i\mathbf{B}_{(\mathbf{p},\,E)}\end{pmatrix}=\begin{pmatrix}(\mathbf{E}_{0(\mathbf{x},t)}+i\mathbf{B}_{0(\mathbf{x},t)})e^{i(\omega t-\mathbf{k}\cdot\mathbf{x})}\\ (\mathbf{E}_{0(\mathbf{p},E)}-i\mathbf{B}_{0(\mathbf{p},E)})e^{i(\omega t-\mathbf{k}\cdot\mathbf{x})}\end{pmatrix} \tag{3.97}$$

$\partial_t\psi_{e,l}+\mathbf{s}\cdot\nabla_x\psi_{e,l}=0$ produces Maxwell equations in external spacetime of the source-free vacuum and $\partial_E\psi_{i,r}-\mathbf{s}\cdot\nabla_p\psi_{i,r}=0$ produce the Maxwell-like equations in internal momentum-energy space of the source-free vacuum as shown in the second expression of (3.90).

Prespacetime-premomentumenergy creates neutrinos in Weyl-like (chiral-like) forms in the dual universe comprised of the external spacetime and the internal momentum-energy space by replacing the last step of expression (3.95) with the following:

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

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

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

Expressions (3.95) - (3.99) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = (tE - \mathbf{x}\cdot\mathbf{p})e^{-ip^{\mu}x_{\mu}+ip^{\mu}x_{\mu}} = \tag{3.95a}$$

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

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

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

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

$$\psi = \begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = \begin{pmatrix} \mathbf{E}_{(\mathbf{p},\mathrm{E})} + i\mathbf{B}_{(\mathbf{p},\mathrm{E})} \\ \mathbf{E}_{(\mathbf{x},\mathrm{t})} - i\mathbf{B}_{(\mathbf{x},\mathrm{t})} \end{pmatrix} = \begin{pmatrix} (\mathbf{E}_{\mathbf{0(p,E)}} + i\mathbf{B}_{\mathbf{0(p.E)}})e^{i(\omega t - \mathbf{k}\cdot\mathbf{x})} \\ (\mathbf{E}_{\mathbf{0(x.t)}} - i\mathbf{B}_{\mathbf{0(x,t)}})e^{i(\omega t - \mathbf{k}\cdot\mathbf{x})} \end{pmatrix} \tag{3.97a}$$

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

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

Prespacetime-premomentumenergy creates and sustains timeless external wave function (timeless graviton) and energy-less internal wave functions (energy-less graviton) of an elementary particle in Dirac-like form as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{-m\tau}{\mathbf{p}\cdot\mathbf{x}}e^{-iM+iM} =$$

$$\left(\frac{-m}{-|\mathbf{p}|}\right)\left(\frac{-|\mathbf{x}|}{+\tau}\right)^{-1}\left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow \tag{3.100}$$

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

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

Alternatively, prespacetime-premomentumenergy creates and sustains timeless external wave function (timeless graviton) and energy-less internal wave functions (energy-less graviton) of an elementary particle in Dirac-like form as follows:

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

Similarly, prespacetime-premomentumenergy creates and sustains timeless external wave function (timeless graviton) and energy-less internal wave functions (energy-less graviton) of an elementary particle in Weyl-like (chiral-like) form as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{-m\tau}{\mathbf{p}\cdot\mathbf{x}} e^{-iM+iM} =$$
$$\left(\frac{-|\mathbf{p}|}{-m} \right) \left(\frac{-\tau}{+|\mathbf{x}|} \right)^{-1} \left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow \tag{3.102}$$
$$\frac{-|\mathbf{p}|}{-m} e^{-iM} = \frac{-\tau}{+|\mathbf{x}|} e^{-iM} \rightarrow \frac{-|\mathbf{p}|}{-m} e^{-iM} - \frac{-\tau}{+|\mathbf{x}|} e^{-iM} = 0$$

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

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

Alternatively, prespacetime-premomentumenergy creates and sustains timeless external wave function (timeless graviton) and energy-less internal wave functions (energy-less graviton) of an elementary particle in Weyl-like (chiral-like) form as follows:

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

Expressions (3.100) - (3.103) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

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

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

$$1 = e^{i0} = 1e^{i0} = Le^{-iM+iM} = \frac{-\tau m}{\mathbf{x}\cdot\mathbf{p}} e^{-iM+iM} =$$

$$\left(\frac{-|\mathbf{x}|}{-\tau}\right)\left(\frac{-m}{+|\mathbf{p}|}\right)^{-1} \left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow \qquad (3.102a)$$

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

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

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = \left(\tau m - \mathbf{x}\cdot\mathbf{p}\right) e^{+iM-iM} =$$

$$\left(Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & +|\mathbf{p}| \end{pmatrix} + Det\begin{pmatrix} 0 & -m \\ -\tau & 0 \end{pmatrix} \right) \left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow$$

$$\left(\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & +|\mathbf{p}| \end{pmatrix} + \begin{pmatrix} 0 & -m \\ -\tau & 0 \end{pmatrix} \right) \begin{pmatrix} g_{W,e} e^{-iM} \\ g_{W,i} e^{-iM} \end{pmatrix} = \begin{pmatrix} -|\mathbf{x}| & -m \\ -\tau & +|\mathbf{p}| \end{pmatrix} \begin{pmatrix} g_{W,e} e^{-iM} \\ g_{W,i} e^{-iM} \end{pmatrix} = 0$$

$$0 = 0e^{i0} = L_0 e^{-iM+iM} = \left(\tau m - \mathbf{x}\cdot\mathbf{p}\right) e^{+iM-iM} = \qquad (3.103a)$$

$$\left(Det\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & +|\mathbf{p}| \end{pmatrix} + Det\begin{pmatrix} 0 & -m \\ -\tau & 0 \end{pmatrix} \right) \left(e^{-iM}\right)\left(e^{-iM}\right)^{-1} \rightarrow$$

$$\left(\begin{pmatrix} -|\mathbf{x}| & 0 \\ 0 & +|\mathbf{p}| \end{pmatrix} + \begin{pmatrix} 0 & -m \\ -\tau & 0 \end{pmatrix} \right) \begin{pmatrix} g_{W,e} e^{-iM} \\ g_{W,i} e^{-iM} \end{pmatrix} = \begin{pmatrix} -|\mathbf{x}| & -m \\ -\tau & +|\mathbf{p}| \end{pmatrix} \begin{pmatrix} g_{W,e} e^{-iM} \\ g_{W,i} e^{-iM} \end{pmatrix} = 0$$

Prespacetime-premomentumenergy creates and sustains spaceless (momentum independent) external wave function and momentumless (space independent) internal wave functions of an elementary particle in Dirac-like form as follows:

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

Similarly, prespacetime-premomentumenergy creates and sustains spaceless (momentum independent) external wave function and momentumless (space independent internal wave functions of an elementary particle in Weyl-like (chiral-like) form as follows:

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

Alternatively, prespacetime-premomentumenergy creates and sustains spaceless (momentum independent) external wave function and momentumless (space independent internal wave functions of an elementary particle in Weyl-like (chiral-like) form as follows:

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

Expressions (3.104) - (3.106) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$0=0e^{0}=L_0e^{-iM+iM}=\left(tE-\tau m\right)e^{-iM+iM}=$$

$$\left(Det\begin{pmatrix}t & 0\\ 0 & E\end{pmatrix}+Det\begin{pmatrix}-\tau & 0\\ 0 & +m\end{pmatrix}\right)\left(e^{-iM}\right)\left(e^{-iM}\right)^{-1}\rightarrow \tag{3.104a}$$

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

$$1=e^{0}=1e^{0}=Le^{-iM+iM}=\frac{tE}{\tau m}e^{-iM+iM}=$$

$$\left(\frac{t}{-\tau}\right)\left(\frac{-m}{E}\right)^{-1}\left(e^{-iM}\right)\left(e^{-iM}\right)^{-1}\rightarrow \tag{3.105a}$$

$$\frac{t}{-\tau}e^{-iM}=\frac{-m}{E}e^{-iM}\rightarrow\frac{t}{-\tau}e^{-iM}-\frac{-m}{E}e^{-iM}=0$$

$$\rightarrow\begin{pmatrix}t & -m\\ -\tau & E\end{pmatrix}\begin{pmatrix}g_{W,e}e^{-iM}\\ g_{W,i}e^{-iM}\end{pmatrix}=\begin{pmatrix}L_{M,e} & L_{M,i}\end{pmatrix}\begin{pmatrix}V_{W,e}\\ V_{W,i}\end{pmatrix}=L_MV_W=0$$

$$0=0e^{i0}=L_0e^{-iM+iM}=\left(tE-\tau m\right)e^{-iM+iM}=$$

$$\left(Det\begin{pmatrix}t & 0\\ 0 & E\end{pmatrix}+Det\begin{pmatrix}0 & -m\\ -\tau & 0\end{pmatrix}\right)\left(e^{-iM}\right)\left(e^{-iM}\right)^{-1}\rightarrow \tag{3.106a}$$

$$\left(\begin{pmatrix}t & 0\\ 0 & E\end{pmatrix}+\begin{pmatrix}0 & -m\\ -\tau & 0\end{pmatrix}\right)\begin{pmatrix}g_{W,e}e^{-iM}\\ g_{W,i}e^{-iM}\end{pmatrix}=\begin{pmatrix}t & -m\\ -\tau & E\end{pmatrix}\begin{pmatrix}g_{W,e}e^{-imt}\\ g_{w,i}e^{-mt}\end{pmatrix}=0$$

Prespacetime-premomentumenergy may create, sustains and causes evolution of a spatially and momentumly self-confined entity such as a proton through imaginary momentum $\mathbf{p}_i$ imaginary position $\mathbf{x}_i$ (downward self-reference such that $m\tau>Et$) in Dirac-like form in the dual universe comprised of the external spacetime and the internal momentum-energy space as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM-iM} = \frac{Et - m\tau}{\mathbf{x}_i \cdot \mathbf{p}_i} e^{-ip^{\mu}x_{\mu} - ip^{\mu}x_{\mu}} =$$

$$\left(\frac{E-m}{-|\mathbf{p}_i|}\right)\left(\frac{-|\mathbf{x}_i|}{t+\tau}\right)^{-1}\left(e^{-ip^{\mu}x_{\mu}}\right)\left(e^{-ip^{\mu}x_{\mu}}\right)^{-1} \rightarrow \tag{3.107}$$

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

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

where $\frac{t}{E} = \frac{\tau}{m} = \frac{|\mathbf{x_i}|}{|\mathbf{p_i}|}$; $\mathbf{x}_i$ parallels to $\mathbf{p}_i$; E and $\mathbf{p}_i$ are operators in spacetime only acting external wave function (they are free parameters in momentum-energy space); and t and $\mathbf{x}_i$ are operators in momentum-energy space only acting on internal wave function (they are free parameters in spacetime),After spinization of expression (3.108), we have:

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

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

Alternatively, prespacetime-premomentumenergy creates, sustain and cause evolution of the spatially and momentumly self-confined entity such as a proton in Dirac-like form in said dual universe as follows:

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(Et - m\tau - \mathbf{x}_i \cdot \mathbf{p}_i\right) e^{+ip^{\mu}x_{\mu} - ip^{\mu}x_{\mu}} = \tag{3.110}$$

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

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

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

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

where $\frac{t}{E}=\frac{\tau}{m}=\frac{|\mathbf{x_i}|}{|\mathbf{p_i}|}$ and $\mathbf{x}_i$ parallels to $\mathbf{p}_i$.

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

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

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

Expressions (3.107) - (3.112) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$1=e^{i0}=1e^{i0}=Le^{+iM-iM}=\frac{tE-\tau m}{\mathbf{p}_i\cdot\mathbf{x}_i}e^{-ip^\mu x_\mu-ip^\mu x_\mu}=$$
$$\left(\frac{t-\tau}{-|\mathbf{x}_i|}\right)\left(\frac{-|\mathbf{p}_i|}{E+m}\right)^{-1}\left(e^{-ip^\mu x_\mu}\right)\left(e^{-ip^\mu x_\mu}\right)^{-1}\rightarrow \quad (3.107a)$$
$$\frac{t-\tau}{-|\mathbf{x}_i|}e^{-ip^\mu x_\mu}=\frac{-|\mathbf{p}_i|}{E+m}e^{-ip^\mu x_\mu}\rightarrow\frac{t-\tau}{-|\mathbf{x}_i|}e^{-ip^\mu x_\mu}-\frac{-|\mathbf{p}_i|}{E+m}e^{-ip^\mu x_\mu}=0$$

$$\rightarrow\begin{pmatrix} t-\tau & -|\mathbf{p}_i| \\ -|\mathbf{x}_i| & E+m \end{pmatrix}\begin{pmatrix} s_{e,-}e^{+iEt} \\ s_{i,+}e^{+iEt} \end{pmatrix}=\begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,-} \\ \psi_{i,+} \end{pmatrix}=L_M\psi=0 \quad (3.108a)$$

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

$$0 = 0e^{i0} = L_0 e^{+iM-iM} = \left(tE - \tau m - \mathbf{p}_i \cdot \mathbf{x}_i\right) e^{+ip^\mu x_\mu - ip^\mu x_\mu} = \tag{3.110a}$$

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

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

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

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

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

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

Similarly, prespacetime-premomentumenergy may create, sustain and cause evolution of a spatially and momentumly self-confined entity such as a proton through imaginary momentum $\mathbf{p}_i$ and imaginary position $\mathbf{x}_i$ (downward self-reference) in Weyl-like (chiral-like) form in the dual universe comprised of the external spacetime and the internal momentum-energy space as follows:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM_\mu - iM} = \frac{Et - \mathbf{p}_i \cdot \mathbf{x}_i}{m\tau} e^{+ip^\mu x_\mu - ip^\mu x_\mu} =$$

$$\left(\frac{E - |\mathbf{p}_i|}{-m}\right)\left(\frac{-\tau}{t + |\mathbf{x}_i|}\right)^{-1}\left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1} \to \tag{3.113}$$

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

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

After spinization of expression (3.114), we have:

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

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

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

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

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

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

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

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

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

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

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

Expressions (3.113) - (3.120) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

$$1 = e^{i0} = 1e^{i0} = Le^{+iM_\mu - iM} = \frac{tE - \mathbf{x}_i \cdot \mathbf{p}_i}{m\tau} e^{+ip^\mu x_\mu - ip^\mu x_\mu} =$$

$$\left(\frac{t - |\mathbf{x}_i|}{-\tau}\right)\left(\frac{-m}{E + |\mathbf{p}_i|}\right)^{-1} \left(e^{+ip^\mu x_\mu}\right)\left(e^{+ip^\mu x_\mu}\right)^{-1} \rightarrow \tag{3.113a}$$

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

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

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

$$0 = 0e^{i0} = L_0 e^{+iM - iM} = \left(tE - \tau m - \mathbf{x}_i \mathbf{p}_i\right) e^{+ip^\mu x_\mu - ip^\mu x_\mu} = \tag{3.116a}$$

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

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

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

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

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

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

3.4 Scientific Genesis of Composite Entities in the Prespacetime-Premomentumenergy Model

Then, prespacetime-premomentumenergy may create, sustain and cause evolution of a neutron in a dual universe comprised of an external spacetime and internal momentum-energy space in Dirac-like form which is comprised of an unspinized proton:

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

where $\dfrac{t-e\phi_{(\mathbf{p},E)}}{E-e\phi_{(\mathbf{x},t)}}=\dfrac{\tau}{m}=\dfrac{\left|\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}\right|}{\left|\mathbf{p}_i-e\mathbf{A}_{(\mathbf{x},t)}\right|}$, $\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}$ parallels to $\mathbf{p}_i-e\mathbf{A}_{(\mathbf{x},t)}$, E and $\mathbf{p}_i$ are operators only in spacetime acting on external wave function (they are continuous parameters in momentum-energy space), and t and $\mathbf{x}_i$ are operators only in momentum-energy space acting on internal wavefunction (they are continuous parameters in spacetime), and a spinized electron:

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

where $\dfrac{t+e\phi_{(\mathbf{p},E)}-V_{(\mathbf{p},E)}}{E+e\phi_{(\mathbf{x},t)}-V_{(\mathbf{x},t)}}=\dfrac{\tau}{m}=\dfrac{\left|\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}\right|}{\left|\mathbf{p}-e\mathbf{A}_{(\mathbf{x},t)}\right|}$, $\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}$ parallels to $\mathbf{p}-e\mathbf{A}_{(\mathbf{x},t)}$, E and $\mathbf{p}$ are operators in in spacetime acting on external wavefunction (they are continuous parameters in momentum-energy space), and t and $\mathbf{x}$ are operators in momentum-energy space only acting on internal wavefunction (they are free parameters in spacetime), as follows:

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

$$=\left(\frac{Et-m\tau}{\mathbf{x}_i\cdot\mathbf{p}_i}e^{+ip^\mu x_\mu-ip^\mu x_\mu}\right)_p\left(\frac{Et-m\tau}{\mathbf{x}_i\cdot\mathbf{p}_i}e^{-ip^\mu x_\mu+ip^\mu x_\mu}\right)_e=$$

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

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

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

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, $\left(A^\mu=(\phi_{(\mathbf{x},t)},\mathbf{A}_{(\mathbf{x},t)})\right)_p$, $\left(A^\mu=(\phi_{(\mathbf{p},E)},\mathbf{A}_{(\mathbf{p},E)})\right)_p$ and $\left(A^\mu=(\phi_{(\mathbf{x},t)},\mathbf{A}_{(\mathbf{x},t)})\right)_e$, $\left(A^\mu=(\phi_{(\mathbf{p},E)},\mathbf{A}_{(\mathbf{p},E)})\right)_e$ are the electromagnetic potentials acting on unspinized proton and tightly bound spinized electron respectively, and $\left(V_{(\mathbf{x},t)}\right)_e$, $\left(V_{(\mathbf{p},E)}\right)_e$ is a binding potential from the unspinized proton acting on the spinized electron causing tight binding.

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

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

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

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

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

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

Expressions (3.121) - (3.126) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

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

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

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

$$=\left(\frac{tE-\tau m}{\mathbf{p}_i\cdot\mathbf{x}_i}e^{+ip^\mu x_\mu-ip^\mu x_\mu}\right)_p\left(\frac{tE-\tau m}{\mathbf{p}_i\cdot\mathbf{x}_i}e^{-ip^\mu x_\mu+ip^\mu x_\mu}\right)_e=$$

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

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

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

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

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

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

Then, prespacetime-premomentumenergy may create, sustain and cause evolution of a hydrogen atom in a dual universe comprised of an external spacetime and internal momentum-energy space in Dirac form comprising of a spinized proton:

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

where $\frac{t-e\phi_{(\mathbf{p},E)}}{E-e\phi_{(\mathbf{x},t)}}=\frac{\tau}{m}=\frac{|\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}|}{|\mathbf{p}_i-e\mathbf{A}_{(\mathbf{x},t)}|}$, $\mathbf{x}_i-e\mathbf{A}_{(\mathbf{p},E)}$ parallels to $\mathbf{p}_i-e\mathbf{A}_{(\mathbf{x},t)}$, E and $\mathbf{p}_i$ are operators in spacetime only acting on external wave function (they are free parameters in momentum-energy space); and t and $\mathbf{x}_i$ are operators in momentum-energy space only acting on internal wavefunction (they are free parameters in spacetime), and a spinized electron:

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

where $\frac{t+e\phi_{(\mathbf{p},E)}}{E+e\phi_{(\mathbf{x},t)}}=\frac{\tau}{m}=\frac{|\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}|}{|\mathbf{p}-e\mathbf{A}_{(\mathbf{x},t)}|}$, $\mathbf{x}-e\mathbf{A}_{(\mathbf{p},E)}$ parallels to $\mathbf{p}-e\mathbf{A}_{(\mathbf{x},t)}$, E and **p** are operators in spacetime only (they are free parameters in momentum-energy space); and t and **x** are operators in momentum-energy space only (they are free parameters in spacetime), as follows:

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

$$=\left(\frac{Et-m\tau}{\mathbf{x}_i\cdot\mathbf{p}_i}e^{+ip^\mu x_\mu-ip^\mu x_\mu}\right)_p\left(\frac{Et-m\tau}{\mathbf{x}_i\cdot\mathbf{p}_i}e^{-ip^\mu x_\mu+ip^\mu x_\mu}\right)_e=$$

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

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

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

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 $\left(A^\mu=(\phi_{(\mathbf{x}.,t)},\mathbf{A}_{(\mathbf{x}.,t)})\right)_p$, $\left(A^\mu=(\phi_{(\mathbf{p}.,E)},\mathbf{A}_{(\mathbf{p}.,E)})\right)_p$ and $\left(A^\mu=(\phi_{(\mathbf{x}.,t)},\mathbf{A}_{(\mathbf{x}.,t)})\right)_e$, $\left(A^\mu=(\phi_{(\mathbf{p}.,E)},\mathbf{A}_{(\mathbf{p}.,E)})\right)_e$ are the electromagnetic potentials acting on spinized proton and spinized electron respectively.

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

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

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

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

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

Expressions (3.127) - (3.132) have the following metamorphoses for the dual universe comprised of the external momentum-energy space and the internal spacetime:

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

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

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

$$=\left(\frac{tE-\tau E}{\mathbf{p}_i\cdot\mathbf{x}_i}e^{+ip^\mu x_\mu-ip^\mu x_\mu}\right)_p\left(\frac{tE-\tau E}{\mathbf{p}_i\cdot\mathbf{x}_i}e^{-ip^\mu x_\mu+ip^\mu x_\mu}\right)_e=$$

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

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

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

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

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

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

4. Metamorphous Prespacetime-premomentumenergy View

4.1 Metamorphoses & the Essence of Spin in the Prespacetime-premomentumenergy Model

The preceding sections make it clear that the particle e^{i0} of prespacetime-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 depending on the questions one asks and the answer one seeks.

This work also makes it clear that primordial self-referential spin in prespacetime-premomentumenergy is hierarchical and that it is the cause of primordial distinctions for creating the self-referential entities in the dual universe comprised of the external spacetime and the internal momentum-energy space. There are several levels of spin: (1) spin in the power level in prespacetime-premomentumenergy making primordial external and internal phase distinctions of external and internal wave functions; (2) spin of the prespacetime-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-momentum spinization; (4) unconfining spatial-momemtum spin through spatial-momentum spinization (electromagnetic and weak interaction) for creating bosonic and fermionic entities in the dual universe; and (5) confining spatial-momentum spin (strong interactions) creating the appearance of quarks through imaginary position-momentum (downward self-reference) in the dual universe.

4.2 The Determinant view & the meaning of Klein-Gordon-like equation in the Prespacetime-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 a dual universe comprised of an external spacetime and internal momentum-energy space in Dirac-like and Weyl-like form respectively:

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

and

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

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

$$\begin{pmatrix} (DetL_M)\psi_{e,+}\psi_{i,-}^* = (Et - m\tau - \mathbf{x}\cdot\mathbf{p})\psi_{e,+}\psi_{i,-}^* = 0 \\ (Et - m\tau - \mathbf{x}\cdot\mathbf{p})\psi_{e,+} = 0 \\ (Et - m\tau - \mathbf{x}\cdot\mathbf{p})\psi_{i,-}^* = 0 \end{pmatrix} \tag{4.3}$$

and

$$\begin{pmatrix} (DetL_M)\psi_{e,l}\psi_{i,r}^* = (Et - \mathbf{p}\cdot\mathbf{x} - \tau m)\psi_{e,l}\psi_{i,r}^* = 0 \\ (Et - \mathbf{p}\cdot\mathbf{x} - \tau m)\psi_{e,l} = 0 \\ (Et - \mathbf{p}\cdot\mathbf{x} - \tau m)\psi_{i,r}^* = 0 \end{pmatrix} \tag{4.4}$$

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$; **p** parallels to **x**, E and **p** are operators in spacetime only acting on external wave function (they are free parameters in momentum-energy space); and t and **x** are operators in momentum-energy space only acting on internal wave function (they are free parameters in spacetime).

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

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

from which we have:

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

where

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

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 quantized gravitational time.

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

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

and

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

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

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

and

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

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$; **p** parallels to **x**, E and **p** are operators in spacetime only acting on external wave function (they are free parameters in momentum-energy space); and t and **x** are operators in momentum-energy space only acting on internal wave function (they are free parameters in spacetime).

Klein-Gordon-like equation in the presence of electromagnetic potential $A^{\mu} = \left(\phi_{(\mathbf{x},t)}, \mathbf{A}_{(\mathbf{x},t)}\right)$ in spacetime and $A^{\mu} = \left(\phi_{(\mathbf{p},E)}, \mathbf{A}_{(\mathbf{p},E)}\right)$ in momentum-energy space will be treated in future articles.

4.3 Schrodinger-like Equation in the Prespacetime-premomentumenergy Model

From equation (4.3), we can obtain the following Schrodinger-like Equations:

$$E\psi_e = \hat{H}\psi_e = \left(\left(\frac{\mathbf{x}}{t}\right)\cdot\mathbf{p} + \frac{\tau m}{t}\right)\psi_e \tag{4.12}$$

that is,

$$i\hbar\partial_t\psi_e = \hat{H}\psi_e = \left(-i\hbar\left(\frac{\mathbf{x}}{t}\right)\cdot\nabla_x + \frac{\tau mc^2}{t}\right)\psi_e \tag{4.13}$$

and

$$t\psi_i = \hat{T}\psi_i = \left(\left(\frac{\mathbf{p}}{E}\right)\cdot\mathbf{x} + \frac{\tau m}{E}\right)\psi_i \tag{4.12}$$

that is,

$$i\hbar\partial_E\psi_i = \hat{T}\psi_i = \left(-i\hbar\left(\frac{\mathbf{p}}{E}\right)\cdot\nabla_p + \frac{\tau mc^2}{E}\right)\psi_i \tag{4.13}$$

4.4 The Third State of Matter in the Prespacetime-premomentumenergy Model

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 potentials or self-gravity. The unspinized entity (spinlesson) is neither a boson nor a fermion but may be classified as a third state of matter described by the unspinized equation in Dirac-like or Weyl-like (chiral-like) form, for example:

$$\begin{pmatrix} E-m & -|\mathbf{x}| \\ -|\mathbf{p}| & t+\tau \end{pmatrix}\begin{pmatrix} a_{e,+}e^{+ip^{\mu}x_{\mu}} \\ a_{i,-}e^{+ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M\psi = 0 \tag{4.14}$$

$$\begin{pmatrix} E-|\mathbf{p}| & -\tau \\ -m & t+|\mathbf{x}| \end{pmatrix}\begin{pmatrix} a_{e,l}e^{+ip^{\mu}x_{\mu}} \\ a_{i,r}e^{+ip^{\mu}x_{\mu}} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi = 0 \tag{4.15}$$

where $\frac{E}{t} = \frac{m}{\tau} = \frac{|\mathbf{p}|}{|\mathbf{x}|}$, **p** parallels to **x**.

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

$$\begin{pmatrix} E-m & -|\mathbf{x}_i| \\ -|\mathbf{p}_i| & t+\tau \end{pmatrix}\begin{pmatrix} s_{e,+}e^{+iEt} \\ s_{i,-}e^{+iEt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \psi = 0 \tag{4.16}$$

$$\begin{pmatrix} E-|\mathbf{p}_i| & -\tau \\ -m & t+|\mathbf{x}_i| \end{pmatrix}\begin{pmatrix} s_{e,l}e^{+iEt} \\ s_{i,r}e^{+iEt} \end{pmatrix} = \begin{pmatrix} L_{M,e} & L_{M,i} \end{pmatrix}\begin{pmatrix} \psi_{e,l} \\ \psi_{i,r} \end{pmatrix} = L_M \psi = 0 \tag{4.17}$$

where $\frac{t}{E} = \frac{\tau}{m} = \frac{|\mathbf{x_i}|}{|\mathbf{p_i}|}$ and $\mathbf{x}_i$ parallels to $\mathbf{p}_i$.

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 in 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 Prespacetime-premomentumenergy 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:

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

that is, for example:

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

and the following reverse process:

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

that is, for example:

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

Processes (5.1) and (5.3) only conserve spin in the dual universe as a whole. 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) may occur 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 mass *m* in external spacetime, intrinsic proper time τ in momentum-energy space, and charge *e* respectively but spinless:

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

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

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

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

$$\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix}=N\begin{pmatrix} e^{-ip^{\mu}x_{\mu}} \\ \frac{|\mathbf{p}|}{t+\tau}e^{-ip^{\mu}x_{\mu}} \end{pmatrix}=N\begin{pmatrix} 1 \\ \frac{|\mathbf{p}|}{t+\tau} \end{pmatrix}e^{-ip^{\mu}x_{\mu}} \tag{5.7}$$

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

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

After spinization of solution (5.7):

$$\begin{pmatrix} 1 \\ \frac{|\mathbf{p}|}{t+\tau} \end{pmatrix} \to \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ \frac{\sigma\cdot\mathbf{p}}{t+\tau} & \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ \frac{p_z}{t+\tau} & \frac{p_x - ip_y}{t+\tau} \\ \frac{p_x + ip_y}{t+\tau} & \frac{-p_z}{t+\tau} \end{pmatrix} \tag{5.9}$$

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

$$\begin{pmatrix} \psi_{e,+}^{\uparrow} \\ \psi_{i,-} \end{pmatrix} = N \begin{pmatrix} 1 \\ 0 \\ \frac{p_z}{t+\tau} \\ \frac{p_z + ip_y}{t+\tau} \end{pmatrix} e^{-ip^{\mu}x_{\mu}} \text{ and } \begin{pmatrix} \psi_{e,+}^{\downarrow} \\ \psi_{i,-} \end{pmatrix} = N \begin{pmatrix} 0 \\ 1 \\ \frac{p_x - ip_y}{t+\tau} \\ \frac{-p_z}{t+\tau} \end{pmatrix} e^{-ip^{\mu}x_{\mu}} \tag{5.10}$$

Prespacetime-premomentumenergy may allow the following bosonic spinization of massive spinless particle:

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

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{x} + I_3) - Det(I_3)\right)} \leftrightarrow \mathbf{s}\cdot\mathbf{x} \tag{5.11}$$

that is, for example:

$$\begin{pmatrix} E-m & -|\mathbf{x}| \\ -|\mathbf{p}| & t+\tau \end{pmatrix} \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \leftrightarrow \begin{pmatrix} E-m & -\mathrm{s}\cdot\mathbf{x} \\ -\mathrm{s}\cdot\mathbf{p} & t+\tau \end{pmatrix} \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \tag{5.12}$$

and/or

$$|\mathbf{p}| = \sqrt{\mathbf{p}^2} = \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{p} + I_3) - Det(I_3)\right)} \to \mathbf{s}\cdot\mathbf{p} \to (\sigma\cdot\mathbf{p})_1 + (\sigma\cdot\mathbf{p})_2$$

$$|\mathbf{x}| = \sqrt{\mathbf{x}^2} = \sqrt{-\left(Det(\mathbf{s}\cdot\mathbf{x} + I_3) - Det(I_3)\right)} \to \mathbf{s}\cdot\mathbf{x} \to (\sigma\cdot\mathbf{x})_1 + (\sigma\cdot\mathbf{x})_2 \tag{5.13}$$

that is, for example:

$$\begin{pmatrix} E-m & -|\mathbf{x}| \\ -|\mathbf{p}| & t+\tau \end{pmatrix} \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \to \begin{pmatrix} E-m & -\mathrm{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{p} & t+\tau \end{pmatrix} \begin{pmatrix} \psi_e \\ \psi_i \end{pmatrix} = 0 \tag{5.14}$$

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

The spinized equation in expression (5.12) for a free massive spin 1 particle may take the following Dirac-like form:

$$\begin{pmatrix} E-m & -\mathrm{s}\cdot\mathbf{p} \\ -\mathrm{s}\cdot\mathbf{p} & t+\tau \end{pmatrix}\begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \begin{pmatrix} \psi_{e,+} \\ \psi_{i,-} \end{pmatrix} = L_M \begin{pmatrix} \mathbf{E}_{(\mathbf{x},\,\mathrm{t})} \\ i\mathbf{B}_{(\mathbf{p},\,\mathrm{E})} \end{pmatrix} = L_M \psi = 0 \tag{5.15}$$

or

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

After calculating the determinant:

$$Det_s \begin{pmatrix} E-m & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{p} & t+\tau \end{pmatrix} = (E-m)(t+\tau) - (-\mathbf{s}\cdot\mathbf{x})(-\mathbf{s}\cdot\mathbf{p}) \tag{5.17}$$

We obtain the following:

$$Det_s \begin{pmatrix} E-m & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{p} & t+\tau \end{pmatrix} = (Et - m\tau - \mathbf{x}\cdot\mathbf{p}) I_3 - \begin{pmatrix} xp_x & xp_y & xp_z \\ yp_z & yp_y & yp_z \\ zp_x & zp_y & zp_z \end{pmatrix} \tag{5.18}$$

$$= (Et - m\tau - \mathbf{x}\cdot\mathbf{p}) I_3 - M_T$$

As mentioned in § 3, the last term M_T in expression (5.18) makes fundamental relation $Et - m\tau - \mathbf{x}\cdot\mathbf{p} = 0$ not to hold in the determinant view (5.17) unless the action of M_T on the external and internal components of the wave function produces null result, that is:

$$M_T \begin{pmatrix} E_x \\ E_y \\ E_z \end{pmatrix} = -(x+y+z)\nabla_{\mathrm{x}} \cdot \mathbf{E}_{(\mathbf{x},\,\mathrm{t})} = 0 \tag{5.19}$$

and

$$M_T \begin{pmatrix} B_x \\ B_y \\ B_z \end{pmatrix} = -(p_x + p_y + p_z)\nabla_{\mathrm{p}} \cdot \mathbf{B}_{(\mathbf{p},\mathrm{E})} = 0 \tag{5.20}$$

6. EM Interaction in the Prespacetime-momentumenergy Model

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

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

that is, for example:

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

and the following reverse process (unspinizing absorption):

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

that is, for example:

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

Assuming a plane wave $\psi_{e,+} = e^{-ip^{\mu}x_{\mu}}$ exists for the spinless and massless particle:

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

we obtain the following solution for this equation:

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

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

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

After spinization:

$$\frac{|\mathbf{p}|}{t} \rightarrow \frac{\mathbf{s}\cdot\mathbf{p}}{t} = \begin{pmatrix} 0 & \frac{-ip_z}{t} & \frac{ip_y}{t} \\ \frac{ip_z}{t} & 0 & -\frac{p_x}{t} \\ -\frac{ip_y}{t} & \frac{ip_x}{t} & 0 \end{pmatrix} \tag{6.8}$$

We arrive at the plane-wave solution:

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

for the spinized photon equation:

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

For bosonic spinization $|\mathbf{p}| = \sqrt{\mathbf{p}^2} \rightarrow \mathbf{s}\cdot\mathbf{p}$ and $|\mathbf{x}| = \sqrt{\mathbf{x}^2} \rightarrow \mathbf{s}\cdot\mathbf{x}$, the Maxwell-like equations in the vacuum in the spacetime-momentumenergy unverse may be written as follows:

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

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

If we calculate the determinant:

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

We obtain the following:

$$Det_s \begin{pmatrix} E & -\mathbf{s}\cdot\mathbf{x} \\ -\mathbf{s}\cdot\mathbf{p} & t \end{pmatrix} = (Et - \mathbf{x}\cdot\mathbf{p})I_3 - \begin{pmatrix} xp_x & xp_y & xp_z \\ yp_z & yp_y & yp_z \\ zp_x & zp_y & zp_z \end{pmatrix} = (Et - \mathbf{x}\cdot\mathbf{p})I_3 - M_T \tag{6.13}$$

The last term M_T in expression (6.13) makes fundamental relation $Et - \mathbf{x}\cdot\mathbf{p} = 0$ 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.

If source $(\rho_{(\mathbf{p},E)}, \mathbf{j}_{(\mathbf{x},t)}) \neq 0$ in the spacetime-momentumenergy universe, we may have instead:

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

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

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

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

which gives:

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

If source $\left(\rho_{(\mathbf{p},E)}, \mathbf{j}_{(\mathbf{x},t)}\right) \neq 0$, we may have:

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

which gives:

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

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 $\mathbf{E}_{(\mathbf{x},\, \mathrm{t})}$ 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 $\mathbf{E}_{(\mathbf{x},\, \mathrm{t})}$ is the external wave function (external object) and its magnetic field $\mathbf{B}_{(\mathbf{p},\, \mathrm{E})}$ is the internal wave function (internal object). These two fields are always self-entangled and their entanglement is their self-gravity. Therefore, the relation between $\mathbf{E}_{(\mathbf{x},\, \mathrm{t})}$ and $\mathbf{B}_{(\mathbf{p},\, \mathrm{E})}$ in a propagating electromagnetic wave is not that change in $\mathbf{E}_{(\mathbf{x},\, \mathrm{t})}$ induces $\mathbf{B}_{(\mathbf{p},\, \mathrm{E})}$ *vice versa* but that change in $\mathbf{E}_{(\mathbf{x},\, \mathrm{t})}$ is always accompanied by change in $\mathbf{B}_{(\mathbf{p},\, \mathrm{E})}$ *vice versa* due to their entanglement (self-gravity). That is, the relationship between $\mathbf{E}_{(\mathbf{x},\, \mathrm{t})}$ and $\mathbf{B}_{(\mathbf{p},\, \mathrm{E})}$ are gravitational and instantaneous.

7. Strong Interaction in the Prespacetime-momentumenergy 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 does not involve spinization, that is, strong force is a confining process.

In order to achieve confinement of a nucleon or stability of the nucleus, we suggest that, in the dual universe comprised of the external spacetime and internal momentum-energy space, strong interaction may involve imaginary momentum and imaginary position respectively in the confinement zone as illustrated below. We have suggested in § 3 that the proton may be considered as an elementary particle that accomplishes spatial and momentum self-confinement through downward self-reference (imaginary momentum and imaginary position).

8. Gravity in the Prespacetime-momentumenergy Model

Gravity in the spacetime-momentumenergy universe is quantum entanglement (instantaneous interaction) across the dual universe comprised of the external spacetime and internal momentum-energy space. 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 external or internal universe 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. We focus here on three particular forms of gravitational fields.

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

$$-m\tau - \mathbf{x}\cdot\mathbf{p} = 0 \quad \text{or} \quad m\tau + \mathbf{x}\cdot\mathbf{p} = 0 \tag{8.1}$$

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

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

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

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

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

and

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

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

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

and

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

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

$$Et - m\tau = 0 \tag{8.18}$$

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

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

and

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

and the equation of spaceless and momemtumless wave functions (self-fields) are respectively the follows:

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

and

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

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:

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

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

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

or

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

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

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

When $m=\tau=0$, we have from fundamental relationship (3.4):

$$Et - \mathbf{x} \cdot \mathbf{p} = 0 \tag{8.31}$$

We can regard expression (8.31) as a relationship governing the massless and intrinsic-proper-time-less dual universe in which the total mass and intrinsic-proper-time are both zero. As shown in § 3, the intrinsic-proper-time-less matrix law in Dirac-like and Weyl-like form is respectively the following:

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

and

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

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

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

and

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

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:

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

The solutions to equation (8.34) are in the forms of:

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

or

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

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

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

or

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

Equations (8.34) and (8.35) describe the self-interaction of external and internal spinless wave functions (self-fields).

9. Human Consciousness in the Spacetime-momentumenergy Universe

We now briefly discuss human consciousness in the prespacetime-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 prespacetime-premomentumenergy has both transcendental and immanent properties. The transcendental aspect of Consciousness as prespacetime-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 prespacetime-premomentumenergy observes the external object (wavefunction) in the external spacetime through the internal object (wavefunction) in the internal momentum-energy space.

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

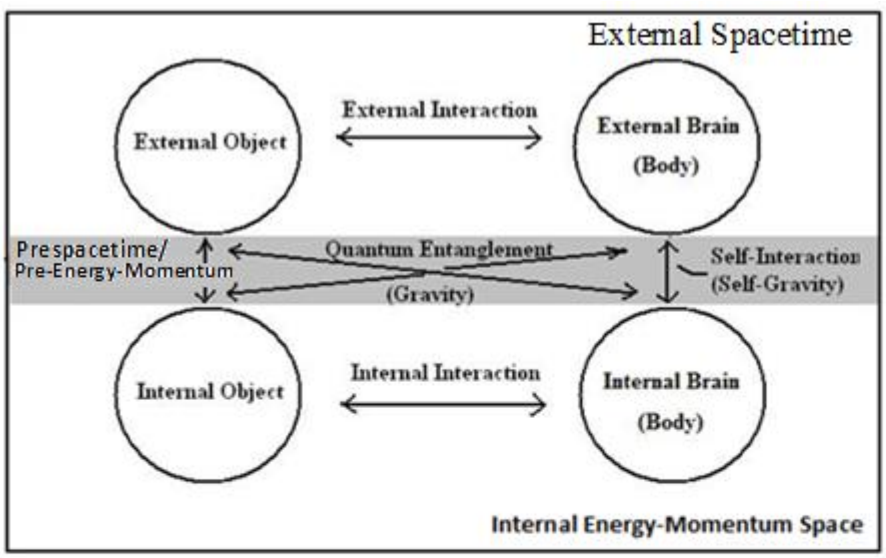

Figure 9.1 Interaction between an object and the brain (body) in the dual universe

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 prespacetime-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 world outside our brain (body) is associated with our brain (body) through quantum entanglement thus influencing and/or generating not only our feelings, emotions and dreams but also the physical, chemical and physiological states of our brain and body.

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

$$\partial_t V_m = -\frac{1}{C_m}\left(\sum_i (V_m - E_i) g_i\right) \tag{9.1}$$

where V_m is the electric potential across the neural membranes, C_m is the capacitance of the membranes and g_i is the ith voltage-gated or constant-leak ion channel; and

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

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 ith voltage-gated or constant-leak ion channel.

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

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

and electromagnetic fields $\mathbf{E}_{(\mathbf{p},\ E)}$ and $\mathbf{B}_{(\mathbf{p},\ E)}$ or their four-potential $A^{\mu}{}_{(\mathbf{p},E)} = (\phi_{(\mathbf{p},E)}, \mathbf{A}_{(\mathbf{p},E)})$ in the internal momentum-energy space:

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

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

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

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

and

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

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

where β and $\boldsymbol{\alpha}$ are Dirac matrices and $\left(\rho_{(\mathbf{p},E)},\mathbf{j}_{(\mathbf{x},t)}\right)$ is the electric density in the internal momentum-energy space and current in external spacetime respectively.

10. Some Questions & Answers

1. Do the uncertainty principle and commutation relations among energy, momentum, time and position hold in the prespacetime-premomentumenergy model? Yes, they hold separately in the external spacetime and the internal momentum-energy space. In external spacetime, time and position are continuous parameters and energy and momentum are quantized dynamical variables. In the internal momentum-energy space, time and position are quantized dynamical variables and energy and momentum are continuous parameters.

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

3. What is the foundation of the dual universe comprised of the external spacetime and the internal momentum-energy space? The foundation is prespacetime-premomentumenergy which is omnipotent, omniscient and omnipresent.

4. Was there something before the dual universe comprised of the external spacetime and the internal momentum-energy space was born (if there was such birth)? Yes,

prespacetime-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 prespacetime-premomentumenergy create, sustain and cause evolution of the dual universe comprised of the external spacetime and the internal momentum-energy space and all entities in it? Prespacetime-premomentumenergy does these things by hierarchical self-referential spin of itself at its free will.

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

7. How does prespacetime-premomentumenergy govern the dual universe comprised of the external spacetime and the internal momentum-energy space? Prespacetime-premomentumenergy governs through metamorphous self-referential matrix law.

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

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

10. What is quantum entanglement in the prespacetime-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 the prespacetime-premomentumenergy model which is outside spacetime and momentum-energy.

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

12. What is strong force in the prespacetime-premomentumenergy model? It is downward self-reference through imaginary momentum in the external spacetime and imaginary position in the internal momentum-energy space.

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

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

15. What is gravity in the prespacetime-premomentumenergy model? It is quantum entanglement across the dual universe comprised of the external spacetime and the internal momentum-energy space 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.

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

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

18. What is quantum information in the prespacetime-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.

19. What is the meaning of imaginary unit *i* in the prespacetime-premomentumenergy model? It is the most elementary self-referential process. As imagination of prespacetime-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 prespacetime-premomentumenergy.

20. What is Consciousness? Consciousness is prespacetime-premomentumenergy which is omnipotent, omniscient and omnipresent.

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

22. 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.

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

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

25. 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 prespacetime-premomentumenergy or reincarnate into a different form of individual consciousness that may be able to recall its past.

26. 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 prespacetime-premomentumenergy equation.

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

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

29. 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.

30. 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.

31. 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 prespacetime-premomentumenergy model of elementary particles, four forces and human consciousness is formulated, which may illustrate how the self-referential hierarchical spin structure of the prespacetime-premomentumenergy provides a foundation for creating, sustaining and causing evolution of elementary particles through matrixing processes embedded in said prespacetime-premomentumenergy. This model generates elementary particles and their governing matrix laws for a dual universe (quantum frame) comprised of an external spacetime and an internal energy-momentum of a dual universe. 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. Then, the premomentumenergy model described recently 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. These quantum frames and their metamorphoses may be interconnected through quantum jumps as demonstrated in forthcoming articles.

The prespacetime-premomentumenergy model may reveal 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 spacetime and an internal wave function or internal object in the internal momentum-energy space. The model may provide a unified causal structure in said dual universe (quantum frame) for weak interaction, strong interaction, electromagnetic interaction, gravitational interaction, quantum entanglement, human consciousness. The model may also provide 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.

In the beginning there was prespacetime-premomentumenergy e^{i0} materially empty but 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 spacetime and internal momentum-energy space, caused them to interact through self-referential matrix law and thus gave birth to the dual universe (quantum frame) comprised of said external spacetime and internal momentum-energy space which it has since sustained and made to evolve.

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

The prespacetime-premomentumenergy can be self-acted on by self-referential matrix law L_M. The prespacetime-premomentumenergy has imagining power *i* to project external and internal objects by projecting, e.g., external and internal phase $\pm M=\pm(Et-\boldsymbol{p}\cdot\boldsymbol{x})/\hbar$ at the power level of prespacetime-premomentumenergy. The universe so created is a dual universe (quantum frame) comprising of the external spacetime with a relativistic frame $x^{\mu}=(t, \boldsymbol{x})$ and internal momentum-energy space with a relativistic frame $p^{\mu}=(E/c, \boldsymbol{p})$. The absolute frame of reference is the prespacetime-premomentumenergy itself. Thus, if prespacetime-premomentumenergy stops imagining ($i0$=0), the dual universe (quantum frame) would disappear into materially nothingness $e^{i0}=e^0=1$.

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

Some other basic conclusions are: (1) the two spinors of the Dirac electron or positron in this dual universe (quantum frame) 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 universe are respectively the external and internal objects of a photon which are always self-entangled.

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

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