Bi-Vacuum, Sub-elementary particles and Dynamic Model of Corpuscle – Wave Duality

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Abstract Our Dynamic Model of Corpuscle-Wave $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ Duality elaborated, is based on the new notion of BI-VACUUM. The hypothesis of bi-vacuum postulates the existence of POSITIVE (real) and NEGATIVE (mirror) vacuum as two non mixing 'oceans' of superfluid quantum liquid from virtual quanta of the opposite energies. The unified system of positive and negative vacuum is termed: BI-VACUUM. It is assumed to be an infinitive source of **bi-vacuum fermions** with half-integer positive ($\mathrm{BVF}^{\uparrow}$) and negative ($\mathrm{BVF}^{\downarrow}$) spins and **bi-vacuum bosons** (BVB^0) of zero spin. In accordance to our model, ($\mathrm{BVF}^{\uparrow}$) and ($\mathrm{BVF}^{\downarrow}$) represent correlated pairs of in-phase [real rotor+ mirror rotor] and [real antirotor + mirror antirotor] of opposite polarization, correspondingly. For the other hand, (BVB^0), formed by the counter phase [real rotor + mirror antirotor] may be considered as intermediate stage of conversion between ($\mathrm{BVF}^{\uparrow}$) and ($\mathrm{BVF}^{\downarrow}$). The rotors and antirotors of all of these three kind of bi-vacuum excitations, as symmetrically excited levels of energy in realms of positive (real) and negative (mirror) vacuum, are separated from each other by energetic gap, which may be different.

The **external** resulting impulse (momentum) of all of three kind of symmetric bi-vacuum excitations: $\mathbf{P_{BVB^0}}$, $\mathbf{P_{BVF^{\uparrow}}}$ and $\mathbf{P_{BVF^{\downarrow}}}$ is equal to zero as far their external group velocity is zero. This means that external virtual wave B length of these primordial excitations, as a ratio of Plank constant to impulse of virtual rotor $\left(\lambda^{ext}= \mathbf{h}/\mathbf{P}_{BVB^0,\, BVF\updownarrow} \rightarrow \infty\right)$ is tending to infinity. Such condition means infinive virtual Bose condensation of bi-vacuum and its nonlocal properties. The symmetric bi-vacuum excitations: BVB^0, $\mathrm{BVF}^{\uparrow}$ and $\mathrm{BVF}^{\downarrow}$ may have a broad spectra of radiuses and related energetic gaps, determined by energy and effective mass of excitations. In primordial vacuum in the absence of matter the number of $\mathrm{BVF}^{\uparrow}$ and $\mathrm{BVF}^{\downarrow}$ should be equal, following the Pauli principle.

The sub-elementary particles and sub-elementary antiparticles in corpuscular [C] phase represent the asymmetrically excited bi-vacuum fermions:

$$(\mathbf{BVF}^{\uparrow})^* \equiv \mathbf{F}_{\uparrow}^- \quad or \quad (\mathbf{BVF}^{\downarrow})^* \equiv \mathbf{F}_{\downarrow}^+$$

in form of [real (m_C^+) + mirror (m_C^-)] mass-dipole with opposite spins $(S = \pm\frac{1}{2})$ and charge $(e^{\pm})$. The spatial image of this mass-dipole is a correlated dynamic pair:

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[real vortex + mirror rotor]. The real inertial (m_C^+) and inertialess (m_C^-) mass are the result of bi-vacuum symmetry shift, accompanied by sub-elementary particle or sub-elementary antiparticle origination, depending on the sign of shift.

The corpuscular [C] and wave [W] phases of sub-elementary particles/antiparticles are considered in our model as two alternative phase of de Broglie wave (wave B), which are in dynamic equilibrium $[C \rightleftharpoons W]$. The frequency of $[C \rightleftharpoons W]$ pulsation is equal to frequency of quantum beats between real and mirror corpuscular states. It the full article (Kaivarainen, 2000) I demonstrate, that basically new approach, developed in this work, elucidate the quantum roots of Golden mean and may serve as effective way to unification of electromagnetic, gravitational and temporal fields.
Keywords: bi-vacuum, sub-elementary particles, corpuscle-wave duality.

1 Introduction

Einstein never accepted the Bohr's philosophy, that properties of particles cannot be analyzed without direct experimental control. Bohr's objection of EPR paradox was based on this point.

David Bohm was the first one, who made an attempt to explain wholeness of the Universe, without loosing the causality principle. Experimental discovery: "Aharonov-Bohm effect" (1950) pointing that electron is able to "feel" the presence of a magnetic field even in a regions where the probability of field existing is zero, was stimulating. For explanation of nonlocality Bohm introduced in 1952 the notion of quantum potential, which pervaded all of space. But unlike gravitational and electromagnetic fields, its influence did not decrease with distance. All the particles are interrelated by very sensitive to any perturbations quantum potential. This means that signal transmission between particles occurs instantaneously. The idea of quantum potential or active information is close to notion of pilot wave, proposed by de Broglie at the Solvay Congress in 1927.

In 1957 Bohm published a book: Causality and Chance in Modern Physics. Later he comes to conclusion, that Universe has a properties of giant, flowing hologram. Taking into account its dynamic nature, he prefer to use term: holomovement. In his book: Wholeness and the Implicate Order (1980) he develops an idea that our explicated unfolded reality is a product of enfolded (implicated) or hidden order of existence. He consider the manifestation of all forms in the universe as a result of enfolding and unfolding exchange between two orders, determined by super quantum potential.

According to Bohm, manifestation of corpuscle - wave duality of particle is dependent on the way, which observer interacts with a system. Both of this properties are always enfolded in a quantum system. It is a basic difference with our model, assuming that the wave and corpuscle phase are realized alternatively with high frequency during two different semiperiods of de Broglie wave (wave B).

Particle in accordance with Bohm is a sequence of incoming and outgoing waves, which are very close to each other. However, particle itself does not have a wave nature after Bohm. Interference pattern in double slit experiment is a result of periodically "bunched" character of quantum potential in Bohm's view.

Our duality model can explain the nonlocality and double slit experiment without using the notion of quantum potential or pilot-wave, but by the internal (hidden) dynamics of the components of elementary particles with alternating change of their properties. The important point of Bohmian philosophy, coinciding with our one, is that everything in the Universe is a part of dynamic continuum.

Serious attack on problem of quantum nonlocality was performed by Roger Penrose (1989) from Oxford University with his twister theory of space-time. In accordance with Penrose, quantum phenomena can generate space-time. The twisters, proposed by Penrose, are lines of infinite extent, resembling twisting light rays. Interception or conjunction of twistors lead to origination of particles. In such a way the local and nonlocal properties and particle-wave duality are interrelated in twistor geometry.

The analysis of main quantum paradoxes was presented by Asher Peres (1992) and Charles Bennett et. al, (1993). One of the most important question is related with possibility of existing of hidden parameters in quantum system. Searching of such parameters was strongly discouraged by a theorem of Von Neumann (1955), claiming to show their to be unnecessary for explanation the known quantum phenomena. Bohm proved his disagreement with such formal statistical interpretation of quantum theory and with conclusions of Von Neuman (Bohm & Hiley, 1993), concerning nonexistence of hidden parameters. We assume in our model that hidden (internal) parameters of elementary particles are existing. It is shown in our work that in corpuscular phase they are interrelated in definite way with external, experimentally detectable parameters.

It is important to note, that quite different approach for computational derivation of quantum relativist systems with forward-backward space-time shifts, developed by Daniel Dubois (1999, 2000), led to some results, similar to ours (Kaivarainen, 1993, 1995, 2000). For example, introduced in his theory group and phase masses, related to internal group and phase velocities has analogy with our real and mirror masses.

2 Basic Notions of New Model of Bi-Vacuum

The new Dynamic Model of Corpuscle -Wave $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ Duality elaborated, is based on the new notion of BI-VACUUM. The hypothesis of bi-vacuum assumes the existence of POSITIVE and NEGATIVE vacuum as two non mixing 'oceans' of superfluid quantum liquid from virtual quanta of the opposite energies. Bi-vacuum is composed from metastable pairs of virtual excitations with two opposite polarization, termed Bi-vacuum Fermions ($BVF^{\pm}$) and Bi-Vacuum Bosons ($BVB^{\pm}$). The $BVB^{\pm}$ are considered as intermediate stage of conversion between $BVF^{\pm}$ of opposite half-integer spins. In accordance to our model, the rotors and antirotors in such pairs are separated and isolated from each other by **energetic gap**, equal to difference between ground or symmetrically excited levels of energy in realms of positive (real) and negative (mirror) vacuum.

The deep symmetry of our bi-vacuum in the absence of matter makes it principally different of Dirac's vacuum (1928, 1930), where its realm of negative energy is filled with electrons. In accordance to his model, the transitions in this realm, filled with fermions, are prohibited due to Pauli principle and cannot be registered directly. However the "hole" in the negative vacuum empirically could be registered as a particle of positive energy and charge (antielectron). Oppenheimer (1930) termed such antiparticle as **positron**. Later the existence of positron was confirmed experimentally. The antiparticles for bosons were revealed experimentally also. Consequently, it becomes clear the Dirac's model, based on Pauli principle, valid only for fermions, is not totally correct.

2.1 Properties of bi-vacuum bosons and bi-vacuum fermions

The unified system of positive and negative vacuum, termed BI-VACUUM, is assumed to be an infinitive source of bi-vacuum fermions ($\mathrm{BVF}^{\pm}$) and bi-vacuum bosons ($\mathrm{BVB}^{\pm}$). Bi-vacuum fermions ($\mathrm{BVF}^{\pm}$) are formed by pairs of [real rotor ($\mathbf{V}^{\pm}$) + mirror rotor ($\mathbf{V}^{\pm}$)], rotating in-phase in two opposite directions:

$$\mathbf{BVF}^{\uparrow} = \mathbf{V}^{+} \upuparrows \mathbf{V}^{-} \quad \textbf{and} \quad \mathbf{BVF}^{\downarrow} = \mathbf{V}^{+} \downdownarrows \mathbf{V}^{-}$$

These two polarization determine the internal spins ($S = \pm\frac{1}{2}$) of $\mathrm{BVF}^{\pm}$.

Bi-vacuum bosons are formed by pair of contra-rotating [real rotor (V^{-}) + mirror antirotor ($\mathbf{V}^{-}$)] with resulting internal spin, equal to zero ($S = 0$) and two possible polarization:

$$\mathbf{BVB}^{+} = \left[\mathbf{V}^{-} \longleftrightarrow \mathbf{V}^{-}\right] \quad \textbf{and} \quad \mathbf{BVB}^{-} = \left[\mathbf{V}^{-} \longleftrightarrow \mathbf{V}^{-}\right]$$

Here $\mathbf{V}^{+}$ and $\mathbf{V}^{-}$ mean clock-wise circulation and opposite ($\longleftrightarrow$) circulation in realms of positive and negative superfluid vacuum, correspondingly. In accordance to idea, proposed by Neil Boid, the dimensions of sub-quantum particles, forming vacuum, may be under Plank scale.

The **external** resulting impulse (momentum) of all of three kind of symmetric bi-vacuum excitations: $\mathbf{P}_{\mathbf{BVB^0}}$, $\mathbf{P}_{\mathbf{BVF}^{\uparrow}}$ and $\mathbf{P}_{\mathbf{BVF}^{\downarrow}}$ is equal to zero as far their external group velocity (v) is zero. This means that external virtual wave B length of these excitations, as a ratio of Plank constant to impulse of virtual rotor is tending to infinity:

$$\lambda^{ext} = \mathbf{h}/\mathbf{P}_{BVB^0,\ BVF\updownarrow} \rightarrow \infty \quad \textbf{at} \quad \mathbf{v} \rightarrow \mathbf{0}$$

Such condition means infinive virtual Bose condensation of bi-vacuum and its nonlocal properties. It was shown, using Virial theorem, that nonlocality, as independence of potential on distance, is a consequence of infinitive Bose condensation

(Kaivarainen, 2000a). The **internal** group and phase velocities of virtual real and mirror rotors of BVB^0 and $\mathrm{BVF}^\updownarrow$ ($\mathbf{V}^\pm \longleftrightarrow \mathbf{V}^\pm$) are always equal to luminal, as it will be shown in this paper. The symmetric excitations: BVB^0, $\mathrm{BVF}^\uparrow$ and $\mathrm{BVF}^\downarrow$ may have a broad spectra of radiuses and energetic gaps, determined by energy and effective mass of excitations. This means a fractal hierarchic structure of bi-vacuum.

We assume that **three most probable energetic zero-point gaps of** $BVF^\uparrow$ and $BVF^\downarrow$, corresponding to three different radiuses of cosmic scale, represent three generation of neutrino and antineutrino: $(\nu_e\ and\ \widetilde{\nu}_e)$, $(\nu_\mu\ and\ \widetilde{\nu}_\mu)$, $(\nu_\tau\ and\ \widetilde{\nu}_\tau)$. The curvature of corresponding trajectory ($\mathbf{L}^{in}_{BVF} = \hbar/m_\nu c \rightarrow \infty$) may tends to infinity, as a result of mass of free neutrino and antineutrino tending to zero $(m_\nu \rightarrow 0)$. Consequently, the radius of BVF^+ and BVF^- may change from almost infinitive, pertinent for neutrino (ν) and antineutrino $(\widetilde{\nu})$, correspondingly, till to Compton radius of the electron, muon or even Plank radius. This means that bi-vacuum has a properties of fractal system.

Between the most probable radius of $\mathrm{BVF}^\updownarrow$, BVB^0 in ground state, equal to (L_V), and related bi-vacuum energetic gap (BVG), defined as A_V, we have the following relation:

$$A_V = \frac{1}{2}\hbar\omega_V - (-\frac{1}{2}\hbar\omega_V) = \hbar\omega_V = m_V c^2 = \frac{\hbar c}{L_V} \tag{2.1}$$

$$\text{where}: \ L_V = \hbar/m_V c; \quad \frac{1}{2}\hbar\omega_V = \frac{1}{2}m_V^+ c^2; \quad -\frac{1}{2}\hbar\omega_V = -\frac{1}{2}m_V^- c^2 \tag{2.1a}$$

$$m_V = \frac{1}{2}m_V^+ + \frac{1}{2}m_V^- = \frac{\hbar}{c}\frac{1}{L_V} \quad \text{is the effective mass of rotor or antirotor of } \mathrm{BVF}^\updownarrow \text{or } \mathrm{BVB}^0; \tag{2.1b}$$

$+\,m_V^+$ *and* $-\,m_V^-$ are the effective virtual masses of ground states of positive and negative vacuum

The increasing of A_V will accompanied by decreasing of L and vice verse:

$$\Delta A_V = \Delta m_V c^2 = -\frac{\hbar c}{L^2}\Delta L \tag{2.2}$$

$$\text{where}: \ \Delta m_V c^2 = \Delta \left| m_V^+ - m_V^- \right| c^2 \tag{2.2a}$$

$$\Delta L_V = -\frac{\hbar}{c}\cdot\frac{\Delta m_V}{m_V^2} \quad \text{or}: \ \Delta L_V = -L\frac{\Delta m_V}{m_V} \tag{2.2b}$$

Due to impulse and energy compensation there are no strict limitations for $\mathrm{BVF}^\updownarrow$ and BVB^0 radiuses and corresponding energetic gap values between rotor and antirotor (real and mirror).

The vacuum amplitude waves (VAW) display themselves as the oscillation of energetic slit between positive and negative ground levels of bi-vacuum:

$$\Delta A_V = (\Delta m_V^+ + \Delta m_V^-)c^2 \tag{2.2c}$$

In some cases propagation of VAW is accompanied by resonant transitions between $BVF^{\updownarrow}$ and BVB^0 of different radiuses and energetic gaps. Corresponding transition states, termed bi-vacuum transitons (VT), or their coherent combination, may be responsible for pairs of virtual [particle + antiparticle] origination/annihilation. Following the principle of uncertainty:

$$\Delta(mc^2)\,\Delta t \geq \hbar \tag{2.2d}$$

the bigger is mass-energy of virtual particles, the shorter is their life-time, equal to transition time between different $BVF^{\updownarrow}$ or BVB^0.

Between $BVB^{\pm}$ and pair of 2-dimensional rotational topological defects on a surface of discontinuity a strong analogy exists. It is supposed, that the pair of contra-rotating uniform vortex cores are connected by 1-dimensional string. This structure has some common features with macroscopic Falaco soliton, described by R. Kiehn (1997). He wrote: "This spin pairing as a topological phenomenon, is independent from size and shape and could occur at both the microscopic and cosmic scales".

In **primordial** bi-vacuum in the absence of matter the number of $BVF^{\uparrow}$ and $BVF^{\downarrow}$ should be equal, following the Pauli principle. However, in presence of gravitating matter and corresponding bi-vacuum symmetry shift: $\Delta m_V = (m_V^+ - m_V^-)$, the $[BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}]$ equilibrium constant, may differ from 1:

$$K_{BVF} = BVF^{\uparrow}/BVF^{\downarrow} = \exp\frac{(m_V^+ - m_V^-)\,c^2}{A_{BVF}} \quad (1 \geq K_{BVF} \geq 1) \tag{2.3}$$

$$\text{where energetic gap of } BVF^{\uparrow} \text{ and } BVF^{\downarrow}: \quad A_{BVF} = m_{BVF}\,c^2 = \frac{\hbar c}{L_{BVF}} \tag{2.3a}$$

$$\text{with radius of selected } BVF^{\updownarrow}: \quad L_{BVF} = \frac{\hbar}{m_{BVF}\,c} \tag{2.3b}$$

The constant of equilibrium K_{BVF} may change, as a result of following reasons:

a) vacuum symmetry shift in the presence of gravitating matter:

$\Delta m_V = (m_V^+ - m_V^-) \neq 0$, where $m_V^+ c^2 = \left|+\frac{1}{2}\hbar\omega_0^-\right|$ and $m_V^- c^2 = \left|-\frac{1}{2}\hbar\omega_0^-\right|$ are zero-point energies of positive and negative vacuum;

b) under the influence of magnetic field $(\vec{H})$ of different interaction with magnetic moments of $\mu_{BVF^{\uparrow}}$ and $\mu_{BVF^{\downarrow}}$;

c) under the influence of kinetic energy of spinning bodies: $E_T = M\omega^2 L^2$, depending on direction of rotation (torsion field).

Combination of factors: (a, b, c) may be responsible for Searl´s mechanic-magneto-gravity effect, produced by dynamic [rotor+stator] system.

2.2 Fusion of Elementary Particles From Sub-Elemetary Ones

The sub-elementary particles in our model, represent the local asymmetric excitations of bi-vacuum fermions with higher energy level in realm of positive and negative vacuum, corresponding to opposite elementary charges (e^- and e^+). Each of such sub-elementary fermions with different charge, may have two polarization: $(\mathrm{BVF}^\uparrow)^\pm$ and $(\mathrm{BVF}^\downarrow)^\pm$, corresponding to opposite spins ($S = \pm\frac{1}{2}$).

The following notations will be used for asymmetrically excited bi-vacuum sub-elementary fermions/antifermions with opposite elementary charge and spins:

$$\text{sub-elementary fermion: } \mathbf{F}_\uparrow^- = \left(\mathbf{BVF}^\uparrow\right)^- \ \textit{with}\ \mathbf{S} = +\frac{1}{2} \tag{2.4}$$

$$\text{and } \ \mathbf{F}_\downarrow^- = \left(\mathbf{BVF}^\downarrow\right)^- \ \textit{with}\ \mathbf{S} = -\frac{1}{2} \ \ (\mathbf{Z} = \mathbf{e}^-) \tag{2.4a}$$

$$\text{sub-elementary antifermion: } \mathbf{F}_\uparrow^+ = \left(\mathbf{BVF}^\uparrow\right)^- \ \textit{with}\ \mathbf{S} = +\frac{1}{2} \tag{2.5}$$

$$\text{and } \ \mathbf{F}_\downarrow^+ = \left(\mathbf{BVF}^\downarrow\right)^+ \ \textit{with}\ \mathbf{S} = -\frac{1}{2} \ \ (\mathbf{Z} = \mathbf{e}^+) \tag{2.5a}$$

It is assumed, that the **fusion of triplets** from sub-elementary particles, like $(\mathrm{BVF}^\pm)^*$ and unification of **coherent clusters of such triplets** - form the elementary particles, like electron, positron, quarks, etc. For example, the electron and positron may be presented as:

electron's composition :

$$\langle [\mathbf{F}_\uparrow^- \bowtie \mathbf{F}_\downarrow^-] + \mathbf{F}_\downarrow^- \rangle \ \tilde{}\ e^- \ \ (S = -\frac{1}{2}) \tag{2.6}$$

$$or: \ \langle [\mathbf{F}_\downarrow^- \bowtie \mathbf{F}_\uparrow^+] + \mathbf{F}_\uparrow^- \rangle \ \tilde{}\ e^- \ \ (S = +\frac{1}{2}) \tag{2.6a}$$

positron composition :

$$\langle [\mathbf{F}_\uparrow^- \bowtie \mathbf{F}_\downarrow^+] + \mathbf{F}_\downarrow^- \rangle \ \tilde{}\, e^- \ \ (S = -\frac{1}{2}) \tag{2.7}$$

$$\langle [\mathbf{F}_\downarrow^- \bowtie \mathbf{F}_\uparrow^+] + \mathbf{F}_\uparrow^- \rangle \ \tilde{}\, e^- \ \ (S = +\frac{1}{2}) \tag{2.7a}$$

The sign ($\bowtie$) means, that energy, impulse, charge and other properties of sub-elementary particle ($\mathbf{F}^+$) and sub-elementary antiparticle ($\mathbf{F}^-$) in pairs $[\mathbf{F}^+ \bowtie \mathbf{F}^-]$, change in-phase and compensate each other. The external properties of each triplet, like mass, spin, charge is determined by **uncompensated** sub-elementary particle ($\mathbf{F}^-$) or sub-elementary antiparticle ($\mathbf{F}^+$).

Photon may be represented as a superposition of electron and positron in form of three pairs of $[\mathbf{F}^- + \mathbf{F}^+]$:

$$\left[3\mathbf{F}^- + 3\mathbf{F}^+\right] \tag{2.7b}$$

this corresponds to boson with resulting spin $J = 1$. The spin ($S = \pm 1$), mass ($2m_{\nu,\tilde{\nu}}$), energy, frequency (ν_p) and wave length (λ_p) of photon:

$$E_p = 2m_{\nu,\tilde{\nu}}c^2 = h\nu_p = hc/\lambda_p$$

are determined by the resulting properties of only one pair $[\mathbf{F}^{+} \rightarrowtail \mathbf{F}^{-}]^{S=+1}$ or $[\mathbf{F}^{+} \leftarrowtail \mathbf{F}^{-}]^{S=-1}$, with resulting momentum, asymmetric as respect to bi-vacuum. Two other pairs: $2[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]$ of photon are symmetric as respect to bi-vacuum. Like in electron and positron, corresponding $\mathbf{F}_{\uparrow}^{-}$ and $\mathbf{F}_{\downarrow}^{+}$ compensate the properties of each other and does not contribute to real mass, energy and spin of photon.

The main difference between **bosons and fermions** is that the former particles are composed from equal number of sub-elementary particles and sub-elementary antiparticles and the latter ones - from unequal number. Symmetry of energy distribution, but not necessary momentum, is a property of elementary bosons, responsible for their propagation in space with light velocity.

In contrast to elementary bosons, like photons, the complex bosons, like neutral atoms or molecules with spatially separated fermions: electrons and protons, compensating the spins of each other and forming the matter, are the source of vacuum symmetry shift and gravitation field.

The *u*-quark is considered in our theory as a superposition of two positron- like structures (see 1.11 and 1.12):

$$\mathbf{u} \sim [\mathbf{e}^{+} + \mathbf{e}^{-}]_{u}. \tag{2.8}$$

The *d*-quark can be composed from two electrons and one positron - like structures

$$\mathbf{d} \sim [2\mathbf{e}^{-} + 1\mathbf{e}^{-}]_{d} \tag{2.9}$$

Each of excessive standing sub-elementary particle: $\mathbf{F}^{-}$ **and** $\mathbf{F}^{-}$ in quark - has an electric charge, equal to +1/3 and -1/3 correspondingly.

In our model, the proton:

$$\mathbf{p} = [2\mathbf{u} + \mathbf{d}] \tag{2.10}$$

contains more standing sub-elementary particles with positive polarization ($12\mathbf{F}^{-}$), than that with negative polarization ($9\mathbf{F}^{-}$). Each proton contains three excessive standing sub-elementary particles $\mathbf{F}^{-}$ with their resulting spin and charge. equal and opposite to that of the electron.

The neutron:

$$\mathbf{n} = [\mathbf{d} + 2\mathbf{u}] \tag{2.11}$$

is composed from the equal number of standing excited bi-vacuum bosons (sub-elementary particles) of both polarization: ($12\mathbf{F}^{-}$) and ($12\mathbf{F}^{-}$).

3 New Dynamics Wave-Corpuscle Duality Model

Our wave-corpuscle duality model is based on assumption of correlated pulsation of sub-elementary particles, between the corpuscular [C] and wave [W] phase, which are in dynamic equilibrium. Each of these alternating phase represents corresponding semiperiod of wave B of elementary particles.

The real and mirror mass origination, pertinent for corpuscular [C] phase of sub-elementary fermions/antifermions ($\mathbf{F}_{\updownarrow}^{-}$ or $\mathbf{F}_{\updownarrow}^{+}$) is assumed to be a result of $\mathbf{BVF}^{\uparrow}$ and $\mathbf{BVF}^{\downarrow}$ asymmetric excitations.

We consider sub-elementary particles/antiparticles ($\mathbf{F}_{\updownarrow}^{-}$ or $\mathbf{F}_{\updownarrow}^{+}$), forming elementary particles in CORPUSCULAR [C] - phase as a Mass-Dipole, represented by real (m_C^+) and "mirror" (m_C^-) masses, corresponding to asymmetric excitation of bi-vacuum fermion $(\mathbf{BVF}_{\updownarrow})^*$. These masses can be positive and negative in general case: $(\pm m_C^+)$ and $(\pm m_C^-)$. However, their product, introduced as the **mass compensation principle** (Kaivarainen, 1993; 1995; 2000):

$$(\pm m_C^+)(\pm m_C^-) = m_0^2 = const \tag{3.1}$$

is always positive and equal to any elementary particle mass of rest (m_0) squared.

If we apply for real mass m_C^+, following the Einstein formula of relativist mechanics (3.2), then from (3.1), we get the velocity dependence of mirror mass in form of (3.3):

$$m_C^+ = \pm m_0/[1-(v/c)^2]^{1/2} \quad and \tag{3.2}$$

$$m_C^- = \pm m_0[1-(v/c)^2]^{1/2} \tag{3.3}$$

In accordance to our model, m_C^+ is a real **inertial** mass in realm of **excited state** of positive vacuum. The mirror mass m_C^- is **inertialess**, because it is the effective virtual mass, corresponding to circulation of sub-quantum particles in the energetic plane of **ground state** of negative realm of bi-vacuum.

The equality of the external velocity (v) of sub-elementary and elementary particle, as de Broglie wave (wave B), with its group velocity (v_{gr}) is generally accepted in quantum mechanics:

$$v = v_{gr}$$

It is easy to see from (3.2 and 3.3), that at $v \to c$, $\quad m_C^- \to \infty$ and $m_C^- \to 0$, however the mass of rest (3.1) remains constant.

It is shown below, that Corpuscle-Wave duality is a result of high-frequency oscillations (quantum beats) between the real and mirror corpuscular states of each of sub-elementary particles/antiparticles ($\mathbf{F}_{\updownarrow}^{\pm}$).

Dividing eq.(3.3) to (3.2), we get new important relations:

$$\frac{m_C^-}{m_C^+} = 1-(v/c)^2 \tag{3.4}$$

$$or:\ E_B = (m_C^+ - m_C^-)c^2 = m_C^+ v^2 = 2T_k \tag{3.5}$$

where: $m_C^+ c^2 = E_C^+$ is energy of excited state of $\mathbf{F}_\updownarrow$ of positive vacuum; $m_C^- c^2 = E_C^-$ is energy of ground state of $\mathbf{F}_\updownarrow$ of negative vacuum; $T_k = m_C^+ v^2/2$ is real kinetic energy of sub-elementary particle, equal to energy of quantum beats between real and mirror states of [C] phase and to energy of relativist wave B (E_B) in both phase [C] and [W]. From (3.4), we can see, that when the external group velocity of particle is tending to zero ($v \to 0$), then the real and mirror mass tend to each other and to rest mass: $m_C^+ \to m_C^- \to m_0$

The eq.3.5 may be presented in another terms:

$$2E_{tot}^+ - 2V^- = 2T_k \tag{3.5a}$$

where the doubled **total energy of real** [C] state of sub-elementary particle ($2E_{tot}^+$) and the doubled **potential energy of mirror** [C] state ($2V^-$) are defined, correspondingly, as:

$$2E_{tot}^+ = m_C^+ c^2 \tag{3.5b}$$

$$2V^- = m_C^- c^2 \tag{3.5c}$$

Using 3.5b and 3.5c, the eqs. 3.2 and 3.3 can be transformed to following shape:

$$\left(E_C^+\right)^2 = 4\left(E_{tot}^+\right)^2 = (m_C^+)^2 c^4 = m_0^2 c^4 + (m_C^+ v)^2 c^2 \tag{3.6}$$

$$\left(E_C^-\right)^2 = 4\left(V^-\right)^2 = (m_C^-)^2 c^4 = m_0^2 c^4 - (m_0 v)^2 c^2 \tag{3.7}$$

where: E_C^+ and E_C^- are the real and mirror energy of wave B.

The first eq. (3.6) coincides with those, obtained by Dirac. The second (3.7) is a new one.

Adding (3.6) and (3.7) we got the formulae for energy, corresponding to mass of rest of sub-elementary particle squared, taking into account its real and mirror corpuscular masses of elementary particle:

$$\begin{aligned} 2E_0^2 = 2m_0^2 c^4 = E_{tot}^2 - \left(P_C^\pm\right)^2 c^2 = \\ = c^4[(m_C^+)^2 + (m_C^-)^2] - c^2 v^2 [(m_C^+)^2 - m_0^2] \end{aligned} \tag{3.8}$$

It is possible after some reorganizations of (3.8) using (3.5) to get the formulae for the **resulting (hidden)** impulse of mass-dipole of sub-elementary particle (3.9). The resulting impulses of [C] and [W] phases are equal to each other ($P_C^\pm = P_W^\pm$) and less than **real** impulse (P_C^+) of sub-elementary particle (3.9a), detectable in experiment:

$$P_C^\pm = m_C^+(v^2/c) = (m_C^+ - m_C^-)c = P_W^\pm \tag{3.9}$$

$$P_C^+ = m_C^+ v \tag{3.9a}$$

$$\text{where}: \ [P_C^+ > P_C^\pm] \tag{3.9b}$$

Consequently, the real external wave B length ($\lambda_C^+ = h/m_C^+ v$) is shorter, than the length of hidden [real +mirror] mass-dipole, equal to that of CVC:

$$\overrightarrow{\lambda^{\pm}} = h/(m_C^+ v^2/c) = h/(m_C^+ - m_C^-)c \tag{3.9c}$$

The difference between total energies of real and mirror states of [C] phase from (3.5), is equal to energy of wave B in both phase [C] and [W]: $E_B = E_C = E_W$.

These energies can be presented in different forms:

$$E_W = \hbar\omega_B = E_C^+ - E_C^- = (m_C^+ - m_C^-)c^2 = m_C^+ v^2 = 2T_{kin}^+ = E_C : \tag{3.10}$$

$$\text{or} : E_W = E_{CVC} = \left|m_C^+ - m_0\right| c^2 + \left|m_C^- - m_0\right| c^2 = E_{VDW}^+ + E_{VSW}^- \tag{3.10a}$$

$$\text{where} : m_C^+ > m_0 > m_C^- \ \ and \ \ m_0^2 = m_C^+ m_C^- \tag{3.10b}$$

where: E_{CVC} is the energy of **cumulative virtual cloud** (CVC), composed from sub-quantum particles and representing [W] phase, in accordance to our model.

We subdivide the total energy of [W] phase in form of **cumulative virtual cloud** (CVC) - to **Vacuum Density Waves** (VDW) of positive vacuum and **Vacuum Symmetry Waves (VSW)** of negative vacuum:

$$E_{VDW}^- = \left|m_C^- - m_0\right| c^2 \tag{3.11}$$

$$E_{VSW}^- = \left|m_C^- - m_0\right| c^2 \tag{3.12}$$

The cumulative virtual cloud (CVC), representing [W] phase, propagates in bivacuum with luminal velocity. The velocity of propagation of particle in real [C] phase is limited by particle's external group velocity and can be much lower than light velocity of CVC. It means that propagation of particle in space in a course of its $[C \rightleftharpoons W]$ pulsation has a jump-way character (kangaroo effect).

The characteristic frequencies of real and mirror corpuscular states are defined as:

$$\omega_C^+ = m_C^+ c^2/\hbar, \ \ \omega_C^- = m_C^- c^2/\hbar \ \ and \ \ \omega_0 = \left(\omega_C^+ \omega_C^-\right)^{1/2} \tag{3.12a}$$

where the signs of real (m_C^+) and mirror (m_C^-) mass coincide with sign of Plank constant ($\hbar$).

The frequency of quantum beats between real and mirror states is equal to

$$\omega_B^{\pm} = [\omega_C^+ - \omega_C^-] \tag{3.13}$$

The energy of beats between two weakly interacting quantum oscillators, as between real and mirror states of [C] phase, with frequency ω_B, equal to total energy of wave B (E_B), may be expressed also as (Kaivarainen, 1992; 1993):

$$E_B = \hbar\omega_B = 2m_0 A_B^2 \omega^2 = \frac{\hbar^2}{2m_0 A_B^2} \tag{3.13a}$$

where: A_B^2 is the amplitude of wave B with rest mass: $m_0 = (m_C^+ m_C^-)^{1/2}$
The kinetic energy of the similar wave B is

$$T_k = \frac{\hbar^2}{2mL_B^2} \tag{3.14}$$

where: $L_B = \hbar/m_C^+ v$ is a real wave B length.

From the known formulae of quantum mechanics, interrelated the **external** kinetic and potential energy of the relativist wave B with its external group ($v = v_{gr}$) and phase (v_{ph}) velocities:

$$E_B = E_C = V + T_k = m_C^- \cdot v^2 = m_C^- \cdot v_{gr} v_{ph} \tag{3.15}$$

$$\text{and} : 2\frac{v_{ph}}{v_{gr}} - 1 = \frac{V}{T_k} \tag{3.16}$$

one can see, that for CVC, the condition under consideration: $2T_k = E_B = V + T_k$ corresponds to that of harmonic oscillator or standing wave:

$$V = T_k \quad at \quad v_{gr} = v_{ph} \tag{3.17}$$

The instant values of potential and kinetic energy $V = T_k$ may be equal, when the instant values of $v_{gr} = v_{ph}$ are equal. In general case (3.14b and 3.15) are true for the average values of variables.

Let us analyze the difference between 3.6 and 3.7. After some reorganization we get:

$$\Delta E_C^2 = (E_C^-)^2 - (E_C^-)^2 = (E_C^- - E_C^-)(E_C^- + E_C^-) = \tag{3.18}$$

$$\left[(m_C^-)^2 - (m_C^-)^2\right] c^4 = \left(m_C^- v^2\right)^2 \left[2(c/v)^2 - 1\right] = (2T_k)^2 \left[2(c/v)^2 - 1\right] \tag{3.19}$$

Using eqs.3.5b and 3.5c, formula (3.19) may be transformed to expression, interrelating the ratio between **internal (hidden)** potential energy of sub-elementary particle (V^-) and **external** kinetic energy (T_k) with velocity of particle (v) :

$$\frac{V^-}{T_k} = \left(\frac{c}{v}\right)^2 - 1 = \frac{v_{ph}}{v_{gr}} - 1 \tag{3.19a}$$

one can see, that at $v \to c$, the hidden potential energy of sub-elementary particle tends to zero: $V^- = E_C^-/2 \to 0$.

3.1 Spatial images

The spatial images of elementary wave B in [C] and [W] phase can be analyzed in terms of the wave numbers or energy distribution, if we transform the basic equations for real and mirror energy, squared (3.6 and 3.7) to forms:

$$\text{for real } [C^+] \text{ state}: \left(\frac{m_C^+ c}{\hbar}\right)^2 - \left(\frac{m_C^+ v}{\hbar}\right)^2 = \left(\frac{m_0 c}{\hbar}\right)^2 \tag{3.20}$$

$$\text{for mirror } [C^-] \text{ state}: \left(\frac{m_C^- c}{\hbar}\right)^2 + \left(\frac{m_0 v}{\hbar}\right)^2 = \left(\frac{m_0 c}{\hbar}\right)^2 \tag{3.20a}$$

The spatial image of energy distribution of real corpuscular state [C$^+$], defined by equation (3.20), corresponds to equilateral hyperbola (Fig.1a):

$$[C^+]: \ X_+^2 - Y_+^2 = a^2 \tag{3.21}$$

where: $X_+ = \left(k_C^+\right)_{tot} = m_C^+ c/\hbar$; $Y_+ = m_C^+ v/\hbar$; $a = m_0 c/\hbar$

The spatial image of mirror [C$^-$] state (3.20a) corresponds to circle (Fig. 1b), described by equation:

$$X_-^2 + Y_-^2 = R^2 \tag{3.22}$$

where: $X_- = (k_C^-)_{tot} = m_C^- \cdot c/\hbar$; $Y_- = (k_0)_{kin} = m_0 v/\hbar$.

The radius of mirror circle: $R = k_0 = m_0 c/\hbar$ is equal to the axe length of equilateral hyperbola: $R = a$ of real [C$^+$] state. In fact this circle represents the half of bi-vacuum boson (BVB).

The [W] phase in form of cumulative virtual cloud (CVC) originates as a result of quantum beats between real and mirror states of [C] phase of elementary wave B. Consequently, the spatial image of CVC energy distribution can be considered as a geometric difference between energetic surfaces of real [C$^+$] state as an equilateral hyperbola and that of [C$^-$] state as a mirror circle. After subtraction of left and right parts of (3.20 and 3.20a) and some reorganization, we get the energetic spatial image of [**W**] phase or [CVC] as a geometrical difference of equilateral hyperbola and circle:

$$\frac{(m_C^+)^2}{m_0^2} + \frac{(m_C^-)^2}{m_0^2}\frac{c^2}{v^2} - \frac{(m_C^+)^2}{m_0^2}\frac{c^2}{v^2} = -1 \tag{3.23}$$

This equation in dimensionless form describes the parted (two-cavity) hyperboloid (Fig. 2):

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = -1 \tag{3.24}$$

The (c) is a real semi-axe; a and $b-$ the imaginary ones.

If we consider the real and the mirror states of [C] phase as a two rotors of different shape and frequency, equal, correspondingly, to ω_C^+ and ω_C^-, then the

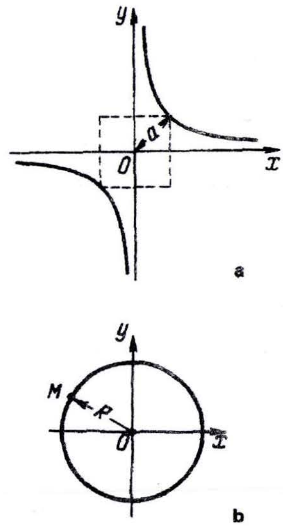

Fig. 1: 1a. Equilateral hyperbola, describing the energy distribution for real corpuscular state $[C^+]$ of sub-elementary particle (positive region) and sub-elementary antiparticle (negative region). The rotation of equilateral hyperbola around common axe of symmetry leads to origination of parted hyperboloid or conjugated pair of paraboloids of revolution. The direction of this rotation as respect to vector of particle propagation in space may be responsible for spin ($S = \pm\frac{1}{2}$). This excited state of bi-vacuum is responsible also for real mass and electric component of electromagnetic charge.

1b. Circle, describing the energy distribution for the mirror (hidden) corpuscular state $[C^-]$. It is located at zero-point level of negative realm of bi-vacuum for sub-elementary particles and at zero-point level of positive region of bi-vacuum for corresponding sub-elementary antiparticles. Circulation of virtual quanta in the ground energetic planes is responsible for magnetic properties of elementary particle in accordance to our model. Such a rotor is a part of bi-vacuum fermions ($BVF^{\updownarrow}$) and bi-vacuum bosons (BVB^0).

difference of rotors of corresponding fields of velocities: $\vec{\mathbf{V}}_C^+(r)$ and $\vec{\mathbf{V}}_C^-(r)$ can be presented as doubled energy of CVC:

$$rot[\hbar\vec{\mathbf{V}}_C^+(\mathbf{r})] - rot[\hbar\vec{\mathbf{V}}_C^-(\mathbf{r})] = \mathbf{2}\vec{\mathbf{n}}\,\hbar(\omega_C^+ - \omega_C^-) = \mathbf{2}\vec{\mathbf{n}}\,\hbar\omega_{CVC} \tag{3.25}$$

where: $\vec{\mathbf{n}}$ is the unit-vector, common for both states; $\omega_{CVC} = (\omega_C^+ - \omega_C^-)$ is frequency of beats between real and mirror rotors. All the sub-quantum microparticles of bi-vacuum as a quantum liquid, forming each of rotors, should have the

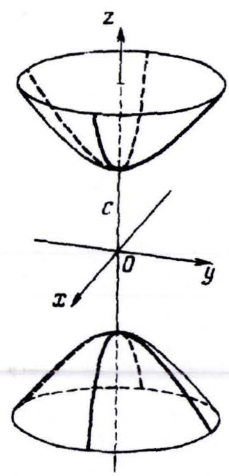

Fig. 2: The parted (two-cavity) hyperboloid (in arbitrary scale) is a spatial image of CVC, corresponding to [W] phase of elementary wave B. The positive half of this parted hyperboloid corresponds to CVC of [W] phase of sub-elementary particle and the negative one - to CVC of sub-elementary antiparticle. The whole picture may characterize the twin CVC of positive and negative energy, produced by pair of sub-elementary $[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]$, as a part of electron, positron, photon and quarks.

same angle frequency (ω_C^+ and ω_C^-). So we can see, that the energy of CVC, equal to energy of wave B ($E_B = E_{CVC} = E_W = E_C$), can be presented as:

$$E_B = \vec{\mathbf{n}}\, \hbar\omega_{CVC} = \frac{1}{2} rot[\hbar\vec{\mathbf{V}}_C^+(\mathbf{r})] - rot[\hbar\vec{\mathbf{V}}_C^-(\mathbf{r})] \tag{3.25a}$$

The spatial image of BVB^0 is a pair of [rotor + antirotor] with opposite circulation and for $\mathrm{BVF}_{\updownarrow}^{\pm}$ – with the same direction of circulation in the ground (zero-point) energetic planes of positive and negative vacuum. Their surfaces are equal, correspondingly to:

$$S_V^+ = \pi\left(L^+\right)^2 = \pi(\hbar/m^+c)^2; \quad S_V^- = \pi\left(L^-\right)^2 = \pi(\hbar/m^-c)^2 \tag{3.26}$$

For the case of totally symmetric primordial vacuum in the absence of matter, when $S_V^+ = S_V^-$, the resulting surface of $\mathrm{BVF}^{\pm}$ and BVB^0 is

$$S_V = S_V^+ + S_V^- = 2S_V^+ = 2S_V^- \tag{3.27}$$

The oscillations of S_V as a result of symmetric oscillations of bi-vacuumum gap at condition (m_C^+ - m_C^-) = 0, are related to excitations of nonlocal vacuum amplitude waves (VAW).

Let us consider the elementary wave B as a quantum harmonic oscillator, with energy quantization in the realms of positive and negative bi-vacuum:

$$E_n = \hbar\omega_B = \pm\hbar\omega\left(n + \frac{1}{2}\right) \tag{3.28}$$

where quantum number: $n = 0; 1; 2; 3...\infty$.

Two sublevels, with $n = 0$ are: $E_0^{\pm} = \pm\frac{1}{2}\hbar\omega$ correspond to positive and negative zero-point states of bi-vacuum. They are general for bi-vacuum bosons (BVB) and bi-vacuum fermions (BVF) and ground mirror states of sub-elementary particles/antiparticles.

The additional third sublevel of positive vacuum at $n = 1$: $E_{n=1}^{+} = +\frac{3}{2}\hbar\omega_0$ characterize the asymmetric bi-vacuum excitation, accompanied the sub-elementary particle origination (Fig. 3). The additional sublevel of negative vacuum: $E_{n=-1}^{-} = -\frac{3}{2}\hbar\omega$ is pertinent for sub-elementary antiparticles origination. Particles and antiparticles have the opposite symmetry of energy distribution, however, with the same absolute values.

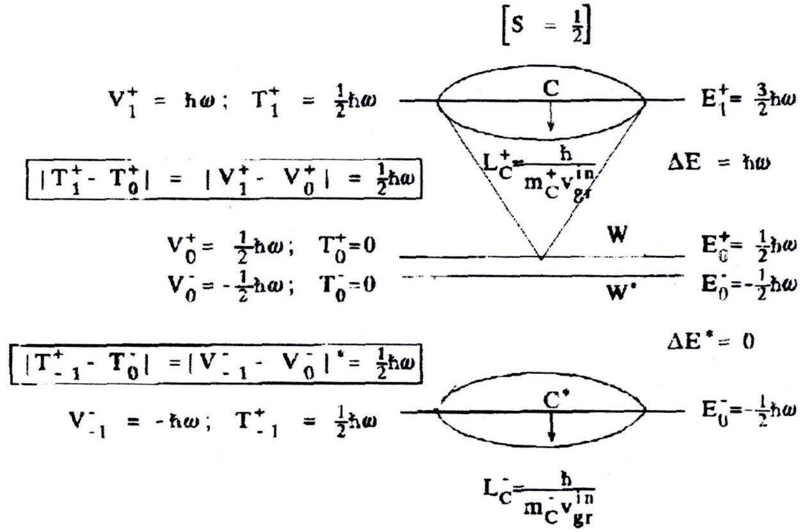

Fig. 3: The spatial image of [C] phase of elementary wave B [real vortex+mirror rotor], corresponding to [real+mirror] mass-dipole.

The real total energy of wave B as quantum oscillator in [C] and [W] phases can be defined as:

$$E_C = \frac{3}{2}\hbar\omega + (-\frac{1}{2}\hbar\omega) = \hbar\omega \text{ total energy of real and mirror states of [C] phase;} \tag{3.29}$$

$$E_W = \frac{3}{2}\hbar\omega - \frac{1}{2}\hbar\omega = \hbar\omega \text{ energy of beats between real and mirror [C] states, equal to energy of [W] phase in form of CVC}$$

4 Scenario of Sub-Elemntary Particle Propagation in Bi-Vacuum

For the end of simplification we consider the behavior of one sub-elementary particle with mass symmetry shift: $\Delta m_C = (m_C^+ - m_C^-) > 0$ in Corpuscular [C] phase. Such sub-elementary particle can exist in accordance to our model only in composition of triplets, like the electron $[2F_{\updownarrow}^{-} + F_{\updownarrow}^{+}]$, positron $[2F_{\updownarrow}^{+} + F_{\updownarrow}^{-}]$ or other more complicated elementary particles (see 2.7b - 2.11).

We can subdivide the process of sub-elementary particle dynamics (external and internal) in a course of its propagation in bi-vacuum to following three stages:

1. The particle in [C] phase, as mass-dipole of real mass (m_C^+) and mirror mass (m_C^-) **moves in bi-vacuum** with external group velocity $(v < c)$. Its resulting energy (E_C), hidden resulting impulse $(P^{\pm})$ and corresponding hidden linear dimension $(\lambda^{\pm})$, the external real impulse (P_C^{ext}) and external wave B length (λ_C^{ext}) are equal correspondingly to:

$$E_C = m_C^+ v^2 = (m_C^+ - m_C^-) c^2 \tag{4.1}$$

$$P^{\pm} = \left[(m_C^+)(\vec{v}_{gr}^{\,2}/c)\right]_C = (m_C^+ - m_C^-)c \quad and \quad \lambda^{\pm} = h/P^{\pm} \tag{4.2}$$

$$P_C^{ext} = \left[(m_C^+)v\right]_C \quad and \quad \lambda_C^{ext} = h/(m_C^+ v) < \lambda^{\pm} \tag{4.3}$$

The ratio of hidden characteristic length of wave B to real one is dependent on external group velocity:

$$\lambda^{\pm}/\lambda_C^{ext} = c/v \quad at \quad v \to c, \quad \lambda^{\pm} \to \lambda_C^{ext} \tag{4.3a}$$

2. Next stage is [C→W] transition. Its driving force is instability of [C] phase due to asymmetric composition of [real+mirror] mass - dipole (Fig. 1) from sub-quantum elements of positive and negative vacuum. As a result of this transition, the excessive energy of real corpuscular state as respect to mirror one (Fig. 3) - turns to the energy of cumulative virtual cloud (CVC), representing [W] phase. The

energy of CVC can be subdivided to energy of Vacuum Density Waves (VDW) and Vacuum Symmetry Waves (VSW):

$$E_W = E_C \tag{4.4}$$

$$\text{or}: E_{CVC} = E_W = E_{VDW} + E_{VSW} \tag{4.5}$$

$$\text{where}: \; E_{VDW} = \left|m_C^+ - m_0\right| c^2; \;\; E_{VSW} = \left|m_C^- - m_0\right| c^2$$

The hidden resulting impulse of CVC, composed from these two kinds of virtual quanta ($P_{CVC}^{\pm}$), determines the resulting radius of CVC ($L_{CVC}^{\pm}$), equal to that of corpuscular mass-dipole:

$$P_{CVC}^{\pm} = c(m_C^+ - m_C^-) = c\Delta m_C \quad and \quad L_{CVC}^{\pm} = \frac{\hbar}{(m_C^+ - m_C^-)c} \tag{4.6}$$

The spatial image of CVC is a half of two-cavity parted hyperboloid (see Fig.2), each of cavity, corresponding to positive for sub-elementary particles and negative for sub-elementary antiparticles components of CVC.

After [C→W] transition and CVC ejection, the resulting energy and the external impulse of bi-vacuum fermion, which serves as the former anchor site for CVC - tends back to zero, as far: [F ≡ (BVF)*] → BVF.

3. At the next reverse stage of our scenario, the "ejected" in a course of $[C \to W]$ transition cumulative virtual cloud (CVC), representing [W] phase of particle, binds to free BVF. The result of this CVC absorption on new anchor site is restoration of the [C] phase. This process represent back $[W \to C]$ transition. The absence of dissipation in the process of $[C \rightleftharpoons W]$ transitions in bi-vacuum, as in superfluid quantum liquid, makes them totally reversible.

The most probable distance of restoration of [C] phase ($[W \to C]$ transition) from the point of previous $[C \to W]$ transition is determined by the external wave B length (4.3). The hidden resulting wave B length ($\lambda^{\pm}$) for big ratio (c/v) may be much bigger than measurable external wave length (λ_C^{ext}) :

$$\lambda^{\pm} = \lambda_C^{ext}(c/v) \tag{4.7}$$

It means, that the distant non electromagnetic and non gravitational interaction between "slow" particles may be explained by interference of hidden resulting de Broglie waves (waves B).

The in-phase $[C \rightleftharpoons W]$ pulsations of symmetric pair of sub-elementary fermions $[F^- \bowtie F^+]$ in composition of the electron $[2F^- + F^+]$ is also accompanied by $[ejection \rightleftharpoons absorption]$ of twin CVC in form of parted hyperboloid (Fig. 2). These correlated CVC of positive and negative vacuum - totally compensate each other and do not contribute to the impulse - energy of uncompensated sub-elementary particle of triplet. However, the periodic [*emission* $\rightleftharpoons$ *absorption*] of CVC doublet may generate Vacuum Amplitude Waves (VAW), as oscillations of bi-vacuum zero-point energy slit (see 2.2 and 2.2c).

Our model do not needs the Bohmian "quantum potential" or "pilot wave" for explanation of two-slit experiment. For the common case of ensembles of particles, the explanation can be based on interference of their [W] phase in form of cumulative virtual clouds (CVC) with wave length, determined by (4.7) . For other hand, the ability of symmetric pair of sub-elementary fermions $[F^- \bowtie F^+]$ in composition of elementary particle to activate nonlocal vacuum amplitude waves (VAW) as well as similar pairs in any target, due to their $[C \rightleftharpoons W]$ pulsation may be responsible for interference of VAW, even in the case of single electron or photon.

Scattering of photons on free electrons will affect their impulse, mass, wave B length and, consequently, the interference picture. Only [C] phase of particle, but not its [W] phase can be registered by detectors of particles. Such a consequences of our dynamic duality model can explain all details of well known and still mysterious double slit experiment.

Propagation of fermion in 3D space in a course of its $[C \rightleftharpoons W]$ pulsation can be considered as a **periodic jumping** of particle in form of CVC of [W] phase with light velocity between wave fronts, corresponding to [C] phase, moving with group velocity lower than luminal one. The wave fronts of [C] and [W] phase are normal as respect to direction of particles propagation.

Such jump-way process may be termed KANGAROO EFFECT [KE].

The [KE] as elastic effect, is a consequence of total compensation of energy of cumulative virtual cloud (CVC) - by energy of mass symmetry shift (real versus to mirror) and corresponding energy of bi-vacuum symmetry shift, induced by binding of (CVC) to bi-vacuum fermion (BVF) as anchor site.

These consequences of dynamic duality model may be verified experimentally. The source of coherent radio waves and corresponding set of detectors, equidistantly distributed along the wave penetration, are necessary for such experiment. To demonstrate the different properties of photon in [C] and [W] phase, the distance between detectors should be less, than the coherent electromagnetic wavelength. It is anticipated, that the correlation between the spatial periodicity of the phase dependent wave B properties (like electric and magnetic fields tension, impulse, etc.) and the length of coherent EM waves should exist.

Spatial stability of complex systems: atoms, molecules and that of solids means that in these systems superposition of CVC, representing [W] states of elementary particles, forms hologram - like 3D standing waves superposition with location of nodes in the most probable positions of corpuscular phase of the nucleons, electrons, atoms and molecules in condensed matter. The binding of CVC by BVF restore the [C] phase of particles in positions, close to the most probable ones. So, thermal fluctuations may be a consequences of quantum $[C \rightleftharpoons W]$ pulsations decoherence and/or phase shift. The opposite statement also is correct: $[C \rightleftharpoons W]$ decoherence and phase shift may be a result of thermal fluctuations.

It shown also in the full article, placed at Los-Alamos archives (Kaivarainen, 2000), that dynamic model of wave-particle, worked out here, may serve as a natural background for unification of electromagnetism and gravitation.

Conclusion

This work is constructed as a set of following stages, interrelated with each other:

1. New model of primordial bi-vacuum in the absence of matter, as a fractal system of symmetric neutral bi-vacuum fermions ($\mathrm{BVF}^{S=1/2}$ and $\mathrm{BVF}^{S=-1/2}$) and bi-vacuum bosons (BVB^0) as intermediate excitations between BVF of the opposite spins. Zero external impulse of $\mathrm{BVF}^{\pm 1/2}$ and BVB^0 provides their infinitive virtual Bose condensation and, as a consequence of Virial theorem, nonlocal properties of bi-vacuum;

2. Formation of sub-elementary particles/antiparticles, as a result of asymmetric excitations: $\left[\mathbf{BVF}^{S=\pm 1/2} \rightarrow \mathbf{F}_{S=\pm 1/2}^{-/-}\right]$, accompanied by origination of difference between inertial real mass (m_C^-) and inertialess mirror mass (m_C^-) and charge $(+/-)$ of sign, depending on sign of mass and bi-vacuum symmetry shift. Elementary particles, like electron, positron, quarks and photons represent mixed triplets of sub-elementary particles/antiparticles and different combinations of such triplets;

3. Elaboration of Dynamic model of corpuscle - wave $[C \rightleftharpoons W]$ duality, as a result of correlated quantum beats between real and mirror states of [C] phase of sub-elementary particles in composition of elementary particles.

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