DYNAMIC MODEL OF WAVE- PARTICLE DUALITY:

Hidden Parameters, Golden Mean, Eigenmoments, Weak and Strong Interaction

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Materials, presented in this original article are based on

[1]. **Kaivarainen A. Part II of book: Hierarchic Concept of Matter and Field. Water, biosystems and elementary particles. New York, NY, 1995 and new version of this book. (see URL: http://www.karelia.ru/~alexk [Book prospect and New articles]);**

[2]. **Kaivarainen A. Dynamic model of wave-particle duality: Introduction, Role of Vacuum in transitions between Corpuscular and Wave phase. (see "New articles" in URL: http://www.karelia.ru/~alexk)**

Contents of article:

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1. External and internal (hidden) parameters of de Broglie wave

1.1. Relations between real and ”mirror” corpuscular masses, internal (hidden) and external group and phase velocities

It is assumed in our model, that to each of three main components of the real external group velocity $(v = v_{gr}^{ext})$ in 3D space, - the corresponding components of the internal (hidden) group and phase velocities: (v_C^+) and (v_C^-), real (m_C^+) and ”mirror” (m_C^-) masses are existing.

The important statement of our de Broglie wave (**wave B**) dynamic model is that the internal (hidden) kinetic energies of both corpuscular states: ”real” (T^+) - in positive energy zone and ”mirror” one (T^-) - in negative energy zone are always equal to each other and to ”resulting” kinetic energy (T_0) (eq.1.4). **In accordance to introduced in our theory notion of time, the pace of time is a measure of selected closed system pace of kinetic energy change. This definition means that the pace of internal time of wave B, in contrast to external one, is zero.**

Consequently:

$$\left[\ 2T^+ = (P_C^+)^2/m_C^+ = m_C^+(v_C^+)^2 = m_C^-(v_C^-)^2 = (P_C^-)^2/m_C^- = 2T^-\ \right]_{in} \quad 1.1$$

where:

$$\left[P_C^+ = m_C^+ \bullet v_C^+ = (2T^+ \bullet m_C^+)^{1/2};\ \ P_C^- = m_C^- \bullet v_C^- = (2T^- \bullet m_C^-)^{1/2}\ \right]_{in} \quad 1.2$$

$$and\ \ P_0 = (P_C^+ \bullet P_C^-)^{1/2} = m_0 \bullet c = const$$

are the internal impulses of corresponding three states: real, mirror and the resulting one $(P_0) = const.$

Taking into account the relation between real and mirror masses and corresponding velocities, introduced earlier:

$$m_C^+ \bullet m_C^- = m_0^2 \quad and \quad v_C^+ \bullet v_C^- = c^2 \quad 1.3$$

we get the following expression, confirming the important statement of our model:

$$[T_k^+ = T_k^-]_{in} = T_0 \quad 1.4$$

where the resulting energy of wave B: $T_0 = (T_k^+ \bullet T_k^-)^{1/2}$

The real inertial mass (m_C^+), mirror, inertialess (m_C^-) and resulting $(m_0 = \hbar\omega_0/c^2)$ corpuscular masses, as well as their internal velocities: $(v_C^+)^2$ and $(v_C^-)^2$ in general case are not equal to each other. It is a result of symmetry breach symmetry of total energy distribution with respect to vacuum states due to origination of particles and antiparticles.

From (1.1) one can see that:

$$m_C^-/m_C^+ = (v_C^+/v_C^-)^2_{in} \qquad 1.5$$

The internal real (v_C^+) and mirror (v_C^-) velocities can be defined as the internal corpuscular group and phase velocities of wave B, correspondingly:

$$v_C^+ \equiv v_{gr}^{\text{in}} \qquad v_C^- \equiv v_{ph}^{\text{in}} \qquad 1.6$$

The known relation between light velocity and external group and phase velocity is similar to (1.6) and is isotropic in 3D space like zero-point resulting mass (m_0):

$$c^2 = (v_{gr}^{\text{ext}} \bullet v_{ph}^{\text{ext}}) = (v_{gr}^{\text{in}} \bullet v_{ph}^{\text{in}}) \qquad 1.7$$

Our wave-particle duality model allows to revise the classical equations of relativistic theory and unify it with quantum mechanics.

The dependence of the of particle's mass (**m**) on its external velocity ($v \equiv v_{gr}^{\text{ext}}$) in accordance with special theory of relativity is

$$m = \frac{\mathrm{m_0}}{\left[\ 1 - (\mathrm{v/c})^2\ \right]^{1/2}} \qquad 1.8$$

where $m = m_0$ is mass of rest, when the external velocity $v = 0$.

Comparison of (1.8) and (1.3) shows that they are compatible only in the case when:

$$m = m_C^+ \qquad 1.9$$

and the following equations are valid for wave B as a [real+mirror] mass-dipole:

$$m_C^+ = \frac{\mathrm{m_0}}{\pm\left[\ 1 - (\mathrm{v/c})^2\ \right]^{1/2}} = \widetilde{m}_C^- \qquad 1.10$$

$$m_C^- = \pm m_0\left[\ 1 - (v/c)^2\ \right]^{1/2} = \widetilde{m}_C^+ \qquad 1.11$$

($\widetilde{m}_C^+$) and ($\widetilde{m}_C^-$) are real and mirror masses of antiparticles in corpuscular phase; m_0 is the mass of rest, corresponding to zero external group velocity: $v = 0$.

The difference between total energies of real and mirror states, equal to energy of quantum beats between them - determines the energy of wave B in both: corpuscular [C] and wave [W] phases, in accordance to our model:

$$E_B = E_C^+ - E_C^- = (m_C^+ - m_C^-) \bullet c^2 = m_C^+ \bullet v^2 = P_d^\pm \bullet c \qquad 1.11a$$

where the resulting hidden impulse of mass-dipole is equal to that of cumulative virtual cloud (CVC):

$$P_d^\pm = m_C^+ \bullet v^2/c = (m_C^+ - m_C^-) \bullet c \qquad 1.11b$$

Only the real inertial corpuscular mass (m^+) of particle corresponding to positive zone of total energy (positive vacuum) *is measurable experimentally*. The "mirror" inertialess mass can be calculated as:

$$m_C^- = m_0^2/m_C^+$$

In the case of antiparticle the situation related to bi-vacuum total energy and corpuscular mass distribution symmetrically changes, however:

$$\tilde{m}_C^+ \bullet \tilde{m}_C^- = m_C^+ \bullet m_C^- = m_0^2 \qquad 1.12$$

where: $\tilde{m}_C^+$ *and* $\tilde{m}_C^-$ are the real and mirror masses of antiparticle.

The ratio of (1.11) and (1.10) is equal to:

$$\frac{\mathrm{m_C^-}}{\mathrm{m_C^+}} = 1 - \left(\frac{\mathrm{v}}{\mathrm{c}}\right)^2 = \left(\frac{\mathrm{m_0}}{\mathrm{m_C^+}}\right)^2 \qquad 1.13$$

or

$$1 - \frac{m_C^-}{m_C^+} = \left(\frac{v}{c}\right)^2 \qquad 1.14$$

From (1.1-1.4) we can obtain:

$$\left(\frac{P_C^+}{P_0}\right)^2 = \left(\frac{L_0}{L_C^+}\right)^2 = \frac{L_C^-}{L_C^+} = \frac{m_C^+}{m_C^-} = \frac{(m_C^+)^2}{m_0^2} \qquad 1.15$$

where: $L_0 = \hbar/P_0 = (L_C^+ \bullet L_C^-)^{1/2}$ *and* $L_C^+ = \hbar/P_C^+$; $L_C^- = \hbar/P_C^-$ are the angle standing wave length of resulting zero-point state, real and mirror corpuscular states of standing neutrino mass-dipole, correspondingly. The latter two represents the radius of round cone cross-sections (real and mirror). They can be considered also as an effective radiuses of real and mirror vortex-dipole, as a spatial image of wave B.

From eq.(1.13) and the principle of conservation of the internal kinetic energies of both: **real and mirror corpuscular states** (*eq*.1.4) **it follows**, **that as a result of particle external group velocity increasing**: $v_{gr}^{ext} \to c$, **when the real corpuscular mass** (m_C^+) **tends to infinity**, **the internal group velocity** (v_{gr}^{in}) **tends to zero**. **For the other hand**, **the internal phase velocity** (v_{gr}^{in}) **tends to infinity and "mirror" corpuscular mass** (m_C^-) **tends to zero**. **These changes are summarized below**:

$$\begin{bmatrix} m_C^+ \to \infty \\ v_{gr}^{in} \to 0 \\ v_{gr}^{ext} \to c \end{bmatrix}_{1,2,3} \quad \text{and} \quad \begin{bmatrix} m_C^- \to 0 \\ v_{ph}^{in} \to \infty \\ v_{ph}^{ext} \to c \end{bmatrix}_{1,2,3} \qquad 1.15a$$

Combining (**1.5**) **and** (**1.13**) **in the form**:

$$m_C^-/m_C^+ = \left(v_{gr}^{in}/v_{ph}^{in}\right)^2 = \left[\left(\; v_{gr}^{in} \;\right)^2/c^2\right]^2 = 1 - \left(\frac{v_{gr}^{ext}}{c}\right)^2 \qquad 1.16$$

we obtain the important interrelation between internal (**hidden**) **and external group velocities of wave B**:

$$\mathbf{v}_{gr}^{in} = \mathbf{c} \bullet \left[\; 1 - (v_{gr}^{ext}/c)^2 \;\right]^{1/4} \qquad 1.17$$

As far the internal group and phase velocities are interrelated as: $v_{gr}^{in} = c^2/v_{ph}^{in}$, **we get from** (**1.17**):

$$v_{ph}^{in} = \frac{c}{\left[\; 1 - (v_{gr}^{ext}/c)^2 \;\right]^{1/4}} \qquad 1.18$$

One can see that $\mathbf{v}_{gr}^{in}$ **and** v_{gr}^{ext} **change in the counterphase manner**. **The minimum value of** $v_{gr}^{ext} \equiv v_0$ **related to the zero-point external oscillations of the electron corresponds to maximum value of internal group velocity** $(v_{gr}^{in})_0$, **as follows from** (**1.18**).

In another way (**1.18**) **can be presented as**:

$$(v_{gr}^{in}/c)^4 = 1 - (v/c)^2 = (m_0/m_C^+)^2 = m_C^-/m_C^+ \qquad 1.19$$

At ($v_{gr}^{ext} \equiv v$) $\to c$, **the condition**: $m_0^2 = m_C^+ \bullet m_C^- = const > 0$ **is in force**, **then** $v_{gr}^{in} \to 0$ **and consequently**, $m_C^+ \to \infty$ **and** $m_C^- \to 0$.

1.2. Golden Mean quantum roots and Hidden Harmony

So called Golden Mean, known from ancient time, is one of the most intriguing, important and universal number in Nature. But in contrast, for example to the number $[\pi]$ its origin is entirely obscure.

Golden Mean ($S \equiv Phi$) can be introduced as a definite relation between two parameters: A and B in a following way:

$$\frac{A+B}{B} = \frac{B}{A} \qquad 1.20$$

or:

$$\left(\frac{A}{B}\right)^2 + \frac{A}{B} = 1 \qquad 1.21$$

If we denote $(A/B) \equiv S$, then (1.21) can be presented as a quadratic equation:

$$S^2 + S - 1 = 0 \qquad 1.22$$

$$or: \quad \frac{S}{(1-S)^{1/2}} = 1 \qquad 1.22a$$

The positive solution of equation (1.22) gives the numerical value of Golden Mean:

$$S = \frac{A}{B} = 0.618 \qquad 1.23$$

So-called *Fibonacci row*, reflecting the law of biological reproduction is related to S:

$$1, 2, 3, 5, 8, 13, 21, 34, 55, 89... \qquad 1.24$$

the (n) number of this row is equal to the sum of two previous numbers (n-1 and n-2). The bigger is (n), the closer is the ratio of numbers to Golden Mean:

$$\left(\frac{n}{n+1}\right) \to S = 0.618 \qquad 1.25$$

The ratio of frequencies of good for human ear musical accord is, as a rule close to S.
Kepler was amazed when he noticed that the ratio of the most important parameters of the orbits of planets coincide with S.
Our aesthetic intuitive feeling of harmony in geometrical constructions and pictures is also strongly related to ratio (3.23).
The universality of Golden Mean points to its very deep physical roots. But as far, not a single physical theory was able to confirm this statement. On the other hand, the ability of any theory to clarify the Golden Mean root can be considered as an evidence of proof for this theory validity.

One of the most important equation of our theory (1.17), relating internal (hidden) and external group velocity of wave B:

$$v_{gr}^{in} = c\left[1 - (v_{gr}^{ext}/c)^2\right]^{1/4} \qquad 1.26$$

turns to quadratic equation and gives a solution, equal to (1.23) under a very definite condition: the equality of internal (hidden) and external group and phase velocities:

$$v_{gr}^{\mathrm{in}} = v_{gr}^{\mathrm{ext}} \qquad 1.27$$

$$v_{ph}^{\mathrm{in}} = v_{ph}^{\mathrm{ext}} \qquad 1.27a$$

These condition we termed a Rule of Hidden Harmony.

It was shown earlier, that a spatial dynamic image of wave B in corpuscular [C] phase is a vortex dipole, representing correlated pair of vortexes [real+mirror], corresponding to positive and negative energy of bi-vacuum. In such presentation, the internal group and phase velocities $(v_{gr}^{in}\ and\ v_{ph}^{in})$ reflect the rotation velocity of real and mirror vortexes, correspondingly. The external group and phase velocities $(v_{gr}^{ext}\ and\ v_{ph}^{ext})$ are related to propagation of vortex-dipole as an integer system in bi-vacuum. **The direction of vortex-dipole propagation coincides always with the main axe of symmetry, general for real and mirror vortexes.**

Putting the conditions (1.27 and 1.27a) in our eq. (1.26), interrelating the internal and external group velocities, we get simple quadratic equation:

$$\left(\frac{\mathrm{v}_{\mathrm{gr}}^{\mathrm{in}}}{\mathrm{c}}\right)^4 + \left(\frac{\mathrm{v}_{\mathrm{gr}}^{\mathrm{in}}}{\mathrm{c}}\right)^2 = 1 \qquad 1.28$$

as far, in accordance to our model, the product of internal (hidden) and external group and phase velocities is equal to the light velocity squared:

$$c^2 = v_{gr}^{\text{in}} \bullet v_{ph}^{\text{in}} = v_{gr}^{\text{ext}} \bullet v_{ph}^{\text{ext}} \qquad 1.29$$

we get from (1.28):

$$\left(\frac{\text{v}_{\text{gr}}^{\text{in}}}{\text{v}_{\text{ph}}^{\text{in}}}\right)^2 + \frac{\text{v}_{\text{gr}}^{\text{in}}}{\text{v}_{\text{ph}}^{\text{in}}} = 1 \qquad 1.30$$

It is obvious that (1.28) and (1.30) coincide with (1.22), if we denote

$$S = \frac{\text{v}_{\text{gr}}^{\text{in}}}{\text{v}_{\text{ph}}^{\text{in}}} = \left(\frac{\text{v}_{\text{gr}}^{\text{in}}}{\text{c}}\right)^2 = \frac{\text{v}_{\text{gr}}^{\text{ext}}}{\text{v}_{\text{ph}}^{\text{ext}}} = \left(\frac{\text{v}_{\text{gr}}^{\text{ext}}}{\text{c}}\right)^2 \qquad 1.31$$

This means that equalities (1.27) can be considered as the Golden Mean Roots or the Rules of Hidden Harmony - the equality of hidden and external velocities (group and phase) of de Broglie wave.

The value of internal-hidden and external, measurable group velocities $[v_{gr}^{\text{in}} = v_{gr}^{\text{ext}}]$ **is equal to**:

$$[v_{gr}^{\text{in}} = v_{gr}^{\text{ext}}] \equiv v_{gr}^{S} = \sqrt{S} \bullet c = (0.618)^{1/2} \bullet c = 0.786 \bullet c \qquad 1.32$$

For internal and external phase velocities at conditions of Hidden Harmony we have:

$$\left[v_{ph}^{\text{in}} = v_{ph}^{\text{ext}}\right] \equiv v_{ph}^{S} = \frac{\text{v}_{\text{gr}}^{\text{S}}}{\text{S}} = \frac{c}{\sqrt{S}} = \frac{0.786 \bullet \text{c}}{0.618} = 1.2718 \bullet c \qquad 1.33$$

The product of (1.32) and (1.33), like for any other values of group and phase velocities of relativist wave B is equal to that of light velocity squared:

$$v_{gr}^{S} \bullet v_{ph}^{S} = c^2 \qquad 1.34$$

where the ratio: $(v_{gr}^{S}/v_{ph}^{S}) = S = 0.618$.

The Golden mean realization in Nature corresponds to conditions of the Hidden Harmony of de Broglie waves in their Corpuscular [C] phase (1.27 and 1.27a). It is a fascinating and important fact that our intuitive perception of beauty and harmony, reflected by Golden Mean, has so deep quantum roots. It points out, that the similar quantum roots are involved in the principles of our consciousness also.

It seems, that any kind of selected system, enable to self-organization and evolution: from atoms to living organisms, galactics and Universe, - are tending to conditions of Hidden Harmony, corresponding to Golden Mean realization. The less is deviation of ratio of characteristic parameters of system from [S ≡ Phi], the more advanced is the evolution of this system. We have to keep in mind that all forms of matter are composed from hierarchic system of de Broglie waves.

We can illustrate our hypothesis on example of energy of wave B, corresponding to Golden mean condition.

The formula (1.13) at condition $(c/v)^2 = S$, taken in account (1.10) and (1.22a), can be easily driven to the following expression for mass symmetry shift:

$$\Delta m_C^S = (m_C^+ - m_C^-)^S = m_C^+ \bullet S = \frac{m_0 \bullet S}{(1-S)^{1/2}} = m_0 \qquad 1.34a$$

From (1.11a), the energy of wave B, corresponding to Golden mean, is equal to that of quantum beats between real and mirror states of [C] phase, leading to emission of cumulative virtual cloud (CVC), representing [W] phase of particle:

$$E_B^S = \Delta m_C^S \bullet c^2 = m_0 \bullet c^2 = \hbar\omega_0 \qquad 1.34b$$

where: m_0 is a mass of rest of electron (uncompensated standing neutrino), corresponding to zero group velocity; ω_0 is a frequency of $[C \rightleftharpoons W]$ pulsations of "ideal" electron with external and internal group velocities, determined by condition (1.32).

It will be shown in the next chapter, that the total electromagnetic energy of the electron (E_{el}) is a part of total energy of wave B (1.34b), determined by the fine structure constant ($\alpha = e^2/\hbar c$). **In condition of Golden Mean realization**

$$E^S_{el} = \alpha \bullet E^S_B = \frac{e^2}{\hbar c} \bullet m_0 c^2 = \frac{e^2}{L_0} \qquad 1.34c$$

$$where: \;\; L_0 = \hbar/m_0 c \;\; is\ a\ Compton\ radius\ of\ the\ electron$$

It is an important result, **pointing that principles of hydrogen and other atoms/molecules construction follow the rule of Golden mean or Hidden harmony**.

The mystery of Sri Yantra diagram

In accordance to ancient archetypal ideas, **geometry and numbers describe the fundamental energies in course of their dance - dynamics**, **transitions**. **For more than ten millenniums it was believed that the famous Tantric diagram-Sri Yantra contains basic functions active in the Universe** (**Fig**. **1**).

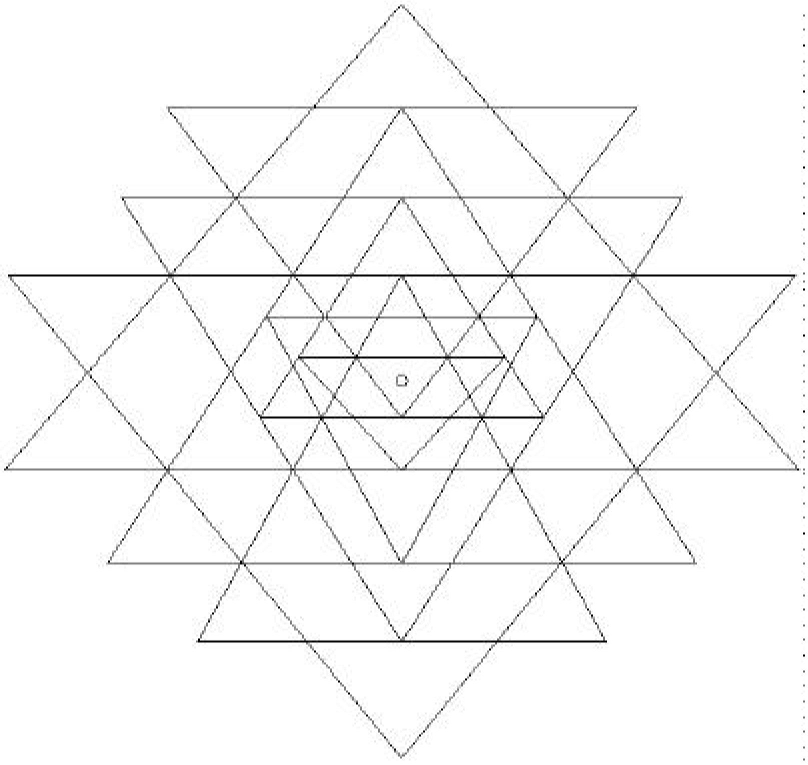


Fig. **1**. The Sri Yantra diagram is composed from nine triangles. Four of them are pointed up and five down. Author is grateful to P. Flanagan for submitting of Sri Yantra with precise coordinates of most important points, making it possible the quantitative analysis of diagram.

Triangle is a symbol of a three-fold nature. The Christian trinity, the symbol of God may be represented by triangle. In Buddhism-Hindu triangle with **apex up** is a symbol of God-male and that with **apex down** is a symbol of God-female.

We found out that Sri Yantra diagram can be considered as a symbolic language, **containing information about the mechanism of wave-particle duality**, **being the background of existing Universe and all kinds of fundamental interaction**. **Each of triangles pair** [**down**+**up**] **in terms of our model corresponds to** [**real**+**mirror**] **vortex dipoles of** [**C**] **phase of the de Broglie wave** (**wave B**) **in different excitation states**.

It possible to extract from Fig.1 the diagram (Fig. 1a), presented below. It is surprising that Fig. 1a, as a part of Sri Yantra, contains information not only about round cone as a spatial image of wave B (see Fig. 1b, analogous to Fig.4a), but as well about its positive and negative energy quantization as a quantum harmonic oscillator.

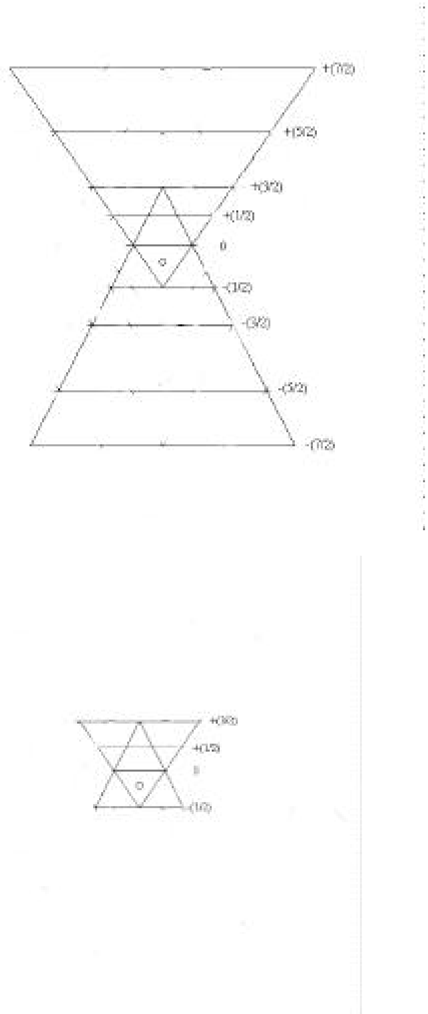


Fig. 1a and 1b - Parts of Sri Yantra, representing in accordance to our model the spatial images of wave B in (1 a) excited corpuscular [C] - phase and its ground phase (1 b), corresponding to image of wave B, as around cone (Fig.4a).
The numbers near the right side of pictures characterize the energy of positive and negative energy sublevels of bi-vacuum excitation:
$E_B = \pm\hbar\omega(n + \frac{1}{2}), \;\; where: \;\; n = 0, 1, 2...$

Other feature of Sri Yantra, compatible with our model of standing neutrino in composition of electron, is its asymmetry. Asymmetry is obvious from position of central zero point of diagram, denoted on Figs. (1) and (1a,1b) as an open circle (o) and diamond shape of its nuclei, composed from two triangles with common base and **different height**.

It is interesting to note that spatial position of zero-point (o), localized in lower triangle of Sri Yantra diamond-nuclei as respect to its base and apex corresponds to Golden mean. The degree of asymmetry of Sri Yantra decreases with increasing the distance from its central point (o).

For example, the shifts of zero-point positive and negative vacuum sublevels, pointed on Fig. 1a:

$$+\frac{1}{2}\hbar\omega \;\; and \;\; -\frac{1}{2}\hbar\omega \quad (n = 0)$$

as respect to central point (o) of Sri Yantra are characterized by ratio: 1.77. It reflects the

asymmetry of bi-vacuum boson of secondary bi-vacuum, perturbed by matter.

The less asymmetric shifts of higher sublevels with quantum number: $n = 1,2,3$, **corresponding to positive and negative energies of vacuum excitation**: $(\pm 3/2)\hbar\omega$; $(\pm 5/2)\hbar\omega$ **and** $(\pm 7/2)\hbar\omega$ **are characterized by the following ratios of their distance from central point: 1.19; 1.1 and 1.046.**

In terms of our model of gravitation this asymmetry reflects the vacuum symmetry shift:

$$\Delta m_V = |m_V^+ - m_V^-|$$

produced by [real+mirror] vortex dipoles, composing elementary particles. The analogy between some features of ancient diagram and wave-corpuscle duality model is surprising and exciting indeed.

We can conclude that our model of wave-particle duality is comprehensive enough to contribute not only modern knowledge, concerning different fields, elementary particles, distant interactions, but as well the ancient holistic perception of World Mystery in forms of sacred geometry, based on trained intuition of most sensitive individuals of the past.

1.3. Properties of bi-vacuum bosons, neutrinos and [neutrino+antineutrino] pairs

Let us consider the properties of elementary particle and antiparticle with equal real (m_C^+) **and "mirror"** (m_C^-) **corpuscular masses:**

$$m_C^+ = m_C^- > 0 \quad \text{and} \quad \tilde{m}_C^+ = \tilde{m}_C^- > 0 \qquad 1.35$$

It is easy to see from the formula for external impulse of wave B in corpuscular and wave phase (1.11b), that for the condition (1.35) the external group velocities ($v_{gr}^{\text{ext}} \equiv v = 0$) and external resulting impulses of particles and antiparticles as a mass-dipoles should be equal to zero:

$$P_B = (m_C^+ - m_C^-) \bullet c = m_C^+ \bullet (v^2/c) = 0 \quad \text{at} \quad m_C^+ = m_C^- \qquad 1.36$$

From (1.26) and conditions (1.35) at the external group velocity $(v = 0)$, **corresponding to ability of bi-vacuum bosons to form the nonlocal and infinitive by dimension virtual Bose condensate (BC), we get the equality of the internal group and phase velocities to that of light** (c):

$$v_{gr}^{\text{in}} = v_{ph}^{\text{in}} = c \qquad 1.37$$

The radius of symmetric primordial bi-vacuum bosons is: $L_{bvb}^{\pm} = \hbar/m_0 c$, **equal to Compton radius of the electron. It is related to primordial bi-vacuum energy slit:**

$$\Delta E_{bvb} = \frac{1}{2}(m_0^+ + m_0^-) = m_0^{\pm} c^2 \qquad 1.37a$$

The particles which are content to all above mentioned properties could be presented also by free neutrino (ν) **and antineutrino** $(\tilde{\nu})$. **Condition (1.36) means that the external de Broglie wave length of primordial bi-vacuum bosons or free neutrino and antineutrino is equal to infinity:**

$$\vec{\lambda}_{\text{ext}}^{\nu} = h/\vec{P}_{\text{d}} \to \infty \qquad 1.38$$

Consequently, particles with equal real and mirror masses $(m_C^+ = m_C^- = m_0)$ **in form of free neutrino and bi-vacuum bosons can form the virtual Bose condensate with nonlocal properties.**

It looks like the Universe is evolving in the giant N-dimensional cobweb of the bi-vacuum Bose condensate with properties, modulated by matter and field.

Three types of free neutrino and antineutrino are existing $(e,\ \mu$ **and** $\tau)$, **corresponding to three types of the electrons. Each of these neutrinos have their own masses**

$(m_C^+ = m_C^- = m_0)_{e,\mu,\tau}$, **corresponding in accordance with our model, to different levels of** bi-vacuum bosons symmetric excitations.

It is generally accepted that neutrino has a spirality: $\lambda = -1/2$ and antineutrino has spirality: $\lambda = +1/2$. **In accordance to existing definition (Berestetski et all., 1989),** $\lambda = -1/2$ **corresponds to state of particle when directions of its spin and impulse (internal in our model) are opposite (neutrino);** $\lambda = +1/2$ **corresponds to state of particle when directions of its spin and impulse coincide (antineutrino).**

Three possibilities can be considered:

1. All kind of neutrino with fermion properties should have real and mirror masses, non equal to zero-point one (m_0) **due to non zero mass-symmetry shift:**

$$\Delta m = m_C^+ - m_C^- > 0 \qquad 1.39$$

Under such condition the neutrinos (antineutrinos) should display the wave-particle duality dynamics, described earlier, determined by the properties of asymmetric [real+mirror] vortex-dipole.

In corpuscular (collapsed) phase the real corpuscular mass (m_C^+) **of standing neutrino/antineutrino determines the real, measurable mass of particle. As a result of beats between real and mirror states both of corresponding mass tends to zero-point mass, producing vacuum density waves (VDW) and vacuum symmetry waves (VSW):**

$$m_C^+ \to m_C^- \to m_0 \qquad 1.40$$

It happens due to partial conversion of m_C^+ and m_C^- **to cumulative virtual cloud (CVC) of positive and negative virtual quanta, corresponding to [W]-phase of particle.**

For the other hand, it follows that at conditions $(m_C^+ - m_C^- > 0)$, the propagation of isolated neutrino $(e,\ \mu$ or $\tau)$ with light velocity is doubtful even at very small mass symmetry shift due to relativist effects;

2. We can also assume the existing of pair correlation between spatially separated neutrino and antineutrino, resulting in the absence of resulting mass-symmetry and vacuum-symmetry shift violation, at following conditions:

$$m_C^+ - \tilde{m}_C^- = 0 \qquad 1.41$$

$$\Delta m_V = m_V^+ - m_V^- = 0 \qquad 1.41a$$

then each of neutrino +antineutrino correlated pairs $[\nu + \tilde{\nu}]$, **can propagate with light velocity in bi-vacuum;**

3. We can suggest finally that all three kinds of neutrino (e, μ, τ) **represent three levels of symmetric bi-vacuum bosons excitations at conditions:**

$$(m_C^+ = m_C^-)_e < (m_C^+ = m_C^-)_\mu < (m_C^+ = m_C^-)_\tau \qquad 1.42$$

However, in contrast to standing neutrino/antineutrino, when: $m_C^+ \bullet m_C^- = m_0^2$, **the conditions for moving with light velocity neutrinos/antineutrinos are:**

$$(m_C^+ \bullet m_C^-)_e = (m_0)_e^2 \qquad 1.43a$$

$$(m_C^+ \bullet m_C^-)_\mu = (m_0)_\mu^2 > (m_0)_e^2 \qquad 1.43b$$

$$(m_C^+ \bullet m_C^-)_\tau = (m_0)_\tau^2 > (m_0)_\mu^2 \qquad 1.43c$$

The conditions above mean, that for each generation of moving neutrino/antineutrino, as excited bi-vacuum bosons, the own, specific zero-point mass should exist. Each of them are different from each other and exceed the effective mass of rest of the electron's standing neutrino $(m_0)_e$. **In the latter model the absence of difference between real and mirror masses means the absence of beats between these states, i.e. the absence of** $[W \rightleftharpoons C]$ **dynamics of symmetrically excited bi-vacuum bosons. This model assumes neutrino and**

antineutrino as nonlocal vacuum excitations (infinitive strings) with energy, depending on generation:

$$E_e = (m_0)_e \bullet c^2 < E_\mu = (m_0)_\mu \bullet c^2 < E_\tau = (m_0)_\tau \bullet c^2 \qquad 1.43d$$

The results, obtained above, points, that the ability of some stable particles, like bi-vacuum bosons in their ground and excited states, correlated [neutrino+antineutrino] pairs, their coherent clusters, like photons, etc. to move with luminal velocity can be a consequence of the above basic conditions (1.41 - 1.43d)

1.4. Formation of elementary particles by standing neutrinos due to Coherent Neutrino Interaction

We put forward a hypothesis that the electrons, quarks and nucleons formation could be resulted from the interception of the certain number of neutrino - antineutrino strings and their [neutrino+antineutrino] coherent pairs in the same point of space. This event should be stimulated by the vacuum symmetry breach, accompanied the pairs of virtual mini [black+white] hole-dipoles origination - annihilation.

Another way of the electron-positron pair origination is a "splitting" of high-energy photons in conditions of strong vacuum symmetry breach (shift), i.e. in strong electric, magnetic or gravitational fields.

At the conditions of strong vacuum symmetry shift, the confinement of triplets of neutrinos and antineutrinos in the form of 3D standing waves (Fig. 2 a, b) leads to the electrons $(2\nu_0 + \widetilde{\nu}_0)$ and positrons $(2\widetilde{\nu}_0 + \nu_0)$ fusion.

The in-phase $[C \Leftrightarrow W]$ transitions of standing neutrino and antineutrino in pair $(\widetilde{\nu}_0 + \nu_0)$ of the electron and positron "compensate" the charge, spin, mass and the vacuum symmetry shift: $[\Delta m_V + \Delta\widetilde{m}_V = 0]$ of each other. This means that only one - uncompensated standing neutrinos or antineutrinos determines the real mass, spin, charge and energy of the electron or positron.

The properties of coherent standing [neutrino-antineutrino] pair in composition of electron or positron are presented on Fig.6.

We propose also that u- and d- quarks are composed of certain coherent clusters of standing neutrinos and antineutrinos (see Section 3 of this article).

Such ideas are in accordance with theory of electroweak interactions of Weinberg and Salam assuming the interconversions between neutrino, electrons and $W^{\pm}$ and Z^0 bosons.

In accordance with our model, the *electron* can exist as a three-dimensional (3D) standing wave: superposition of *pair* of standing neutrino+antineutrino $(\nu_0 + \widetilde{\nu}_0)$ with *resulting* spin, mass (m_{ν_0}) and charge equal to zero and *one* "uncompensated" standing neutrino (ν_0) with a spin ±1/2 and charge Z equal to -1. Schematically such superposition for electron and positron can be presented as:

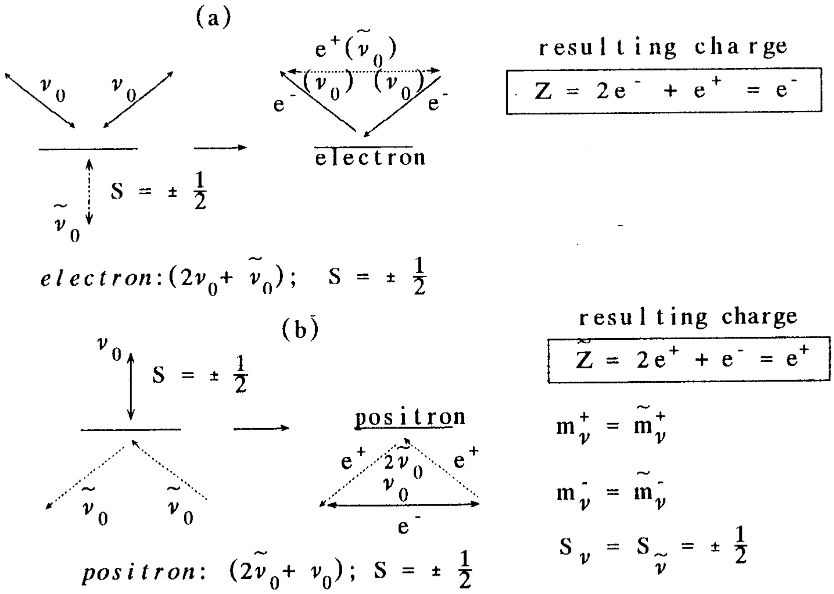


Fig. 2. Schemes of electron (a): $[2\nu_0 + \tilde{\nu}_0]$ and positron (b): $[2\tilde{\nu}_0 + \nu_0]$, as a superposition of triplets of standing neutrino (ν_0) and antineutrino $(\tilde{\nu}_0)$.

Photon may be represented as a superposition of electron and positron as a three pairs of $\left[\textit{neutrino} + \textit{antineutrino} \right]$ that form a boson with resulting spin J $=$ 1 (Fig. 3).

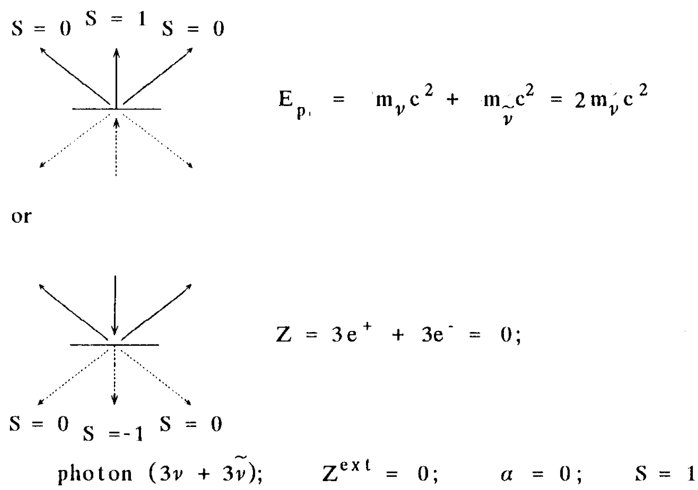


Fig. 3. Schematic representation of two polarizations of photon $[3\nu_0 + 3\tilde{\nu}_0]$ as a dynamic coherent system of 3 neutrino and 3 antineutrino. The spin $(S = \pm 1)$, mass $(2m_{\nu,\tilde{\nu}})$, energy and frequency of photon $(E_p = 2m_{\nu,\tilde{\nu}} \bullet c^2 = h\nu_p)$ are determined by the additive properties of only one pair of standing [neutrino+antineutrino] with asymmetric properties as respect to ”positive” and ”negative” vacuum. Two other pairs are symmetric as respect to bi-vacuum. Like in electron and positron, they compensate the properties of each other and does not contribute to real mass and energy of photon.

The main difference between bosons and fermions is that the former particles are composed from equal number of standing neutrino and antineutrino and the latter ones - from unequal number. This means that in contrast to fermions, the elementary bosons, like photons, cannot produce the resulting mass and vacuum symmetry shift and, consequently,

gravitation. Symmetry of energy distribution is a property of elementary bosons, responsible for their penetration in space with light velocity.

In contrast to elementary bosons, 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 wave length ($\lambda = h/P_{ph}$) **of photons is determined by the resulting external impulse of asymmetric pairs of** $[\nu + \tilde{\nu}]$, **responsible for spin**

$$P_{ph} = P_\nu + P_{\tilde{\nu}} = 2P_\nu = 2(m_C^+ - m_C^-) \bullet c = 2m_C^+(v^2/c) \qquad 1.44$$

Such fermions as $\left[\ u_{Z=2/3}^{S=1/2}\ \right]$ quarks, are supposed to consist of two positron-like triplets of standing [neutrino + 2antineutrino], i.e. from two standing neutrino and four standing antineutrino:

$$2[\nu_0 + 2\tilde{\nu}_0] = [2\nu_0 + 4\tilde{\nu}_0]_u = 6(\nu_0, \tilde{\nu}_0)_u \qquad 1.45$$

For the other hand $\left[\ d_{Z=-1/3}^{S=1/2}\ \right]$**- quarks consists of three triplets: two electron-like** $2[2\nu_0 + \tilde{\nu}_0]$ **and one positron-like** $[\nu_0 + 2\tilde{\nu}_0]$, **i.e. from five standing neutrino and four standing antineutrino:**

$$[5\nu_0 + 4\tilde{\nu}_0]_d = 9(\nu_0, \tilde{\nu}_0)_d \qquad 1.45a$$

These compositions correspond to the ground states of [u] and [d] quarks (see Fig. 7).

1.5. Spatial image of standing neutrino

For each standing neutrino, forming fermion-particles of matter, in contrast to the free one, the external group velocity $v_{gr}^{ext} \equiv v < c$ **and mass symmetry shift is more than zero. Their real** (m_C^+) **and mirror** (m_C^-) **corpuscular masses and other properties of standing neutrino depends on external velocity as follows from eqs.(1.10 and 1.11).**

Eq.(1.13) can be transformed to the form of round cone:

$$m_C^+ v^2 + m_C^- c^2 = m_C^+ c^2 \qquad 1.46$$

multiplying left and right part by m_C^+ **and dividing by** $\hbar^2$, **we obtain the round cone equation:**

$$\left(\frac{\mathrm{m}_C^+ \mathrm{v}}{\hbar}\right)^2 + \left(\frac{\mathrm{m}_0^+ \mathrm{v}}{\hbar}\right)^2 = \left(\frac{\mathrm{m}_C^+ \mathrm{c}}{\hbar}\right)^2 \qquad 1.47$$

or

$$(k_T^+)^2 + k_V^2 = (k_E^+)^2 \qquad 1.48$$

where the wave numbers characterize the kinetic, potential and total energy of wave B.

For each standing neutrino, composing elementary particle, the spatial image (Fig. 4a) is true.

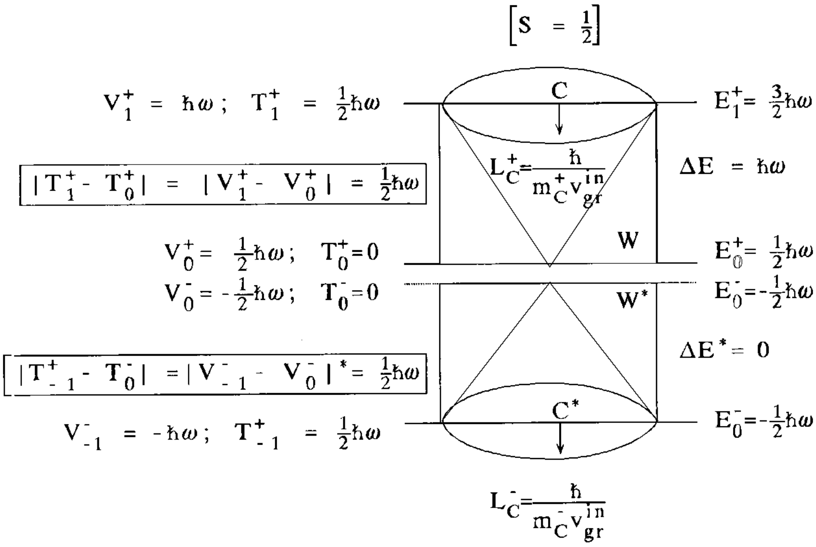


Fig. 4 (a). Spatial image of one of *standing neutrino,* composing particles. It corresponds to round cone. L_C^+ and L_C^- are the radiuses of *internal standing waves, forming bases of round cone bases* for **real** and **mirror** corpuscular states. The in-phase $[C \rightleftharpoons W]$ and $[C^* \rightleftharpoons W^*]$ transitions occurs in the process of periodic [corpuscle ⇌ wave] states realization. The physical asymmetry of round, leading from our
model, is not displayed on this figure.

The impulse-form representation by eq. (1.48) describes as a round cone with changing parameters, dependent on external group velocity and corpuscular mass. These images are true for the corpuscular state of wave B only.

Characteristic radius of primordial bi-vacuum boson in form of [rotor+antirotor] zero-point dipole is equal to Compton radius of the electron:

$$r_0 = \left(\left|\ \frac{1}{2}k_0^+\ \right| + \left|\ \frac{1}{2}k_0^-\ \right|\right)^{-1} = (k_0)^{-1} = \frac{\hbar}{2m_0c} = L_0 \qquad 1.55$$

where: $L_0 = 1/k_0^{\pm} = \hbar/m_0c$ is a Compton wave length and (m_0) is the resulting zero-point mass (mass of rest): $m_0 = (m_C^+ \bullet m_C^-)^{1/2}$.

The radius of positive and negative parts of round cone from eqs. (1.2 and 1.4) can be expressed as:

$$L_C^+ = \hbar/P_C^+ = \hbar/(2T_0 \bullet m_C^+)^{1/2} \qquad 1.56$$

$$L_C^- = \hbar/P_C^- = \hbar/(2T_0 \bullet m_C^-)^{1/2} \qquad 1.57$$

Taking into account (1.10) and (1.11), one can see that with increasing of external group velocity: $L_C^+ \to 0$ and $L_C^+ \to \infty$, *.i.e.* the round cone turns to the regular one with the base in the plane of the negative zero-point vacuum.

The wave [W]- phase of particle, corresponds to polaron like quantum excitation in condensed matter: [cumulative virtual cloud (CVC) + bi-vacuum boson]. The space, corresponding to bi-vacuum boson, can be termed as vacuum "Zero-space" or Z-space, then [C ⇌ W] pulsations mean transitions between 3D and Z-space: [3D ⇌ ZS]. Three-dimensional conjugated space, created by real Corpuscular phase of wave B turns to number of independent one-dimensional states in Vacuum-Wave phase.

However, in accordance with our model, the energy, frequency, phase velocity and wave length keeps the same in both: corpuscular and wave states.

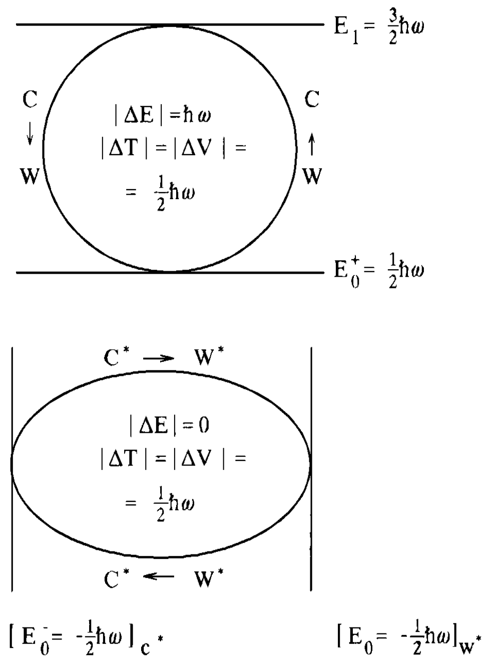


Fig. **4**. (**b**). The in-phase oscillation of the total energy $[E_1 \rightleftharpoons E_0^+]$ (Hamiltonian) and the symmetry oscillation of the mirror state $[|T - V|_C \rightleftharpoons |T - V|_W]$ (Lagrangian) during $[C \rightleftharpoons W]$ and $[C^* \rightleftharpoons W^*]$ transitions of standing neutrino. *These two types of transitions are responsible for electric and magnetic components of the resulting elementary charge,* respectively. **Similar but opposite with respect to positive and negative vacuum sublevels distribution of energy - characterize standing antineutrino in composition of positron**.

1.6. New interpretation of wave function

Our dynamic duality model makes it possible to modify the interpretation of the wave B function of Schrödinger equation. We can present wave functions ψ **and** ψ^* **in dimensionless form, using the effective mass of the electron** $[2\nu_0 + \tilde{\nu}_0]$**, determined by uncompensated standing neutrino** (ν_0) :

$$\Psi^+ = \frac{|m_C^+ - m_0|}{m_0} \qquad 1.58$$

$$\Psi^- = \frac{|m_C^- - m_0|}{m_0} \qquad 1.59$$

On the microscopic level the wave function squared is dependent on the product of instant values of real and mirror corpuscular mass shifts: $(\Delta m^+ \bullet \Delta m^-)$, **related to fraction of time** (f_C^t), **which particle spend in corpuscular phase**:

$$|\Psi|^2 = \Psi^+ \bullet \Psi^- = \frac{|m_C^+ - m_0|}{m_0} \bullet \frac{|m_C^- - m_0|}{m_0} = \frac{(\Delta m^+ \bullet \Delta m^-)}{m_0^2} \qquad 1.60$$

$$f_C^t = \frac{\tau_C}{\tau_C + \tau_W} = \frac{1}{1 + K_{[W \rightleftharpoons C]}} \qquad 1.61$$

where: $m_0^t = (m_C^+ \bullet m_C^-)^{1/2}$ **is the resulting zero-point corpuscular mass. The product of real and mirror mass symmetry shift**: $[(\Delta m^+ \bullet \Delta m^-) > 0]_C$ **in Corpuscular phase is positive. In the Wave phase it is zero**.

In-phase to mass symmetry shifts - changes the probability of location of particle in [C] **phase in the any given volume of space, equal to the wave function squared** $|\Psi|^2$.

Our theory predicts that the equilibrium $[C \rightleftharpoons W]$ **can be shifted and the real mass of**

body - changed as respect to surrounding medium, using the Aharonov-Bohm effect, applied to this body. The coherent acceleration of particles, composing body (for example due to alternation of its rotation velocity) or application of strong magnetic or electric fields, that influence the local vacuum symmetry shift - also can induce the change of the real mass of body.

2. The uncertainty principle and eigenmoments of the fermions and bosons

In this section we will try to analyze on the base of our model such phenomena as uncertainty principle a spin, origination of bosons from pairs of fermions and Pauli principle.

2.1. Principle of uncertainty

The basic law of quantum mechanics, the principle of uncertainty, may be expressed in two forms:

$$(\Delta p)^2 \bullet (\Delta q)^2 \geq \left(\frac{\hbar}{2}\right)^2 \qquad 2.1$$

$$(\Delta t)^2 \bullet (\Delta E)^2 \geq \hbar^2 \qquad 2.2$$

where: Δq and Δp are uncertainties in simultaneous experimental determinations of the coordinate and impulse of wave B; Δt and ΔE are uncertainties of time and energy of wave B in conditions of their simultaneous experimental evaluation.

The reason of this uncertainty is the alternative in time detectable properties in a course of [$C \rightleftharpoons W$] pulsation of particle and perturbation of wave B in a course of measurements. In the selected virtual [W] and instant [C] phase we cannot detect simultaneously the impulse and position of particle, as well as its life-time and energy. The notion of time and space is pertinent only for corpuscular [C] phase, but not for the virtual [W] phase.

In the coherent form, inequality (2.1) turns to equality. Using parameters, introduced in our dynamic model, we get:

$$L_W^2 \bullet P_C^2 = \left(\frac{\hbar}{2}\right)^2 \qquad 2.3$$

where, taking into account (1.11b) the length of mass-dipole (L_W) can be expressed as:

$$L_W = \frac{\hbar}{P_W} = \hbar/[(m_C^+ - m_C^-) \bullet c] \qquad 2.4$$

The resulting implicated impulse of [C] phase of particle as a mass-dipole (P_d) and explicated one (P) in Bohm's terminology are correspondingly:

$$P_d = m_C^+ \bullet v^2/c \qquad 2.5$$

$$and\ P = m_C^+ \bullet v \qquad 2.5a$$

Taking into account (2.4 and 2.5), we can present the uncertainty principle in general form:

$$\Delta\left[\frac{\hbar}{(m_C^+ - m_C^-) \bullet c}\right]_W^2 \bullet \Delta\left[\frac{1}{2} m_C^+ \bullet v^2/c\right]_C^2 \geq \left(\frac{\hbar}{2}\right)^2 \qquad 2.6$$

This means that impossibility of simultaneous precise experimental evaluation of the impulse and position of elementary particle is a result of alternation between two time-separated [W] and [C] phase of particle and contribution of hidden parameters of de Broglie wave (wave B).

In accordance to our model the excessive energy of real Corpuscular state as respect to mirror one - turns to the energy of virtual quanta, equal to that of the Wave phase (see 1.11a). This energy can be subdivided to energy of Vacuum Density Waves (VDW) and Vacuum

Symmetry Waves (VSW):

$$E_W = (m_C^+ - m_C^-) \bullet c^2 = m_C^+ v^2 = 2T_{kin} = E_C \qquad 2.6a$$

$$or: E_W = E_{VDW} + E_{VSW} = |m_C^+ - m_0| \bullet c^2 + |m_C^- - m_0| \bullet c^2$$

It leads from (2.4), that elementary particles (fermions like electrons and positrons) in our model are not mathematical points, but can be strongly delocalized in space of bi-vacuum, when their group velocity is much less than the luminal one: $v << c$ (for example, at zero-point oscillations). The range of particle delocalization can be much bigger, than its Compton wave-length (L_0) and the external, detectable experimentally real wave B length:

$$\lambda_D^\pm >> L_0 = \hbar/m_0 c \geq \lambda_W^{ext} = \lambda_C^{ext} = h/(m_C^+ \bullet v). \qquad 2.6c$$

So, the nonlocal/non-point properties of particles, i.e. their relatively big dimensions, determines the uncertainty of their localization in space. It is true for the both [C] and [W] phase.

The uncertainty, induced by measurement itself is a result of the impulse change in [C] phase, leading to corresponding change of Wave B length.

The principle of uncertainty in the coherent form (2.3) reflects the original relation between [C] and [W] properties of particle without external perturbation, accompanied any kind of experimental observation.

Principle of uncertainty in form (2.2), reflects the inability of simultaneous registration of quantum state life-time (Δt) and the energy of this state (ΔE). As in previous case, it can be explained by alternation of corpuscular and wave phase, i.e. by their incompatibility in time.

Later it will be shown, that as it leads from the principle of least action, the notion of time is related to real external kinetic energy change. It is pertinent for [C] phase only and is uncertain for the virtual [W] phase.

So, our dynamic model of wave-particle duality explains that any selected instant moment of time one can get the relatively exact information about properties of only one of two phases of elementary particle.

2.2. Spins of fermions and bosons

The notion of spin as a constant value could not be related to the external impulse, as far the latter is increasing with external group velocity. This means that just internal (hidden) parameters of wave B are responsible for such important characteristic as spin.

For elucidation of notion of spin of elementary particles in the framework of our model we will use formulae of uncertainty in coherent form (2.3).

Using the conditions, introduced at the beginning of this chapter (1.5 - 1.7), we can show that zero-point impulse squared is equal to the averaged hidden one:

$$P_0^2 = m_0^2 c^2 = (m_C^+ v_{gr}^{\rm in}) \bullet (m_C^- v_{ph}^{\rm in}) = \left(\overline{P_C^{in}}\right)^2 = const \qquad 2.7$$

the resulting mass, equal to that of rest (m_0^2) and light velocity can be expressed in accordance with our model as:

$$m_0^2 = m_C^+ \bullet m_C^- \qquad 2.8$$

$$\text{and} \quad c^2 = v_{gr}^{\rm in} \bullet v_{ph}^{\rm in} \qquad 2.8a$$

From (2.7) it follows, that corresponding averaged hidden radius of real and mirror cross-sections of round cone (Fig.3a) also has a constant value:

$$L_0^2 = \left(\overline{L}_C^{in}\right)^2 = (\hbar/P_0)^2 = const \qquad 2.9$$

where $L_0 = \hbar/m_0 c$ - is the Compton wave length of a particle.

Using eqs. (2.7 and 2.9) and the uncertainty principle in coherent form, reflecting the coherent properties of uncompensated [real + mirror] vortex - dipole in composition of elementary particle, we come to the following expression:

$$L_0^2 \bullet P_0^2 = \left(\frac{\hbar}{2}\right)^2 = const \quad 2.10$$

Taking a square root from both side of (2.10), we get the values of the internal moment of impulse, equal to semi-integral spin values of the fermions, like electrons, protons, neutrino and their antiparticles:

$$L_0 \bullet P_0 = \pm\frac{1}{2}\hbar \quad 2.11$$

In general case spin (J) is a quantum number in units of ($\hbar$), reflecting the internal dynamics of elementary particles and number of projections of internal momentum of impulse on any selected direction of space. The number of corresponding spin states is equal to $2J+1$. Consequently at $J = 1/2$ we have two possible states of the fermions.

The best interpretation of our results obtained, corresponds to model of elementary particles, considering them as a coherent superposition of the vortex-dipoles and antivortex-dipoles [real+mirror]. For example $J = 1/2$ means the resulting momentum of impulse (momentum of quantity of movement), resulted from the unpaired vortex-dipole rotation can be positive and negative, depending on two possible directions of round cone rotation as respect to direction of particle propagation.

Particles with half-integral spin number, like electrons, termed fermions. They follow Fermi-Dirac's statistics. Our model predicts that fermions contain "uncompensated" vortex-dipoles, violating the symmetry of bi-vacuum.

Spin of bosons with integer value, like photon's is equal to $J = 1$ and that of π and K –mesons to $J = 0$. Bosons do not violate the bi-vacuum symmetry due to "compensating" effect of standing neutrino and antineutrino and follow the Bose-Einstein statistics.

The spin of bosons, like photons, equal to 1 means that three projections of internal momentum of impulse on any selected direction of space: +1; 0; -1 are possible. For bosons with spins, equal to zero, we suppose that the vortex-dipoles of positive and negative vacuum form coherent pairs (bi-dipoles) with rotation of each of these dipole opposite to each other. The projection of internal momentum of resulting impulse of such pair on any selected direction of space is equal to zero (S = 0). If positive and negative vortex-dipoles rotate in the same directions, the "clock-wise" rotation of pair can correspond to positive integer spin (+1) and the opposite direction of rotation corresponds to negative integer spin (-1).

The influence of bosons on bi-vacuum symmetry is absent and it makes possible Bose condensation (accumulation) of unlimited number of particles in the state of the same energy.

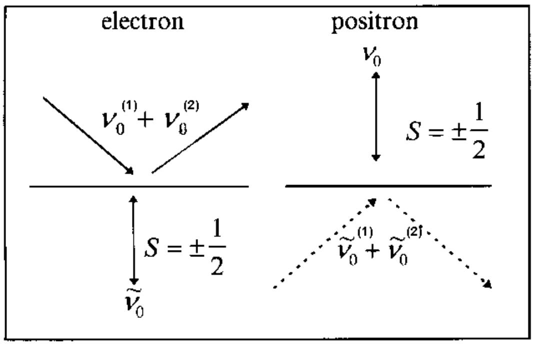
The identical particles with opposite half-integral spins: $+\frac{1}{2}$ *and* $-\frac{1}{2}$, **like two standing neutrinos (or vortex-dipoles) in composition of electron** $(2\nu_0 + \tilde{\nu}_0)$**can be spatially compatible, because of the counterphase manner of their** $[C \rightleftharpoons W]$ **pulsations. In this case the resonant exchange by cumulative virtual cloud (CVC), representing [W] phase between two corresponding bi-vacuum bosons (anchor sites for CVC) can stabilize the electron's structure. Similar situation can be realized in composition of other elementary particles and antiparticles as well as between them.**

It is known fact that the total rotating cycle for electron' spin is not 360^0, **but** 720^0, **i.e. double turn by magnetic field of special configuration is necessary to bring the electron to the starting state (Davies, 1985). This result could be explained by spatial image - round cone of uncompensated standing neutrino in composition of electron, responsible for its charge and spin (Fig. 4a). If we assume that direction of rotation of both - real and mirror vortexes, that determines a sign of spin, is changing separately, only one after another in magnetic field, then the full rotation angle of** $720^0 = 2 \times 360^0$ **became understandable.**

2.2 Spatial compatibility of the fermions with opposite spins

The [*corpuscle* ⇔ wave] *transitions of two standing neutrinos in composition of electron* $(2\nu_0 + \tilde{\nu}_0)$ *in accordance to our model, are counterphase.*

In this case of **counterphase** ($W \Leftrightarrow C$) pulsations of two standing neutrinos with **opposite** spins - they are *spatially compatible*. Their corpuscular and wave states are realized alternatively in two different semi-periods (Fig.5). **In this system the mass of pair is equal to real mass of one of standing neutrino and the instant spin of pair is determined by spin of one of standing neutrino being in corpuscular phase**: $S_{inst} = \pm\frac{1}{2}$. **The example of such pair of two neutrinos is presented on (Fig.5).**



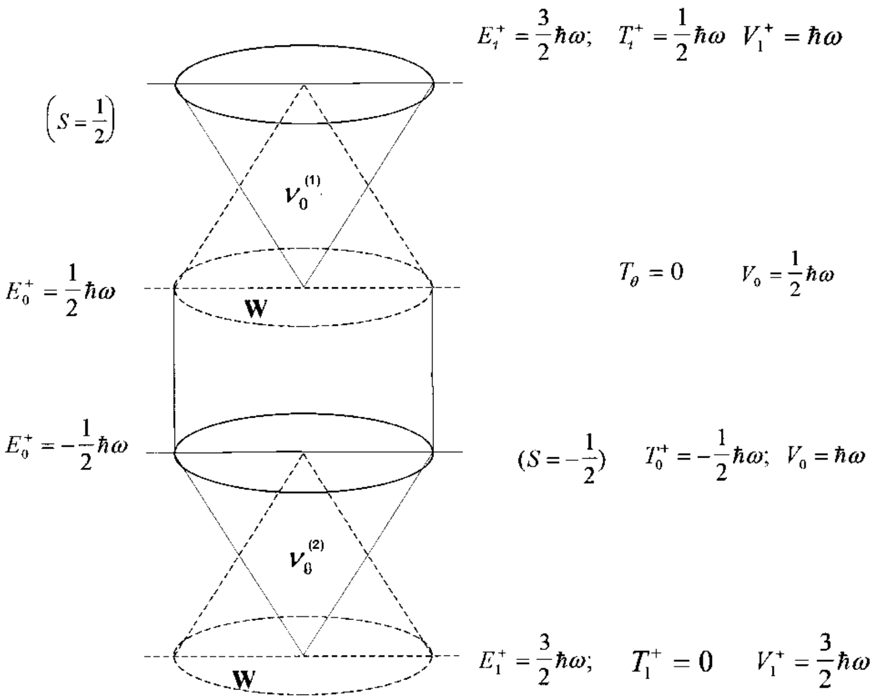


Fig. 5. Schematic representation of pair of a *spatially compatible* standing neutrinos (vortex-dipoles) of the *electron* $[2\nu_0 + \tilde{\nu}_0]$, with opposite half-integer spins. *At the counterphase transitions of two neutrinos with opposite spins between the excited and ground* (*zero-point*) *sublevels* $[\frac{3}{2}\hbar\omega \rightleftharpoons \frac{1}{2}\hbar\omega]$, *the* [$C \Leftrightarrow W$] *pulsations of* 2 *vortex-dipoles are counterphase also* and the pair behaves itself as a single spatial unit. It happens due to exchange interaction between counterphase vortex-dipoles by means of cumulative virtual cloud (CVC). At each semiperiod the spin of pair change its sign from $+\frac{1}{2}$ to $-\frac{1}{2}$

In accordance to our model, in triplet $[2\nu_0 + \tilde{\nu}_0]$, **representing the electron, one of the instant spin and charge values of one of two standing neutrino is compensated always by corresponding values of standing antineutrino in a course of their in-phase** $[C \rightleftharpoons W]$

oscillations. Consequently, the resulting spin and charge of the electron is determined by "uncompensated" spin of one of two standing neutrinos, presented on Fig.5. Changing the spin of the electron is determined by that of this standing neutrino. The real inertial mass of the electron is also determined by corpuscular mass of uncompensated standing neutrino in form of [real+mirror] vortex-dipole.

Two standing antineutrino as a part of positron $[2\widetilde{\nu}_0 + \nu_0]$, have a similar behavior, like 2 standing neutrinos in composition of electron.

The system of two **different** particles with the opposite spins, like [electron+electron], [electron+proton], [positron+positron], etc. also could be spatially compatible, if their $[C \rightleftharpoons W]$ pulsations are counterphase. Such a particles systems have a properties of bosons, like Cooper pairs.

The energy exchange between two different spin-states of the fermions in coherent pairs:

$$(S = +\frac{1}{2}) \rightleftharpoons (S = -\frac{1}{2}) \qquad 2.13$$

in a course of their counterphase $[C \rightleftharpoons W]$ pulsations is accompanied by the [absorption ⇌ emission] of cumulative virtual cloud (CVC). Such a process is responsible for coherent neutrino interaction.

2.3 Bosons as a coherent system of pairs of fermions with opposite spins

The spatial image of bosons (Fig. 6) could be presented as a superposition of two round cones (vortex-dipoles), each of cone describing the fermion or as the integer number of such round cone pairs. In another terms the elementary boson can be considered as a superposition of two vortex+antivortex dipoles.

Bosons have a zero or integer spin $(0, 1, 2 \ldots)$ in the $\hbar$ units in contrast to the half integer spins of fermions. The bosons with S=1 include: photons, gluons, mesons and boson resonances, phonons, *pairs of fermions with opposite spins* (i.e. Cooper pairs under the conditions of Bose-condensation), atoms and molecules.

We subdivide bosons into two types: asymmetric (localized), representing a system of different coherent particles with fermion properties (like atoms) and symmetric bosons (like photons), moving with light velocity with respect to asymmetric ones.

Asymmetric bosons, like atoms, are coherent system of pairs of different particles-fermions with the opposite spins and in-phase $(C \Leftrightarrow W)_{+1/2}$ and $(C \Leftrightarrow W)_{-1/2}$ transitions, confined in the volume, determined by 3D superposition of their de Broglie standing waves.

Symmetric vector bosons, moving with light speed, are superposition of integer number of pairs of coherent neutrino and antineutrino with **symmetric distribution of corpuscular mass as respect to vacuum**.

In the case of **in-phase** $(C \Leftrightarrow W)_{+1/2}$ and $(C \Leftrightarrow W)_{-1/2}$ transitions, the instant internal moments of 2 standing fermions like standing neutrinos, electrons or nucleons in composition of *elementary effectons* (by analogy with molecular primary effectons, introduced in Part I of our book) **become the additive parameters**. This determines the integer values for bosons spins. Pairs of fermions behave in this case like a single particle. Formation of *elementary effectons* - bosons from fermions, even with different corpuscular masses : $(m_C^+)_1 \neq (m_C^+)_2$ is possible, if the length of their waves B are equal due to corresponding difference in their external group velocities:

$$L_1 = \hbar/(m_C^+ \bullet v)_1 = L_2 = \hbar/(m_C^+ \bullet v)_2 \ldots = L_n = \hbar/(m_C^+ \bullet v)_n \qquad 2.14$$

The **hydrogen atom**, composing from two fermions: electron and proton is an example of such bosons. The heavier atoms also must follow the same principle.

The resulting averaged dimension of standing neutrino, determined by hidden group and phase velocities is a constant value, equal to Compton's wave length:

$$L_0 = [(\hbar/m_C^+ v_{gr}^{\text{in}}) \bullet (\hbar/m_C^- v_{ph}^{\text{in}})]^{1/2} = \hbar/m_0 c \qquad 2.15$$

The kinetic and potential energies of boson are equal to the sum of the corresponding energies of two constituent fermions, being simultaneously in corpuscular or wave state (Fig.6).

In accordance with our model, symmetric bosons such as photons (Fig.3), represent dynamic superposition of fermions and their antiparticles (two triplets of neutrino and antineutrino, corresponding to electron and positron) with different internal and external charges and spins: $\pm\frac{1}{2}$. The latter determines the value of photon's spin: $J = +1, 0$ or -1.

Stability of all types of *elementary* particles: symmetrical and asymmetrical bosons and fermions (electrons, positrons etc.) is due to energy exchange by means of cumulative virtual clouds in the process of $[C \rightleftharpoons W]$ counterphase pulsations of mass-dipoles, composing these particles.

Coherent Neutrino Interaction

Interaction between components of elementary particles occurs during in-phase [corpuscle ⇔ wave] pulsation of (neutrino + antineutrino) pairs and the counterphase pulsation of the adjoining couples of neutrino and antineutrino, as a result of cumulative virtual cloud (CVC) exchange.

It follows from our concept of elementary particles that only bi-vacuum symmetrical bosons and excited bi-vacuum bosons, such as photons with $m_C^+ = \tilde{m}_C^+$ and $m_C^- = \tilde{m}_C^-$ (*see* 2.15) and neutrino with $(m_C^+ = m_C^-)_{e,\mu,\tau}$ can propagate in vacuum with light velocity. The luminal velocity of symmetrical bosons is related to the absence of the **resulting vacuum symmetry shift** in a course of their [corpuscle ⇔ wave] transitions. This means that the $[C \rightleftharpoons W]$ pulsations keep the equilibrium of virtual quanta of positive and negative vacuum unchanged.

Nevertheless, the *resulting* symmetry of elementary bosons with respect to vacuum is ideal, but the mass symmetry shift of **individual** neutrino and antineutrino (Δm_C), which form such bosons, is not zero. The origination of the *electric* and *magnetic components* of a *photon* is the result of inequality of the real (m_C^+) and mirror (m_C^-) corpuscular masses of individual neutrino and an antineutrino that form photons:

$$\Delta m_C = (m_C^+ - m_C^-) > 0 \quad \text{and} \quad \Delta\widetilde{m}_C = (\tilde{m}_C^+ - \tilde{m}_C^-) > 0 \qquad 2.16$$

Properties of symmetric pair of standing neutrino and antineutrino $[\nu_0 + \tilde{\nu}_0]$ at Fig.6:

Resulting electric charge: $i_\nu + i_{\tilde{\nu}} = 0$;
resulting magnetic charge: $\eta_\nu + \eta_{\tilde{\nu}} = 0$;
resulting spin: $S_{\nu,\tilde{\nu}} = \pm 1, 0$

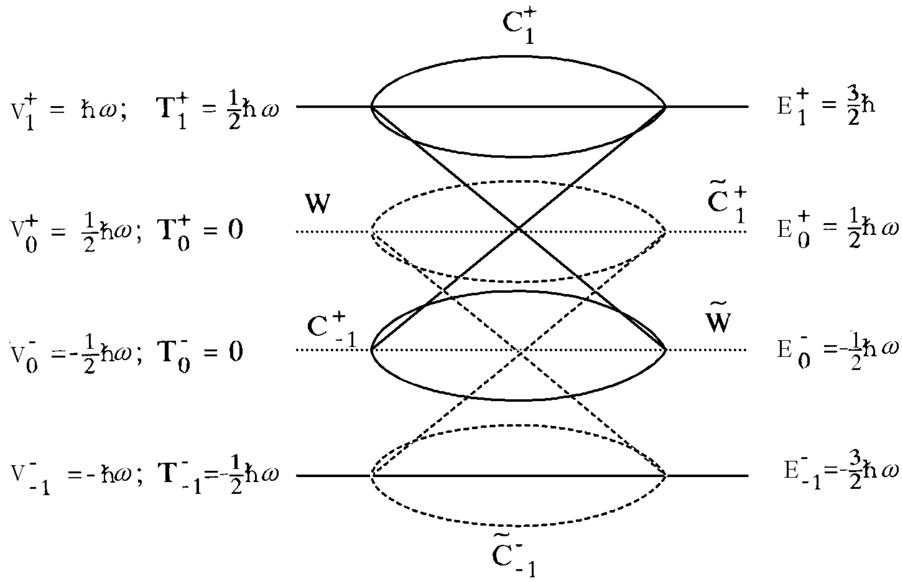


Fig. **6**. Schematic representation of symmetric and coherent [neutrino + antineutrino] pair (two coherent vortex-dipoles) with boson properties. Each of fermions of the pair pulsates between the corpuscle and wave states: $C \Leftrightarrow W$ and $\tilde{C} \Leftrightarrow \tilde{W}$ in-phase manner. Such a pair could be a component of different elementary particles, like electrons, positrons, quarks and others.

We can resume this part of our model description as follows:

During two semiperiods of de Broglie wave, the corpuscular [C] and wave [W] properties of each standing neutrinos (vortex-dipoles), composing elementary particle, are realized alternatively with frequency of quantum beats between real and mirror states of corpuscular phase. The $[C \rightleftharpoons W]$ pulsations of two standing neutrinos, composing the electron $(2\nu_0 + \tilde{\nu}_0)$ are counterphase. It means that when one of them is in local [C] phase the other is always in cumulative virtual cloud [W] phase. The $[C \rightleftharpoons W]$ pulsations of standing antineutrino is in-phase with one of these two neutrinos. They form the coherent pair $(\nu_0 + \tilde{\nu}_0)$, symmetrical as respect to vacuum (Fig.6).

The energy, charge, impulse of neutrino and antineutrino in pair $(\nu_0 + \tilde{\nu}_0)$ of electron, positron or other elementary particles compensate each other in the each phase of wave B. **Their in-phase pulsations are responsible for origination of standing waves from primary and secondary cumulative virtual clouds (CVC), unable to transfer the energy, as far their resulting Pointing vector is equal to zero**: $\vec{P}_{\nu_0+\tilde{\nu}_0} = \overrightarrow{P_{\nu_0}} + \overrightarrow{P_{\tilde{\nu}_0}} = 0$:

$$\overrightarrow{P_{\nu_0}} = \left[\vec{E} \times \vec{H}\right]_{\nu_0} = -\overrightarrow{P_{\tilde{\nu}_0}} = \left[\vec{H} \times \vec{E}\right]_{\tilde{\nu}_0} \qquad 2.17$$

This "symmetrical" component of wave B is a hidden one in contrast to asymmetrical component, related to unpaired/uncompensated standing neutrino (ν_0) *of* $(2\nu_0 + \tilde{\nu}_0)$ triplet.

The oscillation of symmetrical component of CVC$^{\pm}$ of particles, activated by those of asymmetrical one, can be responsible for modulation of bi-vacuum Bose condensate energy slit:

$$\Delta E_{bvb} = \frac{1}{2}(m_0^+ + m_0^-) \bullet c^2 \qquad 2.17a$$

and, consequently for nonlocal interaction between the particles of in-phase $[C \rightleftharpoons W]$ pulsations. For example, the twin photons are such coherent system, enable to nonlocal interaction until the phase shift of pulsation origination. Corresponding

oscillations of bi-vacuum slit can be termed the "vacuum amplitude waves (VAW)".

In accordance to our model, $[C \rightleftharpoons W]$ pulsations of each standing neutrino, composing elementary particles are accompanied by:

a) oscillations of vacuum virtual quanta pressure (vacuum density waves, VDW), due to reversible dissociation of part of real corpuscular mass to fraction of CVC with energy:

$$E_{VDW} = |m_C^+ - m_0| \bullet c^2 \qquad 2.18$$

b) oscillations of difference between virtual kinetic and potential energies of "mirror" vacuum substates (vacuum symmetry waves, VSW) at the constant zero point energy of negative (mirror) vacuum. It can be considered as reversible transformation of part mirror corpuscular mass to fraction of CVC with energy:

$$E_{VSW} = |m_C^- - m_0| \bullet c^2 \qquad 2.18a$$

The total energy of CVC is, consequently:

$$E_{CVC} = E_{VDW} + E_{VSW} \qquad 2.18b$$

The part of virtual VDW and VSW quanta can propagate in vacuum with superluminal velocity, i.e. have the tachyon properties without controversy with special theory of relativity. However, they are not nonlocal like the vacuum amplitude waves (VAW).

It is important, that the microscopic [wave ⇌ corpuscle] dynamic equilibrium could be a reason and background for corresponding macroscopic [Secondary Vacuum ⇌ Matter] equilibrium.

Secondary Vacuum [VACUUM$_S$] is a result of PRIMORDIAL VACUUM perturbation by presence of matter and related fields.

When the pair $(\nu_0 + \tilde{\nu}_0)$ of the electron is in the Wave phase, forming a standing waves from secondary CVC of BI-VACUUM$_S$, the second standing neutrino (ν_0) of the electron - is in Corpuscular phase and form the MATTER. This instant situation corresponds to our Real Corpuscular [ON] World.

At the next semiperiod of wave B, when standing [neutrino-antineutrino] pair $(\nu_0 + \tilde{\nu}_0)$ is in corpuscular state the VACUUM turns to the medium with very special properties, affecting the nonlocal properties of bi-vacuum Bose condensate, like vacuum amplitude (ΔE_{bvb}) waves (VAW), see eq.2.17a.

We suppose that such unusual active medium represents the integrated Alternative [OFF} World, able to self-organization. The possibility of feed back reaction between [OFF] and [ON] Words means possibility of influence of evolution of matter on secondary vacuum evolution and vice versa.

The quantum beats between [C] and [W] phases of uncompensated mass-dipoles in form of standing neutrino or vortex-dipole and related oscillations of bi-vacuum symmetry shift are a source of real fundamental fields and interactions (electromagnetic and gravitational) emergency in accordance to our model.

2.4. Pauli principle: How it works?

Let us consider now the reasons of the Pauli principle "working" for fermions and its absence for bosons. The total energy of wave B does not change in the course of [corpuscle ⇔ wave] transitions:

$$E_B = \hbar\omega_B \qquad 2.19$$

where:

$$\omega_B = (m_C^+ - m_C^-) \bullet c^2/\hbar \qquad 2.19a$$

is a frequency of wave B, i.e. frequency of beats between real and mirror states.

To understand the action of Pauli principle, we should compare our models for fermions (Fig. 4a) and bosons (Fig.6).

In *corpuscular* phase both fermions and bosons, including photons, have finite instant masses (m_C^+ *and* m_C^-) and they do not influence on equilibrium of positive and negative virtual quanta.

In contrast to [C] phase, the properties of fermions and bosons in the [W] phase are principally different.

Because standing [*neutrino* + *antineutrino*] in each pair, composing **bosons** with the resulting spin 0,+1 or -1 change their [corpuscular ⇔ wave] states in the *in-phase manner*, it means that *the density of "positive" and "negative" virtual quanta oscillate* ***equally*** *and the symmetry of vacuum remains unperturbed. The kind of "****compensation effect****" take a place. The interaction between bosons due to* ***excessive*** *virtual quanta pressure is absent.*

For the other hand, the number of standing neutrino and antineutrino in composition of **fermions are not equal to each other** in contrast to that of bosons. Consequently, the oscillation of positive and negative virtual quanta density, accompanied the cumulative virtual cloud (CVC) ejection/absorption, in the process of $[C \rightleftharpoons W]$ pulsations of neutrinos and antineutrinos, composing fermions, is not compensated. It leads to asymmetric oscillations of bi-vacuum virtual quanta density and energy.

This excessive virtual quanta density, determines the spatial incompatibility and repulsing of two separate fermions with the **same spins and the same phase of** **[C⇌ W]** pulsation *due to the effect, similar to that of excluded volume. It is a result of the difference between virtual quanta density (pressure) of "positive" and "negative" vacuum in space between fermions of similar spins.*

In accordance to our model, the reason of the electromagnetic and Pauli repulsion is the same - asymmetric distribution of positive and negative virtual quanta density, leading to excessive virtual pressure. *However, the Pauli repulsion* $[\varepsilon_P]$ *is much stronger than electromagnetic one* $[\varepsilon_{el}]$. *Their ratio should be equal to the ratio of total charge of the electron squared, introduced in our work as*: $Q^2 = \hbar c$ to electromagnetic charge squared, i.e. to reciprocal value of fine structure constant:

$$\frac{[\varepsilon_P]}{[\varepsilon_{el}]} = \frac{\hbar c}{e^2} = 1/\alpha \simeq 137 \qquad 2.20$$

For the other hand, if the spins of two fermions (electrons) are opposite, then their $[C \rightleftharpoons W]$ oscillations are counterphase and their are spatially compatible, as presented on Fig.5. Such a process did not increase the existing already difference between positive and negative virtual quanta density. Consequently, the Pauli repulsion is absent for this case.

In composition of boson, virtual quanta with total energy: $(m_C^+ - m_C^-) \bullet c^2$, emitted as a result of $C \to W$ transition of one of neutrino, could be absorbed by other neutrino with the opposite spin in a course of its $W \to C$ transition at the same semiperiod.

The effect of "excluded volume" in a system of two different elementary particles-fermions with the same spins and in-phase $C \to W$ **transitions is a result of asymmetric increasing of virtual quanta density and pressure (vacuum density waves) in space between them as respect to outer volume. In such a way our model explains the Pauli principle action**.

3. Weak and strong interactions

3.1. Weak interaction in the course of β-decay

There are two types of quarks (fermions) forming nucleons such as protons and neutrons: (u) **and** (d) **with the same spins** $S = \pm 1/2$, **but with different non integer charges**:+2/3 **and**−1/3, **correspondingly**. **The mass of** (d)- **quark is a bit more than that of** (u)-**quark** $\sim$ 10 **MeV**, **and much more than the electron mass** (**0**.**511 MeV**).

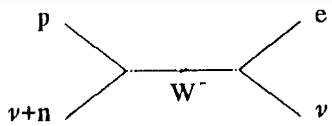
The resulting charge of a proton is equal to +**1 and that of a neutron to zero**, **because a proton is composed of two u-quarks and one d-quarks** $[2 \bullet (2/3) - 1/3 = 1]$ **and a neutron consists of two d-quarks and one u-quark** $[2 \bullet (-1/3) + 2/3 = 0]$. **The internal charges of neutrons and protons means the external charges of quarks in the framework of our model**. **Protons and neutrons are fermions with spin** $J = 1/2$.

Each of three quarks can exist in 3 states: red, green and blue.

In the course of *strong interaction* between quarks the gluons play the same role as virtual photons at the electromagnetic interaction. **Like a photon**, **a gluon has a spin equal to 1**. There are *eight types* of gluons (8 colors) responsible for changing the colors of quarks. In accordance with our model, gluons represent different dynamic combinations of possible instant states of three quarks, composing nucleons in a course of cumulative virtual cloud (CVC) exchange (see Fig.9).

Weak interaction is related to the transition of neutron (n) to proton (p), or so called isospin changing. **In contrast to traditional theory**, **we suppose that such isospin change is not spontaneous**, **but is stimulated by the neutron absorption of the external free neutrino** (ν):

$$\nu + n \rightarrow p + e^- + \tilde{\nu}$$



(3.1)

where: e^-, ν and $\tilde{\nu}$ mean the electron, free neutrino and antineutrino correspondingly.

The energy of ν and $\tilde{\nu}$ can vary strongly, depending on the energy of the emitted electron.

This β-decay occurs when one of two d-quarks of a neutron transforms to u-quark with emission of heavy ($m \sim 80.000$ MeV) charged (-1) particle: W^--boson ($s = 1$). Its antiparticle: W^+-boson has an opposite charge (+1).

The origination of a neutral Z^0-boson interacting with d-quark, u- quark, electron and neutrino is also possible in accordance with the theory of *electroweak* interaction (Salam, Weinberg, Glashow, 1979). The scattering of a neutrino by electrons is confirmed experimentally.

In accordance with our model (u) and (d)-quark are composed from 2 *positron-like* structures and [2 *electron* + 1 *positron*]-*like structures correspondingly*, forming a system of coherent standing waves (see Fig. 1 a,b). Each *standing* neutrino and antineutrino in this system has an electric charge, equal to -1/3 and + 1/3, respectively.

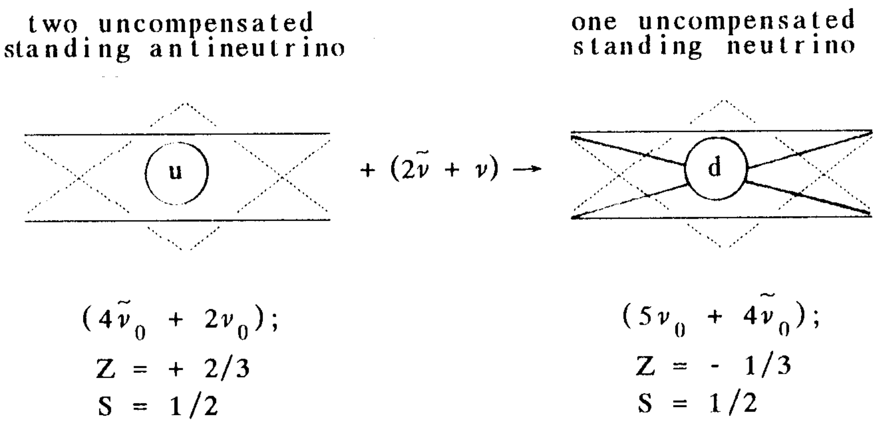


Fig. 7. Models of **u** and **d**-quarks as a system of standing waves of neutrino and antineutrino: doublet and triplet of triangles.

Neutron **and** ***proton*** **can be represented as:**

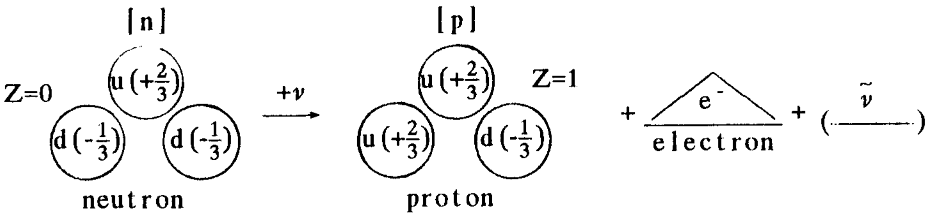


Fig. **8**. Transition: [neutron → proton] as a result of excitation of one of two d-quarks forming neutron by external "free" neutrino (ν) and the oscillation ($\nu_0 \to \tilde{\nu}_0$) of standing neutrino in composition of this d-quark .

Our model assume the possibility of [neutrino $(\nu_0)\frac{X}{Y} \to$ antineutrino $(\tilde{\nu}_0)$] oscillation (conversion) in the process of (d $\overset{\nu}{\longrightarrow}$ u) quark transformation, accompanied by X-boson excitation:

$$d + \nu = (5\nu_0 + 4\tilde{\nu}_0)_d + \nu \to [6\nu_0 + 4\tilde{\nu}_0]^* \overset{(X-boson)}{\longrightarrow} [6\tilde{\nu}_0 + 4\nu_0]^* \to$$

$$\to (4\tilde{\nu}_0 + 2\nu_0)_u + (2\nu_0 + \tilde{\nu}_0) + \tilde{\nu} =$$

$$= u + e^- + \nu \qquad 3.2$$

In this reaction the intermediate short-living complexes $[6\nu_0 + 4\tilde{\nu}_0]^*$ and $[6\tilde{\nu}_0 + 4\nu_0]^*$ can be considered as W^- *and* W^+ bosons correspondingly..

The reverse conversion of W^+ boson to W^-- boson can be presented as a result of neutrino/antineutrino oscillations, via intermediate state: Y-boson:

$$[6\tilde{\nu}_0 + 4\nu_0]^* \overset{(Y-boson)}{\longrightarrow} [6\nu_0 + 4\tilde{\nu}_0] \qquad 3.3$$

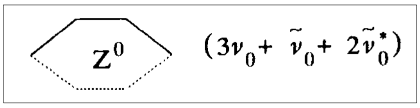
Oscillations of the electron's $(e^- - neutrino)$ means its reversible transformation to antineutrino $(e^+ - neutrino)$: $[\nu_0 \rightleftharpoons \tilde{\nu}_0]$.

Using our model of electron and positron (Fig. 1a) - the *neutral* Z^0 boson, revealed experimentally, can be constructed as a *short-life complex* of standing neutrino (ν_0) plus two virtual antineutrinos $(2\tilde{\nu}_0^*)$, forming virtual positron $(\nu_0 + 2\tilde{\nu}_0^*)$ with the real electron $(2\nu_0 + \tilde{\nu}_0)$. Such a complex can be represented as:

$$Z^0 = (e^+)^* + (e^-)$$

Neutral $\mathbf{Z^0}$ **boson** can be illustrated as a virtual hexagonal superposition of standing neutrino and antineutrinos, excited in composition of d-quark:

$$\nu + (2\nu_0 + \tilde{\nu}_0) \overset{+2\nu_0^*}{\longrightarrow} \left[\ (\nu_0 + 2\tilde{\nu}_0^*) + (2\nu_0 + \tilde{\nu}) \ \right] \to \nu + e^- \qquad 3.4$$



In accordance with this process, the origination of Z^0-boson needs 2 *virtual antineutrino* $(2\tilde{\nu}_0^*)$.

The "price" of this massive particle formation is the loss of vacuum symmetry. The *electroweak* theory of Weinberg and Salam introduce the spontaneous loss of symmetry on the basis of Higgs field. This theory predicts the existence of very heavy *Higgs bosons* (X and Y) with spin and charge equal to zero.

In our model X and Y bosons can be related to very short living oscillation stages (right and back, see 3.2 and 3.3) correspondingly:

$$n \bullet \nu_0 \ \overset{X}{\underset{Y}{\Leftrightarrow}} \ n \bullet \tilde{\nu}_0 \qquad (n = 1,2,3,\ldots)$$

In accordance with Fermi theory of β-decay, the scattering of neutrino on proton should lead to origination of the neutron and positron.

Our model predicts that similar result could be a consequence of high energy γ-quantum absorption by proton:

$$p + [3\nu + 3\tilde{\nu}] \to n + e^+$$

where: $[3\nu + 3\tilde{\nu}]$ corresponds to structure of γ-quantum (see Fig 2) and $e^+ = [2\tilde{\nu}_0 + \nu_0]$ is a positron.

We assume in our model that each electric (i) **and magnetic** (η) **components of elementary charge of standing neutrino** (ν_0) **in quark are interrelated as**: (see Chapter 4 of [1]) **and are equal to**:

$$\left. \begin{array}{c} i = -\frac{1}{3}e \quad \eta = -3e \\ i \bullet \eta = e^2 \end{array} \right\} \qquad 3.5$$

and for each standing antineutrino $(\tilde{\nu}_0)$ **in quark**:

$$= +\tfrac{1}{3}e^+ \quad \tilde{\eta} = +3e^+ \qquad 3.6$$

$$\bullet \ \tilde{\eta} = (e^+)^2 \qquad 3.6a$$

For calculating the resulting charges of $(u)^{+2/3}$ and $(d)^{-1/3}$ quark we use the following rules:

1. The charge of a standing neutrino can be neutralized or "compensated" by the opposite charge of standing antineutrino:

$$\left. \begin{array}{l} i + \quad = 0 \\ \eta + \tilde{\eta} = 0 \end{array} \right\} \qquad 3.7$$

2. The interaction between a standing neutrino and an antineutrino and their spatial organization in the composition of quarks are determined by their tendency to maximum reciprocal neutralization of charges.

3.2. Strong interaction

The dynamics of corpuscular and wave states of standing neutrinos and antineutrinos, forming the quarks of proton or neutron has another character than that of the electron.

The stability of nucleons is a result of simultaneous correlated exchange of virtual quanta - gluons between 3 quarks.

In accordance with our model (Fig. 9), each of three quarks (u or d) can exist in 3 states (red, green and blue):

[**1**] **red state of quark** :

2/3 **of neutrino and antineutrino, composing [u] quark** $(4\tilde{\nu}_0 + 2\nu_0)$

or [d] quark $(5\nu_0 + 4\tilde{\nu}_0)$ **are in corpuscular state;**

[**2**] **green state of quark** :

2/3 **of neutrino and antineutrino of a given quark (u or d) are in the wave state;**

[**3**] **blue state of quark**:

all neutrino and antineutrino of the given quark are in transition state, making it possible the simultaneous energy exchange between quarks by [emission$\rightleftharpoons$ *absorption*] **of cumulative virtual clouds (CVC).**

The dynamic interplay between 3 quarks may be represented as follows:

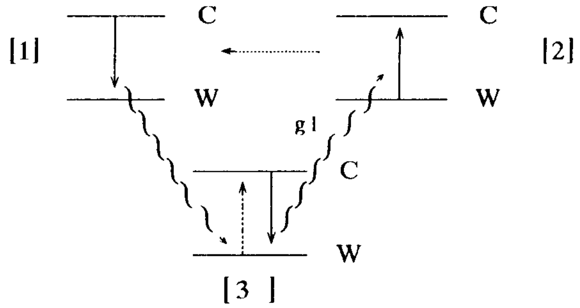


Fig. 9. Dynamic interaction between three quarks, being in red [1], green [2] and blue [3] states by means of gluons exchange. *The* 8 *different combinations* of 3 above mentioned quarks states and corresponding ways of *energy exchange* between them are possible. *Each of these combinations, corresponding to certain energy exchange mechanism by [emission$\rightleftharpoons$ absorption] of cumulative virtual cloud, may be attributed to one color of gluon.* Only one of 8 combinations of the possible energy exchange process is presented.

The exchange by gluons between 3 quarks, which form protons and neutrons, determines "strong interaction". Nucleons can exist only as a dynamic unity of three quarks. It is a reason why they are inseparable experimentally.

Electromagnetic interaction is characterized by electromagnetic charge ($e^2 = i \bullet \eta$). Similarly, strong interaction can be related to a"strong"charge:

$$g_S^2 = i_S \bullet \eta_S \qquad 3.8$$

and the strong interaction fine structure constant:

$$\alpha_S = g_S^2/\hbar c \qquad 3.9$$

The energy of strong interaction (ϵ_S) can be re presented in a similar way as electromagnetic one (see next chapter):

$$\epsilon_S = \frac{g_S^2}{(L_D)_S} = \frac{g_S^2(m_C^+ - m_C^-)_S \bullet c}{\hbar} = \alpha_S (m_C^+)_S \bullet c^2 \qquad 3.10$$

where:

$$(L_D)_S = \hbar/(m_C^+ - m_C^-)_S \bullet c \qquad 3.11$$

is the [real+mirror] mass dipole length of standing neutrino in composition of quarks.

The mass symmetry shift (see 1.11):

$$\Delta m_S = (m_C^+ - m_C^-)_S = (m_C^+)_S(v/c)^2 \qquad 3.11a$$

is dependent on external group velocity (v) of elementary particles. Small spatial dimensions of the nucleons and quarks means huge impulses, i.e. big real masses and external velocities of coherent neutrino and antineutrino, forming them.

The problem of neutron and proton mass origination can be approached in the framework of our model, if we assume, that the ratio between charge and mass components for the electron and positron - like structures in composition of quarks follow the rule:

$$(m_C^+/m_0)^* = (\eta/e)^6 \quad \text{or} \quad (m_C^+/m_C^-)^* = (\eta/i)^6 \qquad 3.12$$

As far it is assumed that the ratio (η/e) for all quarks is equal to 3 (see 3.5), we get from (3.12) the mass of one electron (positron) - like structures in composition of quarks:

$$(m_C^+)^* = m_0^*(\eta/e)^6 = 729m_0^* \qquad 3.13$$

where: $m_0^* \sim m_0$ is close to resulting mass of the electron.

Multiplying this value by the number of (e^-) and (e^+)-like structures, composing proton: $n = [7]$ and neutron $n = [8]$, we obtain their effective masses (the sum of the real corpuscular and concealed ones, related with defect of mass effect).

Calculated in such a way the fraction of "mass defect" - undetectable mass for proton, as an excessive theoretical mass value as respect to experimental one is about:

$$f_p = \frac{M_{theor} - M\exp}{M_{\exp}} \sim 0.6$$

and that for neutron $f_n \sim 0.3$, i.e. two times less.

We can assume, that this mass-defect is an energy-mass equivalent, characterizing the contribution of massless gluons, responsible for interaction between three quarks. Consequently, the two-times difference in mass-defect ($f_p/f_n \sim 2$) can explain much higher stability of proton than neutron as respect to decay.

Another possible way for explanation of nucleons big mass origination is the assumption that $[m_C^+]$ of standing neutrinos, composing quarks and nucleons is much bigger than that of electron.. This could be due to stronger vacuum symmetry shift in the volume of quarks: $\triangle m_V = |m_V^+ - m_V^-|$.

It leads from our theory of gravitation [see next chapter] that

$$m_C^+ \sim |m_C^+ - m_C^-| = \left(\frac{M_{Pl}}{m_0}\right)^2 \bullet |m_V^+ - m_V^-| \qquad 3.13a$$

This formula means that the bigger is vacuum symmetry shift in region of particle localization, the bigger is its mass. In case of complex fermions like μ and τ electrons, quarks, protons, neutrons, the big value of $\triangle m_V$ could be interrelated with their big corpuscular mass.

In accordance to relativist mechanics, the bigger is particle velocity (v), the bigger is its real mass: $m_C^+ = m_0/[1 - (v/c)^2]^{1/2}$ and corresponding vacuum symmetry shift.

3.3. Three levels of quark-lepton generations

First generation includes: e-electron, u- and d-quarks and (e^-) neutrino. As a result of scattering of high energy protons on nuclei, two new types of electrons and corresponding two new types of quarks, representing second and third generations, were revealed.

Second lepton-quark generation is represented by: μ – **electron with mass** $m_\mu = 105.8$ **MeV**. **It is more than two hundred times heavier than electron**: $m_\mu/m_e = 207.045$ **with almost similar magnetic moment** ($\mu = 1.001165924$) **and by two quarks**:

(**S**)-**strange quark** ($m_S \cong 1860$ **MeV**) **and** (**C**)- **charm quark** ($m_C \cong 1800$ **MeV**).

Third lepton-quark generation includes: τ-**electron with mass** $m_\tau \cong 1860$ **MeV**, **much heavier than** μ – *electron*; ($m_\tau/m_e = 3639.921$) *and* (**b**)-**beauty quark** ($m_b \cong 4800$ **MeV**).

It was suggested that each generation of the electrons and quarks is related also to corresponding 3 types of the neutrino.

Because our model explains the formation of electrons and quarks from the standing neutrino, *the most natural explanation of three generations of leptons and quarks* is to assume that 3 corresponding *moving* neutrino have the increasing zero-point corpuscular masses, as it was discussed before:

$$\left.\begin{array}{l} \nu_e \sim (m_C^+ \bullet m_C^-)_\nu = (m_0)^2_\nu \\ \nu_\mu \sim (m_C^+ \bullet m_C^-)_\mu = (m_0)^2_\mu \\ \nu_\tau \sim (m_C^+ \bullet m_C^-)_\tau = (m_0)^2_\tau \end{array}\right\} \qquad 3.14$$

In accordance with model, the spin, zero charge and velocity of free moving neutrino are not dependent on m_C^+ and m_C^- values due to their equality in conditions of zero vacuum symmetry shift. However, when these 3 generation of neutrino compose electrons and quarks in the form of triplets of standing de Broglie waves, the difference in their (m_C^+) and $(m_0)^2_{\nu,\mu,\tau}$ become significant and determines the difference in mass of corresponding generations of quarks and electrons.

Three generations of neutrino can be resulted from different bi-vacuum bosons excitation states. (see section 1.3).

3.4 New approach to evaluation of magnetic moments of proton and neutron

The experimental values of proton and neutron magnetic moments are:

$$\mu_p = 2.79275\mu_{\text{nuc}} \qquad 3.25$$

$$\mu_n = -1.913\mu_{\text{nuc}} \qquad 3.26$$

respectively, where: μ_{nuc} - nuclear magneton is an analog of Bohr magneton:

$$(\mu_{\text{nuc}})_{p,n} = \frac{e\hbar}{2m_{p,n}c} \qquad 3.27$$

It was assumed that for each of 2 types of quarks (u and d) that form protons and neutrons the same relation between *electric* (i) and *magnetic* (η) components of electromagnetic charge (e) as for electron is valid:

$$e^2 = i_u \bullet \eta_u \qquad 3.28$$

$$e^2 = i_d \bullet \eta_d \qquad 3.29$$

Because the electric charges for **u** and **d** quarks are equal, respectively to:

$$i_u = (+2/3)e \quad \text{and} \quad i_d = (-1/3)e \qquad 3.30$$

the magnetic charges for these quarks from (3.28) and (3.29) are

$$\eta_u = (+3/2)e \quad \text{and} \quad \eta_d = (-3)e \qquad 3.31$$

Assuming that in composition of nucleons the magnetic and electric charges of quarks are additive parameters we have the following resulting values for the *proton*:

$$i_p = 2i_u + i_d = \left[2 \bullet \frac{2}{3} + \left(-\frac{1}{3}\right)\right] = 1e^+ \qquad 3.32$$

$$\eta_p = 2\eta_u + \eta_d = \left[2 \bullet \frac{3}{2} + \left(-3 \right)\right] = 0 \qquad 3.33$$

and these for the neutron:

$$i_u = 2i_d + i_u = \left[2(-\tfrac{1}{3}) + \tfrac{2}{3} \right]e = 0 \qquad 3.34$$

$$\eta_n = 2\eta_d + \eta_u = \left[-6 + \frac{3}{2}\right]e = -4.5e^- \qquad 3.35$$

In accordance with our model, we introduce the *magnetic moments of protons and neutrons* as proportional to their magnetic charges, but with due regard for the contributions of internal motion of quarks ($\Delta\mu_p$ and $\Delta\mu_n$):

$$\mu_p = \eta_p \frac{\hbar}{2m_p c} + \Delta\mu_p = 0 + \Delta\mu_p = 2.792\mu_{\text{nuc}} \qquad 3.36$$

$$\mu_n = \eta_n \frac{\hbar}{2m_n c} + \Delta\mu_n = -4.5\mu_n + \Delta\mu_n = -1.913\mu_{\text{nuc}} \qquad 3.37$$

For protons and neutrons the contributions of internal relative motion of quarks in (3.36) and (3.37) are quite close to each other:

$$\Delta\mu_p = 2.792\mu_{\text{nuc}}$$

$$\Delta\mu_n = -1.913\mu_{\text{nuc}} - 4.5\mu_{\text{nuc}} = 2.587\mu_{\text{nuc}} \qquad 3.39$$

These calculations, based on our model, are rough. However, the close values of $\Delta\mu_p$ and $\Delta\mu_n$ show that it could be the right way, alternative to conventional one.

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