UNIFIED THEORY OF BIVACUUM, CORPUSCLE - WAVE DUALITY, FIELDS AND TIME

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SUMMARY

New concept of Bivacuum is introduced, as a dynamic superfluid matrix of the Universe, composed from non mixing sub-quantum particles of the opposite energies, separated by energy gap. Their collective excitations form mesoscopic vortical structures. These structures, named Bivacuum fermions ($\mathbf{BVF}^{\uparrow} = \mathbf{V}^{+} \Uparrow \mathbf{V}^{-})^{i}$ and antifermions ($\mathbf{BVF}^{\downarrow} = \mathbf{V}^{+} \Downarrow \mathbf{V}^{-})^{i}$, are presented by infinitive number of double cells-dipoles, each cell containing a pair of correlated *positive and negative torus (donuts)*: actual ($\mathbf{V}^{+}$) and complementary ($\mathbf{V}^{-}$) one of the opposite quantized energy, mass, charges and magnetic moments. It is postulated, that the absolute values of internal kinetic rotational energy of $\mathbf{V}^{+}$ and $\mathbf{V}^{-}$ are permanent and independent on the external translational velocity of $\mathbf{BVF}^{\updownarrow}$:

$$\frac{1}{2}|\mathbf{m}_V^+\mathbf{v}_{gr}^2|_{\mathbf{V}^+} = \frac{1}{2}|-\mathbf{m}_V^-\mathbf{v}_{ph}^2|_{\mathbf{V}^-} = \frac{1}{2}\mathbf{m}_0\mathbf{c}^2 = \mathbf{const}$$

The shift of symmetry between $\mathbf{V}^{+}$ and $\mathbf{V}^{-}$ of $\mathbf{BVF}^{\updownarrow}$ results in origination of uncompensated actual mass and charge of asymmetric $\mathbf{BVF}_{as}^{\updownarrow}$. In such a way our theory explains origination of the rest mass and elementary charge of sub-elementary fermions/antifermions. The fusion of asymmetric Bivacuum fermions, representing in Golden mean conditions sub-elementary fermions/antifermions: $(\mathbf{BVF}_{as}^{\updownarrow})^{\phi} \equiv \mathbf{F}_{\updownarrow}^{\pm}$ to triplets of elementary particles becomes possible at the Golden mean ($\mathbf{v}^2/\mathbf{c}^2 = \phi = 0,618$) conditions. At this GM condition $\mathbf{F}_{\updownarrow}^{\pm}$ are stabilized by the resonance interaction with Bivacuum in the process of their [$Corpusle(C) \rightleftharpoons Wave(W)$] pulsation. These pulsations are accompanied by the [*emission* $\rightleftharpoons$ *absorption*] of cumulative virtual clouds ($CVC^{\pm}$), and corresponding recoil energy of particles. This recoil momentum and energy activate in superfluid matrix of Bivacuum longitudinal and transversal spherical elastic waves, responsible for electromagnetic and gravitational potentials. The recoil potential energy, pertinent for the wave [W] phase of particle, is compensated by the opposite change of particle's kinetic energy in its corpuscular [C] phase. The total energy of particle, moving in space with velocity (**v**) is the averaged sum of both phase energy, equal to:

$$\mathbf{E}_{tot} = \mathbf{m}_V^+\mathbf{c}^2 = \hbar\omega_{\mathbf{C}\rightleftharpoons\mathbf{W}} = \mathbf{R}_{tr}(\hbar\omega_0)_{rot} + (\hbar\omega_B^{ext})_{tr} = \mathbf{R}_{tr}(m_0\omega_0\mathbf{L}_0^2)_{\mathbf{rot}} + \left(\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2}\right)_{\mathbf{tr}}$$

where: $\mathbf{R}_{tr} = \sqrt{1-(\mathbf{v}/\mathbf{c})^2}$ is a relativist translational coefficient; $\mathbf{v} \equiv \mathbf{v}_{tr}^{ext}$ is the external translational group velocity; $\boldsymbol{\lambda}_B = h/\mathbf{m}_V^+\mathbf{v}$ is the external translational de Broglie wave length.

The phenomenon of [$\mathbf{C} \rightleftharpoons \mathbf{W}$] duality is a result of modulation of carrier frequency of [$\mathbf{C} \rightleftharpoons \mathbf{W}$] pulsation, determined by the rest mass of particle: $\omega_0 = \mathbf{m}_0\mathbf{c}^2/\hbar$ by the modulation frequency of de Broglie wave: $\omega_B^{ext} = \mathbf{m}_V^+\mathbf{v}_{ext}^2/\hbar$.

It follows from our theory that the Principle of least action is a consequence of Harmonization energy (HaE) of Bivacuum influence on particles, driving the properties of matter on all hierarchical levels to Golden mean condition. It is shown, that the introduced dimensionless *pace of time* for any closed coherent system is determined by the pace of its kinetic energy change (anisotropic in general case), related to changes of the electric ($\mathbf{E_E}$) and gravitational ($\mathbf{E_G}$) potentials: $[\mathbf{dt}/\mathbf{t} = \mathbf{d}\ln\mathbf{t} = -\mathbf{d}\ln\mathbf{T}_k = -\mathbf{d}\,\mathbf{ln}(\mathbf{E_E}+\mathbf{E_G})]_{x,y,z}$. Using these relations, the time itself for closed system of particles can be presented via their acceleration and velocity:

$$\left[\mathbf{t} = -\frac{\mathbf{v}}{\mathbf{dv/dt}}\frac{1-(\mathbf{v}/\mathbf{c})^2}{2-(\mathbf{v}/\mathbf{c})^2}\right]_{x,y,z}$$

The pace of time, following from this formula is:

$$\left[\frac{\mathbf{dt}}{\mathbf{t}} = \mathbf{d}\ln\mathbf{t} = -\frac{\mathbf{1}}{d\mathbf{v}/\mathbf{v}}\frac{1-(\mathbf{v}/\mathbf{c})^2}{2-(\mathbf{v}/\mathbf{c})^2}\right]_{x,y,z}$$

The time is positive ($\mathbf{t} > \mathbf{0}$), if the particles motion is slowing down ($\mathbf{dv}/\mathbf{dt} < \mathbf{0}$), for example at temperature decreasing, and vice verse. Oscillations of atoms and molecules in condensed matter are accompanied by alternation the sign of acceleration and, consequently sign of time. In the absence of acceleration ($\mathbf{dv}/\mathbf{dt} = \mathbf{0}$), the time turns to infinitive and its 'pace' to zero ($\mathbf{dt}/\mathbf{t} = \mathbf{0}$). Standing waves satisfy this condition. *The time for each selected closed system of particles is a parameter, characterizing the average velocity and acceleration of these particles, i.e. this system dynamics.*

Introduced in our theory notion of Virtual replica (VR) or virtual hologram of any material object in Bivacuum, is a result of interference of fundamental Virtual Pressure Waves ($VPW^{\pm}$) of Bivacuum (reference waves), modulated by $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation of elementary particles, with de Broglie waves of particles, composing this object (object waves).

A lot of experimental results, like Kozyrev's ones, pointing to existing of new kind of Bivacuum mediated interactions, incompatible with existing paradigm, find the explanation in terms of our approach.

Unified theory, presented in this work, turns the paradigm of Holographic Universe, proposed by David Bohm and Karl Pribram, to more concrete shape and opens a new perspectives in physics.

1. The new concept of Bivacuum

The Unified Theory (UT) represents our efforts for unification of vacuum, matter and fields from few ground postulates. New concept of Bivacuum is introduced, as a dynamic superfluid matrix of the Universe, composed from non mixing sub-quantum particles of the opposite energies, separated by energy gap. It is a consequence of new interpretation of Dirac theory, pointing to equal probability of positive and negative energy. The collective excitations of sub-quantum particles represent the quantized mesoscopic vortical structures. The infinitive number of such structures, named Bivacuum fermions ($\mathbf{BVF}^{\uparrow} = \mathbf{V}^{+} \upuparrows \mathbf{V}^{-})^{i}$ and antifermions ($\mathbf{BVF}^{\downarrow} = \mathbf{V}^{+} \downdownarrows \mathbf{V}^{-})^{i}$, are existing as a double cells-dipoles, each cell containing a pair of correlated *negative and positive torus (donuts)*: $\mathbf{V}^{+}$ and $\mathbf{V}^{-}$ of the opposite quantized energy:

$$[\mathbf{E}_{\mathbf{V}^{\pm}} = \pm \mathbf{m}_0 \mathbf{c}^2 (\frac{1}{2} + \mathbf{n}) = \pm \hbar \boldsymbol{\omega}_0 (\frac{1}{2} + \mathbf{n})]^{e,\mu,\tau} \qquad \mathbf{n} = 0,1,2\ldots \tag{1}$$

virtual mass, charge and magnetic moments, compensating each other. There are three types of these symmetric mass ($\mathbf{m}_V^{+}$ and $\mathbf{m}_V^{-})^{i}$, electric (e_{+} and e_{-}) and magnetic ($\boldsymbol{\mu}_{+}$ and $\boldsymbol{\mu}_{-}$) dipoles, corresponding to three lepton generations ($i = e, \mu, \tau$). The torus and antitorus ($\mathbf{V}^{+} \Updownarrow \mathbf{V}^{-}$) of pairs are both rotating in the same direction: clockwise or anticlockwise. This determines the positive and negative spins ($\mathbf{S} = \pm \mathbf{1}/\mathbf{2}\hbar$) of Bivacuum fermions: $\mathbf{BVF}^{\uparrow}$ or $\mathbf{BVF}^{\downarrow}$.

The energy gap between torus and antitorus of symmetric $\mathbf{BVF}^{\updownarrow}$ is:

$$[\mathbf{A}_{BVF} = \mathbf{E}_{\mathbf{V}^{+}} - (-\mathbf{E}_{\mathbf{V}^{-}}) = \hbar \boldsymbol{\omega}_0 (1 + 2\mathbf{n})]^{i} \tag{2}$$

The radius of each type of symmetric $\mathbf{BVF}^{e,\mu,\tau}$ is equal to radius of corresponding type dual torus:

$$\mathbf{L}^{e} = \hbar/\mathbf{m}_0^{e}\mathbf{c} >> \mathbf{L}^{\mu} = \hbar/\mathbf{m}_0^{\mu}\mathbf{c} > \mathbf{L}^{\tau} = \hbar/\mathbf{m}_0^{\mu}\mathbf{c} \tag{2a}$$

The smaller $(\mathbf{BVF}^{\updownarrow})^{\mu,\tau}$ can be located inside and outside of bigger $(\mathbf{BVF}^{\updownarrow})^{e}$.

The reversible transitions of torus and antitorus of $(\mathbf{BVF}^{\updownarrow} = \mathbf{V}^{+} \Updownarrow \mathbf{V}^{-})_n^{i}$ between states with different quantum numbers: $n = 1,2,3\ldots$ and fundamental frequency

$$(\boldsymbol{\omega}_0 = \mathbf{m}_0 \mathbf{c}^2/\hbar)^{i} \tag{2b}$$

are accompanied by the [emission $\rightleftharpoons$ absorption] of virtual clouds $(\mathbf{VC}_{j,k}^{+} \sim V_j^{+} - V_k^{+})^{i}$ and anticlouds $(\mathbf{VC}_{j,k}^{-} \sim V_j^{-} - V_k^{-})^{i}$

The energy and momentum of primordial Bivacuum keeps constant in a course of strictly correlated spontaneous transitions between excited and ground states of torus and antitorus, in realms of positive (+) and negative (-) energy, because these transitions compensate each other.

Virtual particles and antiparticles in our model are the result of certain combinations of virtual clouds , composed from sub-quantum particles with dimensions of Plank length or lower. The density oscillation of $\mathbf{VC}^{+}_{j,k}$ and $\mathbf{VC}^{-}_{j,k}$ and virtual particles and antiparticles represent *positive and negative virtual pressure waves* ($\mathbf{VPW}^{+}$ and $\mathbf{VPW}^{-}$).

As far Bivacuum has a properties of active medium, the superposition of virtual waves may have a tendency to self-organization in certain conditions and the autowaves formation.

The virtual particles, in contrast to real ones, may exist only in the wave [W] phase, but not in corpuscular [C] phase (see section 8). It is a reason, why [$\mathrm{VPW}^{\pm}$] and their superpositions in form of virtual holograms (section 16), interrelated with matter properties, do not obey the laws of relativist mechanics and causality principle.

The correlated *virtual Cooper pairs* of Bivacuum fermions ($\mathrm{BVF}^{\updownarrow}$) with opposite spins ($S = \pm\frac{1}{2}\hbar$) and the Boson properties can be presented as:

$$[\mathbf{BVF}^{\uparrow}\bowtie\ \mathbf{BVF}^{\downarrow}]_{S=0} \equiv [(\mathbf{V}^{+}\upuparrows\ \mathbf{V}^{-})\ \ \bowtie\ (\mathbf{V}^{+}\downdownarrows\ \mathbf{V}^{-})]_{S=0} \qquad 3$$

Such a pairs, like *Goldstone bosons* have zero mass and spin: $S = 0$. Superposition of their virtual clouds ($\mathbf{VC}^{\pm}_{j,k}$), emitted and absorbed in a course of correlated transitions of $[\mathbf{BVF}^{\uparrow}\bowtie\ \mathbf{BVF}^{\downarrow}]^{j,k}_{S=0}$ between (j) and (k) sublevels in form of $\mathbf{VPW}^{\pm}$ compensate the energy of each other - totally in primordial Bivacuum and partly in secondary Bivacuum - in presence of matter and fields. The latter case is a reason for the excessive virtual pressure origination: $\mathbf{\Delta VP}^{\pm} = |\mathbf{VP}^{+} - \mathbf{VP}^{-}| \sim |\mathbf{VC}^{+}_{j,k} - \mathbf{VC}^{-}_{j,k}|_{S=0} \geq 0$:

$$(BVF^{\uparrow})^{j,k} \equiv (\mathbf{V}^{+}\upuparrows\ \mathbf{V}^{-})^{j,k} \qquad 3a$$

$$\Updownarrow \qquad \rightleftharpoons \left|(\mathbf{VC}^{+}_{j,k})^{\circlearrowleft} - (\mathbf{VC}^{-}_{j,k})^{\circlearrowright}\right|^{j,k}_{S=0} \geq 0$$

$$(BVF^{\downarrow})^{j,k} \equiv (\mathbf{V}^{+}\downdownarrows\ \mathbf{V}^{-})^{j,k} \qquad 3b$$

The massless nonlocal *virtual spin waves (VirSW)* with properties of collective Nambu-Goldstone modes represent oscillation of equilibrium of Bivacuum fermions with opposite spins:

$$\mathbf{VirSW} \sim \left[\mathbf{BVF}^{\uparrow}(\mathbf{V}^{+}\upuparrows\ \mathbf{V}^{-})\ \overset{K_{BVF^{\uparrow}\rightleftharpoons BVF^{\downarrow}}}{\rightleftharpoons}\ \mathbf{BVF}^{\downarrow}(\mathbf{V}^{+}\downdownarrows\ \mathbf{V}^{-})\right] \qquad 29a$$

These VirSW can serve as a carrier of the phase/spin information and the angular momentum, but not the energy. Superposition of VirSW may provide the Pauli repulsion effects in Bivacuum domains, where density of Bivacuum fermions with parallel spins exceeds the density of antiparallel spins. This may results in Bivacuum domains expansion. The so called 'dark energy', accelerating the Universe expansion, can be explained by such mechanism.

The energy distribution in a system of weakly interacting bosons (ideal gas), described by Bose-Einstein statistics, do not work for Bivacuum due to strong coupling of pairs $[BVF^{\uparrow}\ \bowtie\ BVF^{\downarrow}]_{S=0}$, forming virtual Bose condensate (VirBC) with nonlocal properties. The statement of nonlocality can be proved using Virial theorem.

2 Virtual Bose condensation (VirBC), as a base of Bivacuum nonlocality

The infinitive number of Cooper like pairs $[\mathbf{BVF}^{\uparrow}\bowtie\ \mathbf{BVF}^{\downarrow}]^{i}_{S=0}$, as the elements of Bivacuum, due to zero or very small (in presence of fields and matter) external zero-point translational momentum, form huge domains of virtual Bose condensate (**VirBC**) with nonlocal properties with radius of domains: $\mathbf{L}^{i} = \hbar/(\mathbf{m}^{i}_{\mathbf{BVF}^{\uparrow}\bowtie\mathbf{BVF}^{\downarrow}}\mathbf{v}) \to \infty$. Nonlocality, as the independence of potential on the distance in the volume of virtual or real Bose condensate, follows from application of Virial theorem to system of $(\mathbf{BVF}^{\updownarrow})^{i}$ (Kaivarainen, 2002). The Virial theorem in general form is correct not only for classical, but also for quantum systems. It relates the averaged external kinetic $\bar{\mathbf{T}}_k(\vec{\mathbf{v}}) = \sum_i \overline{\mathbf{m}_i \mathbf{v}_i^2/2}$ and potential $\bar{\mathbf{V}}(\mathbf{r})$ energies of particles, composing these systems in such a form:

$$2\bar{\mathbf{T}}_k(\vec{\mathbf{v}}) = \sum_i \overline{\mathbf{m}_i \mathbf{v}_i^2} = \sum_i \overline{\vec{\mathbf{r}}_i \partial \mathbf{V}/\partial \vec{\mathbf{r}}_i} \qquad 4$$

If the potential energy $\overline{\mathbf{V}}(\mathbf{r})$ is a homogeneous *n – order* function like:

$$\overline{\mathbf{V}}(\mathbf{r}) \sim \mathbf{r}^n \qquad 4a$$

then the average external kinetic and potential energies are related via the power (**n**) as:

$$\mathbf{n} = \frac{2\overline{\mathbf{T}}_k}{\overline{\mathbf{V}}(\mathbf{r})} \qquad 4b$$

For example, for a harmonic oscillator, when $\bar{\mathbf{T}}_k = \bar{\mathbf{V}}$, we have $\mathbf{n} = \mathbf{2}$. For Coulomb interaction: $\mathbf{n} = -\mathbf{1}$ and $\bar{\mathbf{T}} = -\bar{\mathbf{V}}/\mathbf{2}$.

The important consequence of Virial theorem is that if the average kinetic energy and momentum ($\overline{\mathbf{p}}$) of particles in certain volume of Bose condensate tends to zero:

$$\overline{\mathbf{T}_k} = \overline{\mathbf{p}}^2/2\mathbf{m} \rightarrow \mathbf{0}$$

the interaction between particles in volume of BC, characterized by radius: $L_{BC} = \hbar/\overline{\mathbf{p}}$, becomes nonlocal, i.e. independent on distance between them:

$$\overline{\mathbf{V}}(\mathbf{r}) \sim \mathbf{r}^{(0)} = \mathbf{1} = \mathbf{const} \qquad 4c$$

In the case of virtual Bose condensation of Cooper pairs of Bivacuum fermions $[\mathbf{BVF}^{\uparrow} \bowtie \mathbf{BVF}^{\downarrow}]_{S=0}$ the power (3b) is tending to zero: $\mathbf{n} = \mathbf{2T}_{kin}^{ext}/\mathbf{V} \rightarrow 0$, as far the external momentum and kinetic energy of pairs tend to zero. *We define the nonlocality, as independence of any potential in the volume of Bose condensation (real or virtual) on distance (r). The informational signals transmission in such a system should be instant, corresponding to their infinitive velocity.*

3 Two conservation rules for asymmetric Bivacuum fermions $(\mathbf{BVF}^{\updownarrow})_{as}$

There are two important postulates in our theory:

I. The absolute values of internal rotational kinetic energy of torus and antitorus are equal to the half of the rest mass energy of the electrons of corresponding lepton generation, independent on the external group velocity of asymmetric $\mathbf{BVF}_{as}^{\updownarrow} = [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]$:

$$[\mathbf{I}]: \quad \left(\frac{1}{2}\mathbf{m}_V^+(\mathbf{v}_{gr}^{in})^2 = \frac{1}{2}|-\mathbf{m}_V^-(\mathbf{v}_{ph}^{in})^2| = \frac{1}{2}\mathbf{m}_0\mathbf{c}^2 = \mathbf{const}\right)_{in}^{e,\mu,\tau} \qquad 5$$

II. The internal magnetic moments of torus ($\mathbf{V}^+$) and antitorus ($\mathbf{V}^-$) of asymmetric Bivacuum fermions and antifermions: $\mathbf{BVF}_{as}^{\updownarrow} = [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]$ are equal to that of symmetric $\mathbf{BVF}^{\updownarrow}$ $\left[\boldsymbol{\mu}_0 \equiv \frac{1}{2}|\mathbf{e}_0|\frac{\hbar}{\mathbf{m}_0\mathbf{c}}\right]$ and independent on their external translational velocity, in contrast to changes of their mass, internal angular velocities and electric charges, compensating each other:

$$\left([\mathbf{II}]: \quad \begin{array}{c} |\pm\boldsymbol{\mu}_+| \equiv \frac{1}{2}|\mathbf{e}_+|\frac{|\pm\hbar|}{|\mathbf{m}_V^+|(\mathbf{v}_{gr}^{in})_{rot}} = |\pm\boldsymbol{\mu}_-| \equiv \frac{1}{2}|-\mathbf{e}_-|\frac{|\pm\hbar|}{|-\mathbf{m}_V^-|(\mathbf{v}_{ph}^{in})_{rot}} = \\ = \boldsymbol{\mu}_0 \equiv \frac{1}{2}|\mathbf{e}_0|\frac{\hbar}{\mathbf{m}_0\mathbf{c}} = \mathbf{const} \end{array}\right)^{e,\mu,\tau} \qquad 6$$

The dependence of the actual mass of torus $\mathbf{V}^+$ of asymmetric Bivacuum fermions ($\mathbf{BVF}_{as}^{\updownarrow} = \mathbf{V}^+ \Updownarrow \mathbf{V}^-$), on the external group velocity (**v**) follows relativist mechanics:

$$\mathbf{m}_V^+ = \mathbf{m}_0/\sqrt{1-(\mathbf{v/c})^2} = \mathbf{m} \qquad 6a$$

while the complementary mass of antitorus $\mathbf{V}^-$ has the reverse velocity dependence:

$$\mathbf{m}_V^- = \mathbf{m}_0\sqrt{1-(\mathbf{v/c})^2} \qquad 6b$$

The product of actual (inertial) and complementary (inertialess) mass is equal to the rest mass of particle squared and represent the *mass compensation principle*:

$$|\mathbf{m}_V^+||-\mathbf{m}_V^-| = \mathbf{m}_0^2 \qquad 7$$

The ratio of complementary mass to the actual one of $\mathbf{BVF}_{as}^{\updownarrow} \equiv [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]$ is equal to:

$$\left|\frac{\mathbf{m}_V^-}{\mathbf{m}_V^+}\right| = 1-(\mathbf{v/c})^2 \qquad 7a$$

Taking into account that the products of internal group and phase velocities of torus and antitorus, as well as external ones, are equal to the light velocity squared:

$$(\mathbf{v}_{gr}^{in})_{\mathbf{V}^+}\left(\mathbf{v}_{ph}^{in}\right)_{\mathbf{V}^-} = \mathbf{v}_{gr}^{ext}\mathbf{v}_{ph}^{ext} = \mathbf{c}^2 \qquad 8$$

where $\mathbf{v}_{gr}^{ext} \equiv \mathbf{v}$ is the external rotational - translational group velocity, we get from (6) the internal *actual & complementary charge compensation principle:*

$$|\mathbf{e}_+\mathbf{e}_-| = \mathbf{e}_0^2 \qquad 9$$

For primordial symmetric Bivacuum (in the absence of matter and fields), when the external translational group velocity of $\mathbf{BVF}_0^{\updownarrow} = [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]$ is zero: $\mathbf{v}_{tr}^{ext} \equiv \mathbf{v} = \mathbf{0}$, we get from 5 and 6, using 6a, 6b, and 8:

$$|\mathbf{m}_V^+| = |-\mathbf{m}_V^-| = \mathbf{m}_0 \qquad 9a$$
$$(\mathbf{v}_{gr}^{in})_{\mathbf{V}^+} = \left(\mathbf{v}_{ph}^{in}\right)_{\mathbf{V}^-} = \mathbf{c}$$
$$|\mathbf{e}_+| = |\mathbf{e}_-| = \mathbf{e}_0$$
$$\mathbf{v}_{tr}^{ext} \equiv \mathbf{v} = \mathbf{0}$$

We have to note here, that the experimental electric charge $|\mathbf{e}^{\pm}|$, which determines the Bohr magneton ($\boldsymbol{\mu}_B$), is not equal to charge of symmetric torus or antitorus: $|\mathbf{e}^{\pm}| \neq \mathbf{e}_0$ and primordial magnetic moment ($\boldsymbol{\mu}_0$) differs from the Bohr magneton ($\boldsymbol{\mu}_B$):

$$\boldsymbol{\mu}_0 \equiv \frac{1}{2}|\mathbf{e}_0|\frac{\hbar}{\mathbf{m}_0\mathbf{c}} \neq \boldsymbol{\mu}_B \equiv \frac{1}{2}|\mathbf{e}^{\pm}|\frac{\hbar}{\mathbf{m}_0\mathbf{c}} \qquad 9b$$

4 Definitions of the total, potential and kinetic energies of asymmetric Bivacuum fermions, based on Unified theory

The total energy of asymmetric $\mathbf{BVF}_{as}^{\updownarrow}$, participating in collective vortical movement, we can present as:

$$\mathbf{E}_{tot} = \mathbf{V} + \mathbf{T}_k = \mathbf{m}_V^+\mathbf{c}^2 = \frac{1}{2}(\mathbf{m}_V^+ + \mathbf{m}_V^-)\mathbf{c}^2 + \frac{1}{2}(\mathbf{m}_V^+ - \mathbf{m}_V^-)\mathbf{c}^2 = \qquad 10$$

$$or:\ \mathbf{E}_{tot} = \mathbf{V} + \mathbf{T}_k = \frac{1}{2}\mathbf{m}_V^+(2\mathbf{c}^2 - \mathbf{v}^2) + \frac{1}{2}\mathbf{m}_V^+\mathbf{v}^2 \qquad 10a$$

$$\mathbf{E}_{tot} \to \mathbf{m}_0\mathbf{c}^2 \quad \text{at} \quad \mathbf{v} \to \mathbf{0} \quad \text{and} \quad \mathbf{m}_V^+ \to \mathbf{m}_0$$

The total potential energy ($\mathbf{V}_{tot}$) of $\mathbf{BVF}_{as}^{\updownarrow}$, including the internal and external ones, can be presented as:

$$\mathbf{V}_{tot} = \frac{1}{2}(\mathbf{m}_V^+ + \mathbf{m}_V^-)\mathbf{c^2} = \frac{1}{2}\mathbf{m}_V^+(2\mathbf{c}^2 - \mathbf{v}^2) \qquad 11$$

The total kinetic energy (internal +external) of asymmetric $\mathbf{BVF}_{as}^{\updownarrow}$ and de Broglie wave length (λ_B) is determined by the difference between the actual and complementary energies of torus and antitorus:

$$(\mathbf{T}_k)_{tot} = \frac{1}{2}|\mathbf{m}_V^+ - \mathbf{m}_V^-|\mathbf{c}^2 = \frac{1}{2}\mathbf{m}_V^+\mathbf{v}^2 \qquad 11a$$

The known Dirac equation (12) can be easily derived from (10a), multiplying its left and right part on $\mathbf{m}_V^+\mathbf{c}^2$. It follows from our model (see 6a), that the actual torus mass is the experimental inertial mass of particle ($\mathbf{m}_V^+ = \mathbf{m}$), in contrast to inertialess complementary mass ($\mathbf{m}_V^-$) :

$$\mathbf{E}_{tot}^2 = (\mathbf{m}_V^+\mathbf{c}^2)^2 = (\mathbf{m}_0\mathbf{c}^2)^2 + (\mathbf{m}_V^+)^2\mathbf{v}^2\mathbf{c}^2 \qquad 12$$

Using our Bivacuum model, as a system of dual torus - dipoles, participating in both: rotational and translational movements (internal and external) and taking into account (11a), this formula can be transformed to:

$$\mathbf{E}_{tot} = \mathbf{m}_V^+\mathbf{c}^2 = \mathbf{E}^{in} + \mathbf{E}^{ext} = \frac{\mathbf{m}_0\mathbf{c}^2}{\mathbf{m}_V^+\mathbf{c}^2}(\mathbf{m}_0\mathbf{c}^2)_{rot}^{in} + \left[\frac{1}{2}\mathbf{c}^2(\mathbf{m}_V^+ - \mathbf{m}_V^-) + \left(\frac{1}{2}\mathbf{m}_V^+\mathbf{v}^2\right)\right]_{tr}^{ext} \qquad 12a$$

$$or: \quad \mathbf{E}_{tot} = \mathbf{m}_V^+\mathbf{c}^2 = \sqrt{1-(\mathbf{v}/\mathbf{c})^2}\,(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{\mathbf{rot}}^{in} + \left[\frac{\mathbf{h}^2}{\mathbf{m}_V^+\lambda_\mathbf{B}^2}\right]_{tr}^{ext}$$

The external translational de Broglie wave length, modulating the internal rotational one is:

$$\lambda_\mathbf{B} = \frac{h}{\mathbf{m}_V^+\mathbf{v}}$$

The internal rotational-translational energy contribution ($\mathbf{E}^{in}$) can be expressed in a few ways:

$$\mathbf{E}^{in} = \frac{\mathbf{m}_0\mathbf{c}^2}{\mathbf{m}_V^+\mathbf{c}^2}(\mathbf{m}_0\mathbf{c}^2)_{\mathbf{rot}}^{in} = \sqrt{1-(\mathbf{v}/\mathbf{c})^2}\,(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{\mathbf{rot}}^{in} \equiv \mathbf{R_{tr}}\left(\frac{\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)_{\mathbf{rot}}^{in} \qquad 12b$$

where: $\mathbf{R_{tr}} = \sqrt{1-(\mathbf{v}/\mathbf{c})^2}$ is the relativist external translational coefficient; $\mathbf{L}_0 = \hbar/\mathbf{m}_0\mathbf{c}$

At the external translational group velocity $\mathbf{v} \equiv \mathbf{v}_{tr}^{ext}$ tending to zero, the internal energy: $\mathbf{E}_{rot}^{in} \to (\mathbf{m}_0\mathbf{c}^2)_{\mathbf{rot}}^{in}$ and the external translational energy is tending to zero, as far $|\mathbf{m}_V^+| \to |\mathbf{m}_V^-| \to \mathbf{m}_0$ (see 6a and 6b):

$$\mathbf{E}_{\mathbf{tr}}^{ext} = \overline{\mathbf{V}}^{ext} + \overline{\mathbf{T}}_k^{ext} = \left[\frac{1}{2}\mathbf{c}^2(\mathbf{m}_V^+ - \mathbf{m}_V^-) + \left(\frac{1}{2}\mathbf{m}_V^+\mathbf{v}^2\right)\right]_{\mathbf{tr}}^{ext} = \left[\frac{\mathbf{h}^2}{\mathbf{m}_V^+\lambda_\mathbf{B}^2}\right]_{\mathbf{tr}}^{ext} \to 0 \qquad 13$$

Our expressions (10, 10a and 12a -13) are more general, than the known (12), following from special theory of relativity (6a), as far they take into account the both Bivacuum dipoles properties: actual and complementary and subdivide the total energy of particle on the internal and external, kinetic and potential ones.

The asymmetry of rotation velocity of torus and antitorus of ($\mathbf{BVF}_{as}^{\updownarrow} = \mathbf{V}^+ \Updownarrow \mathbf{V}^-$), is a result of participation of one or more pairs of $\mathbf{BVF}_{as}^{\updownarrow}$ of opposite spins $[\mathbf{BVF}^{\uparrow} \bowtie \mathbf{BVF}^{\downarrow}]_{S=0}^{i}$ in excitations of Bivacuum, like vorticity. This motion can be described, as a rolling of pairs of $\mathbf{BVF}_{as}^{\uparrow} = [\mathbf{V}^+ \upuparrows \mathbf{V}^-]$ and $\mathbf{BVF}_{as}^{\downarrow} = [\mathbf{V}^+ \downdownarrows \mathbf{V}^-]$ with their *internal* radiuses:

$$\mathbf{L}_{\mathbf{BVF}^{\updownarrow}} = \hbar/|\mathbf{m}_V^+ + \mathbf{m}_V^-|_{\mathbf{BVF}^{\updownarrow}}\mathbf{c} \qquad 14$$

around the outside of a larger *external* circle with radius of vorticity:

$$\mathbf{L_{ext}} = \hbar/|\mathbf{m}_V^+ - \mathbf{m}_V^-|_{\mathbf{BVF}_{as}^{\updownarrow} \bowtie \mathbf{BVF}_{as}\downarrow} \cdot \mathbf{c} = \hbar\mathbf{c}/\left(\mathbf{m}_V^+ \mathbf{v}^2_{\mathbf{BVF}_{as}^{\updownarrow} \bowtie \mathbf{BVF}_{as}\downarrow}\right) \qquad 14a$$

The increasing of velocity of vorticity $\mathbf{v_{vor}}$ decreases both dimensions: $\mathbf{L}_{in}$ and $\mathbf{L_{ext}}$ till minimum vorticity radius, including pair of $[\mathbf{BVF}_{as}^{\updownarrow} \bowtie \mathbf{BVF}_a s\downarrow]^i_{S=0}$ with shape of *two identical truncated cones* of the opposite orientation of planes with common rotation axis. Corresponding asymmetry of torus $\mathbf{V}^+$ and $\mathbf{V}^-$ is responsible for resulting mass and charge of $\mathbf{BVF}_{as}^{\updownarrow}$. The trajectory of fixed point on $\mathbf{BVF}_{as}^{\updownarrow}$, participating in such dual rotation, is *hypocycloid*.

5 The relation between the external and internal parameters of Bivacuum fermions & quantum roots of Golden mean

The formula, unifying the internal and external parameters of $\mathbf{BVF}_{as}^{\updownarrow}$, is derived from eqs. (5 - 9):

$$\left(\frac{\mathbf{m}_V^+}{\mathbf{m}_V^-}\right)^{1/2} = \frac{\mathbf{m}_V^+}{\mathbf{m}_0} = \frac{\mathbf{v}_{ph}^{in}}{\mathbf{v}_{gr}^{in}} = \left(\frac{\mathbf{c}}{\mathbf{v}_{gr}^{in}}\right)^2 = \qquad 15$$

$$= \frac{\mathbf{L}^-}{\mathbf{L}^+} = \frac{|\mathbf{e}_+|}{|\mathbf{e}_-|} = \left(\frac{\mathbf{e}_+}{\mathbf{e}_0}\right)^2 = \frac{1}{[1-\left(\mathbf{v}^2/\mathbf{c}^2\right)^{ext}]^{1/2}} \qquad 15a$$

where:

$$L^+ = \hbar/(m_V^+ \mathbf{v}_{gr}^{in}) \qquad and \qquad L^- = \hbar/(m_V^- \mathbf{v}_{ph}^{in}) \qquad 15b$$

are the radiuses of torus ($\mathbf{V}^+$) and antitorus ($\mathbf{V}^-$) of $\mathbf{BVF}_{as}^{\updownarrow} = [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]$, correspondingly.

The formula, unifying the internal and external group and phase velocities of asymmetric Bivacuum fermions ($\mathbf{BVF}_{as}^{\updownarrow}$), leading from 15 and 15a, is:

$$\left(\frac{\mathbf{v}_{gr}^{in}}{\mathbf{c}}\right)^4 = 1 - \left(\frac{\mathbf{v}}{\mathbf{c}}\right)^2 \qquad 16$$

At the conditions of "Hidden harmony", meaning the equality of the internal rotational and external translational group and phase velocities of $\mathbf{BVF}_{as}^{\updownarrow}$:

$$(\mathbf{v}_{gr}^{in})_{\mathbf{V}^+}^{rot} = (\mathbf{v}_{gr}^{ext})^{tr} \equiv \mathbf{v} \qquad 16a$$

$$\left(\mathbf{v}_{ph}^{in}\right)_{\mathbf{V}^-}^{rot} = \left(\mathbf{v}_{ph}^{ext}\right)^{tr} \qquad 16b$$

and assuming $\left(\frac{\mathbf{v}_{gr}^{in}}{\mathbf{c}}\right)^2 = \left(\frac{\mathbf{v}}{\mathbf{c}}\right)^2 \equiv \phi$, formula (16) turns to simple quadratic equation:

$$\phi^2 + \phi - 1 = 0, \qquad 17$$

which has a few modes : $\phi = \frac{1}{\phi} - 1 \quad or: \quad \frac{\phi}{(1-\phi)^{1/2}} = 1$ 17a

$$or: \quad \frac{1}{(1-\phi)^{1/2}} = \frac{1}{\phi} \qquad 17b$$

with solution, equal to Golden mean: $(\mathbf{v}/\mathbf{c})^2 = \phi = 0.618$. The overall shape of asymmetric $(\mathbf{BVF}_{as}^{\updownarrow} = [\mathbf{V}^+ \Updownarrow \mathbf{V}^-])^i$ is a *truncated cone* (Fig.1) with plane, parallel to the base with radiuses of torus (L^+) and antitorus (L^-), defined by eqs. 15b.

Using Golden mean equation in form (17b), we can see, that all the ratios (15 and 15a) at GM conditions turns to:

$$\left[\left(\frac{\mathbf{m}_V^+}{\mathbf{m}_V^-}\right)^{1/2} = \frac{m_V^+}{m_0} = \frac{\mathbf{v}_{ph}^{in}}{\mathbf{v}_{gr}^{in}} = \frac{L^-}{L^+} = \frac{|\mathbf{e}_+|}{|\mathbf{e}_-|} = \left(\frac{e_+}{e_0}\right)^2\right]^{\phi} = \frac{1}{\phi} \qquad 17c$$

where the actual (e_+) and complementary (e_-) charges and corresponding mass at GM conditions are:

$$\mathbf{e}_{+}^{\phi}=\mathbf{e}_0/\boldsymbol{\phi}^{1/2}; \qquad \mathbf{e}_{-}^{\phi}= \mathbf{e}_0\boldsymbol{\phi}^{1/2} \qquad (17d)$$
$$(\mathbf{m}_V^{+})^{\phi}=\mathbf{m}_0/\boldsymbol{\phi}; \qquad (\mathbf{m}_V^{-})^{\phi}= \mathbf{m}_0\,\boldsymbol{\phi}$$

The radius of vorticity (14a) at GM conditions turns to Compton radius:

$$\mathbf{L}_{\mathbf{ext}}^{\phi}= \hbar/|\mathbf{m}_V^{+}-\mathbf{m}_V^{-}|^{\phi}_{\mathbf{BVF}_{as}^{\uparrow}\bowtie\mathbf{BVF}_{as}^{\downarrow}}\mathbf{c} = \hbar/\mathbf{m}_0\mathbf{c} \qquad (17e)$$

6 Formation of sub-elementary particles and fusion of elementary particles from asymmetric Bivacuum fermions

At the Golden Mean (GM) conditions the vortex in Bivacuum, containing number of pairs of asymmetric Bivacuum fermions, rotating around the common axis of vorticity with radius (14a) reduces to one pair of sub-elementary fermions with common Compton radius (17d):

$$[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}] \equiv [\mathbf{BVF}_{as}^{\uparrow}\bowtie\ \mathbf{BVF}_{as}^{\downarrow}]^{\phi} \qquad (18)$$

of opposite charge, spin and energy, compensating each other. The spatial image of pair $[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]$ is two identical *truncated cones* of the opposite orientation of planes rotating without slip around common rotation axis (Fig.1).

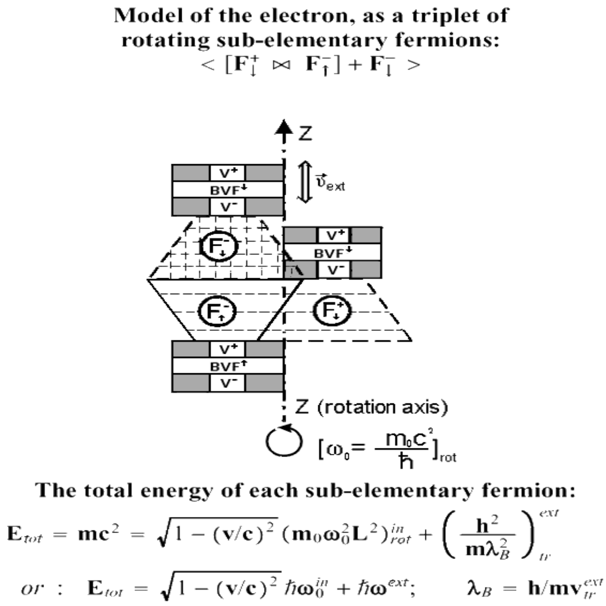

Fig.1 Model of the electron, as a triplets, resulting from fusion of third sub-elementary antifermion $[\mathbf{F}_{\downarrow}^{-}]$ to sub-elementary antifermion $[\mathbf{F}_{\uparrow}^{-}]$ with opposite spin in rotating pair $[\mathbf{F}_{\downarrow}^{+} \bowtie \mathbf{F}_{\uparrow}^{-}]$. The velocity of rotation of unpaired sub-elementary $[\mathbf{F}_{\downarrow}^{-}]$ around the same axis of common rotation axis of pair provide the similar rest mass (m_0) and absolute charge $|e^{\pm}|$, as have the paired $[\mathbf{F}_{\uparrow}^{+}$ and $\mathbf{F}_{\downarrow}^{-}]$.

The fusion of elementary particles in form of *triplets* of metastable sub-elementary fermions and antifermions $[\mathbf{F}_{\updownarrow}^{\pm} \equiv (\mathbf{BVF}_{as}^{\updownarrow})^{\phi}]^{i}$ (Fig.1) becomes possible at GM conditions:

$$< [\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}] + \mathbf{F}_{\updownarrow}^{\pm} >^{i} \qquad (18a)$$

Corresponding fusion threshold is due to 'switching on' the resonant exchange interaction of $\mathbf{CVC}^{\pm}$ with Bivacuum virtual pressure waves $\mathbf{VPW}^{\pm}$ of fundamental frequency $(\boldsymbol{\omega}_0= \mathbf{m}_0\mathbf{c}^2/\hbar)^{e,\mu,\tau}$ in the process of [**corpuscle**(**C**) $\rightleftharpoons$ **wave**(**W**)] transitions of elementary particles (see next section). The *triplets* of elementary particles and antiparticles formation

(Fig.1) is a result of conjugation of third sub-elementary fermion (antifermion) $[\mathbf{F}_{\updownarrow}^{\pm}]$ to sub-elementary fermion (antifermion) of rotating pair $[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]$ of the opposite spins. The latter means that their $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsations are counterphase and these two sub-elementary particles are spatially compatible (Kaivarainen, 2002). The velocity of rotation of unpaired sub-elementary fermion $[\mathbf{F}_{\downarrow}^{-}]$ around the same axis of common rotation axis of pair (Fig.1) provide the similar rest mass (m_0) and absolute charge $|e^{\pm}|$, as have the paired $[\mathbf{F}_{\uparrow}^{+}$ and $\mathbf{F}_{\downarrow}^{-}]$.

Using (11a and 17a) it is easy to show, that the GM difference between the actual and complementary mass of each of asymmetric Bivacuum fermions of triplets of the electron is equal to its rest mass, determined by unpaired $(\mathbf{BVF}_{as}^{\updownarrow})^{\phi} \equiv \mathbf{F}_{\updownarrow}^{\pm}$:

$$|\Delta \mathbf{m}_V^{\pm}|^{\phi} = |\mathbf{m}_V^{+} - \mathbf{m}_V^{-}|^{\phi} = [|\mathbf{m}_V^{+}|(\mathbf{v}^2/\mathbf{c}^2)]^{\phi} = |\mathbf{m}_V^{+}|^{\phi}\,\phi = \mathbf{m}_0 \frac{(\mathbf{v}^2/\mathbf{c}^2)^{\phi}}{\sqrt{1-(\mathbf{v}^2/\mathbf{c}^2)^{\phi}}} = \mathbf{m}_0 \qquad 19$$

$$and: \qquad |\mathbf{m}_V^{+}\mathbf{m}_V^{-}| = \mathbf{m}_0^2$$

and the GM difference between actual and complementary charges, using 17d and 17a in form $\phi = (1/\phi - 1)$, determines corresponding minimum charge of sub-elementary fermions or antifermions:

$$\mathbf{e}^{\phi} \equiv |\Delta \mathbf{e}_{\pm}|^{\phi} = |\mathbf{e}_{+} - \mathbf{e}_{-}|^{\phi} = \mathbf{e}_0 \phi^{1/2}(1/\phi - 1) = \phi^{3/2}\mathbf{e}_0 \qquad 19a$$

$$\text{and} \quad \mathbf{e}^{\phi} \equiv |\Delta \mathbf{e}_{\pm}|^{\phi} = |\mathbf{e}_{+}|^{\phi}\phi^2 = \phi^{3/2}\mathbf{e}_0 \qquad 19b$$

$$\text{compared to:} \quad |\Delta \mathbf{m}_V^{\pm}|^{\phi} = |\mathbf{m}_V^{+} - \mathbf{m}_V^{-}|^{\phi} = |\mathbf{m}_V^{+}|^{\phi}\,\phi = \mathbf{m}_0$$

$$\text{where:} \quad (|\mathbf{e}_{+}||\mathbf{e}_{-}|) = \mathbf{e}_0^2 \quad \text{and} \quad |\mathbf{m}_V^{+}\mathbf{m}_V^{-}| = \mathbf{m}_0^2$$

where from (17d): $|\mathbf{e}_{+}|^{\phi} = e_0/\phi^{1/2}$; $\quad |\mathbf{e}_{-}|^{\phi} = \mathbf{e}_0\phi^{1/2}$.

The actual minimum charge of the electron/positron at GM conditions from (19b) is:

$$|\mathbf{e}_{+}|^{\phi} = |\Delta \mathbf{e}_{\pm}|^{\phi}/\phi^2 = \mathbf{e}_0/\phi^{1/2} \qquad 19c$$

It follows from our theory, that the ratio of charge to mass symmetry shifts, oscillating in the process of $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation at Golden mean (GM) conditions, is a permanent value:

$$\frac{n|\Delta e_{\pm}|^{\phi}}{n|\Delta m_V|^{\phi}} = \frac{|\mathbf{e}_{+}|^{\phi}\phi}{|\mathbf{m}_V^{+}|^{\phi}} = \frac{\mathbf{e}_0\phi^{3/2}}{\mathbf{m}_0} = \mathbf{const} \qquad 19d$$

$$or: \quad \frac{n|\Delta \mathbf{e}|^{\phi}}{e_0\phi^{3/2}} = \frac{n|\Delta \mathbf{m}_V|^{\phi}}{\mathbf{m}_0} \qquad 19c$$

where: $(m_V^{+})^{\phi} = m_0/\phi$ is the actual mass of unpaired sub-elementary fermion, equal to mass of triplet of elementary particle at Golden mean conditions.

Let us consider the dynamics of $\mathbf{F}_{\updownarrow}^{\pm} >^{e,\mu,\tau} = [V^{+} \Updownarrow V^{-}]$ in triplets (Fig.1) *without external translational motion of triplets*. Such sub-elementary fermion properties are the result of participation in two rotational process simultaneously:

1) rotation of asymmetric [actual torus + complementary antitorus] around central axis of $\mathbf{F}_{\updownarrow}^{\pm} >$ with spatial image of truncated cone with average radius:

$$\mathbf{L}_{\mathbf{BVF}_{as}}^{\phi} = \hbar/|\mathbf{m}_V^{+} + \mathbf{m}_V^{-}|^{\phi}\mathbf{c} = \hbar/[\mathbf{m}_0(1/\phi + \phi)\mathbf{c}] = \hbar/2.236\mathbf{m}_0\mathbf{c} \qquad 20$$

2) rolling of this truncated cone around the another axis, common for pair of sub-elementary particles $[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]$ (Fig.1) inside of a larger vorticity with bigger radius, equal to *Compton radius*:

$$\mathbf{L}_{\mathbf{BVF}_{as}^{\uparrow} \bowtie \mathbf{BVF}_{as}^{\downarrow}}^{\phi} = \hbar/|\mathbf{m}_V^{+} - \mathbf{m}_V^{-}|^{\phi}\mathbf{c} = \hbar/\mathbf{m}_0\mathbf{c} \qquad 20a$$

The ratio of radius of $(\mathbf{BVF}_{as}^{\updownarrow})^{\phi} \equiv \mathbf{F}_{\updownarrow}^{\pm} >$ to radius of their pairs $[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]$ at GM conditions is equal to the ratio of potential energy (**V**) to kinetic energy ($\mathbf{T}_k$) of relativistic de Broglie wave (wave B) at GM conditions. This ratio is known from the formula for relativist wave B $\left(\frac{\mathbf{V}}{\mathbf{T}_k} = 2\frac{\mathbf{v}_{ph}}{\mathbf{v}_{gr}} - 1\right)$:

$$\frac{\mathbf{L}^{\phi}_{\mathbf{BVF}^{\uparrow}_{as} \bowtie \mathbf{BVF}_{as}^{\downarrow}}}{\mathbf{L}^{\phi}_{\mathbf{BVF}_{as}}} = \frac{|\mathbf{m}_V^+ + \mathbf{m}_V^-|^{\phi}}{|\mathbf{m}_V^+ - \mathbf{m}_V^-|^{\phi}} = \left(\frac{\mathbf{V}}{\mathbf{T}_k}\right)^{\phi} = 2\left(\frac{\mathbf{v}_{ph}}{\mathbf{v}_{gr}}\right)^{\phi} - 1 = 2,236 \qquad 20b$$

This result is a good evidence in proof of our expression (10 and 10a) for total energy of sub-elementary particle, as sum of internal potential and rotational kinetic energies.

The triplets of the regular electrons and positrons are the result of fusion of sub-elementary particles of e − leptons generation:

$$\mathbf{e}^- \equiv < [\mathbf{F}_{\uparrow}^- \bowtie \mathbf{F}_{\downarrow}^+] + \mathbf{F}_{\uparrow}^- >^e \qquad 21$$

$$\mathbf{e}^+ \equiv < [\mathbf{F}_{\uparrow}^- \bowtie \mathbf{F}_{\downarrow}^+] + \mathbf{F}_{\uparrow}^+ >^e \qquad 21a$$

with mass, charge and spins, determined by uncompensated sub-elementary particle: $\mathbf{F}_{\uparrow}^+ >^e$.

The neutral bosons, like *photons* ($Z = 0;\ S = \pm 1$), represent fusion of pairs of virtual [**electron** + **positron**] with parallel spins (Fig.2):

$$< \mathbf{2}[\mathbf{F}_{\uparrow}^- \bowtie \mathbf{F}_{\downarrow}^+]_{S=0} + (\mathbf{F}_{\updownarrow}^- + \mathbf{F}_{\updownarrow}^-)_{S=\pm 1} >^e \qquad 21b$$

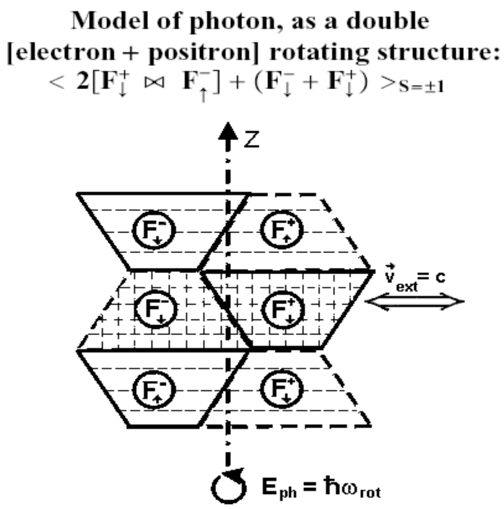

Fig.2 Model of photon as result of fusion of two electron-like triplets of sub-elementary fermions, presented on Fig.1.

The *proton* ($Z = +1;\ S = \pm 1/2$) *is constructed* by the same principle as electron. It is a result of fusion of pair of [$\boldsymbol{\tau}$] sub-elementary fermion and antifermion $< [\mathbf{F}_{\uparrow}^- \bowtie \mathbf{F}_{\downarrow}^+]^{\tau}_{S=0}$ and one unpaired [$\boldsymbol{\tau}$] sub-elementary fermion $(\mathbf{F}_{\uparrow}^+)^{\tau}_{S=\pm 1/2}$. These three components of proton have some similarity with **u** - and **d** - quarks. The difference is that we do not need to use the notion of fractional charge in our model of proton (Fig.1):

$$\mathbf{p} \equiv < [\mathbf{F}_{\uparrow}^- \bowtie \mathbf{F}_{\downarrow}^+]_{S=0} + (\mathbf{F}_{\uparrow}^+)_{S=\pm 1/2} >^{\tau} \qquad 22$$

The charges, spins and mass/energy of sub-elementary particles and antiparticles in pairs $[\mathbf{F}_{\uparrow}^- \bowtie \mathbf{F}_{\downarrow}^+]^{\tau}$ compensate each other. The resulting properties of protons (**p**) and electrons are determined by unpaired/uncompensated sub-elementary particle $\mathbf{F}_{\uparrow}^+ >^{\tau,e}$.

The *neutron* ($Z = 0;\ S = \pm 1/2$) can be presented as:

$$\mathbf{n} \equiv \; < [\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]_{S=0}^{\tau} + [(\mathbf{F}_{\uparrow}^{+})^{\tau} \bowtie (\mathbf{F}_{\downarrow}^{-})^{e}]_{S=\pm 1/2} > \qquad 23$$

This means that the positive charge of unpaired heavy sub-elementary particle $(\mathbf{F}_{\uparrow}^{+})^{\tau}$ in neutron ($\mathbf{n}$) is compensated by the charge of the light sub-elementary fermion $(\mathbf{F}_{\downarrow}^{-})^{e}$. In contrast to charge, the spin of $(\mathbf{F}_{\uparrow}^{+})^{\tau}$ is not compensated (totally) by spin of $(\mathbf{F}_{\downarrow}^{-})^{e}$ in neutrons.

We assume, that the life times of isolated sub-elementary particles (e,μ,τ) strongly increases, as a result of their fusion in triplets, possible at Golden mean conditions. The experimental values of μ and τ electrons, corresponding in accordance to our model, to monomeric asymmetric $(\mathbf{BVF}_{as}^{\updownarrow})^{\mu,\tau}$ are equal to $2,19 \cdot 10^{-6}s$ and $3,4 \cdot 10^{-13}$s, respectively.

7 The solution of Dirac monopole problem

The Dirac theory, searching for elementary magnetic charges (g^{-} and g^{+}), symmetric to electric ones (e^{-} and e^{+}), named **monopoles**, leads to following relation between the magnetic monopole and electric charge of the same signs:

$$\mathbf{ge} = \frac{n}{2}\hbar\mathbf{c} \qquad 23a$$

$$where: \; n = 1,2,3 \quad \text{is the integer number}$$

It follows from this definition, that minimal magnetic charge ($at\ \mathbf{n} = \mathbf{1}$) is as big as $g \cong 67.7e$. The mass of monopole should be huge $\sim 10^{16}\,GeV$. All numerous attempts to reveal such particles experimentally has failed.

Our theory explains this fact in such a way. In contrast to electric and mass dipoles (see 19 and 19a) oscillation, accompanied $[C \rightleftharpoons W]$ pulsation, the symmetry oscillation between the actual and complementary magnetic charges of elementary fermions is absent because of their permanent values in both [C] and [W] phase, as postulated by our magnetic moment conservation rule (6). The zero symmetry shift between the actual and complementary magnetic moments of sub-elementary fermions and antifermions:

$$\Delta|\mu_{\pm}|_{C,W} = (|\mu_{+}| - |\mu_{-}|)_{C,W} = 0$$

independent on their external velocity, explains the *absence of magnetic monopoles in Nature.*

Magnetism is a consequence of the electric charges dynamics and shift of Bivacuum fermions/antifermions spin equilibrium: $[BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}]$ to the left or right.

8 The dynamic mechanism of corpuscle-wave duality

The [**Corpuscle**(**C**) $\rightleftharpoons$ **Wave**(**W**)] *duality of sub-elementary fermions*, is a consequence of quantum beats between two states: the asymmetrically excited Bivacuum fermion: $\mathbf{BVF}_{as}^{\updownarrow} = [\mathbf{V}^{+} \Updownarrow \mathbf{V}^{-}]_{as} \equiv \mathbf{F}_{\updownarrow}^{\pm}$, representing [C] phase of sub-elementary fermion, and its symmetric anchor state $(\mathbf{BVF}_{anc}^{\updownarrow})^{i} = [\mathbf{V}^{+} \Updownarrow \mathbf{V}^{-}]_{anc}^{i}$, accompanied by emission $\rightleftharpoons$ absorption of cumulative virtual cloud ($\mathbf{CVC}^{\pm}$) :

$$\left[(\mathbf{F}_{\updownarrow}^{\pm})_{\mathbf{C}} \overset{\mathbf{recoil}}{\rightleftharpoons} (\mathbf{BVF}_{anc}^{\updownarrow} + \mathbf{CVC}^{\pm})_{\mathbf{W}} \right]^{i} \qquad 23b$$

$$\text{or:} \qquad [\mathbf{C} \rightleftharpoons \mathbf{W}] \quad \text{transitions}$$

where: i means *three leptons* generation: $i = e,\mu,\tau$.

The cumulative virtual clouds of [W] phase are composed from of sub-quantum particles ($\mathbf{CVC}^{+}$) or antiparticles ($\mathbf{CVC}^{-}$), depending on direction of symmetry shift between $\mathbf{V}^{+}$ and $\mathbf{V}^{-}$, forming sub-elementary fermion or antifermion. The reversible $[\mathbf{C} \to \mathbf{W}]$ pulsations of sub-elementary fermions/antifermions are accompanied by the *recoil energy* of the anchor Bivacuum fermion ($\mathbf{BVF}_{anc}^{\updownarrow}$) and excitation of the spherical elastic waves in superfluid matrix of Bivacuum. These divergent from $\mathbf{BVF}_{anc}^{\updownarrow}$ longitudinal and translational spherical elastic waves represent the electromagnetic and gravitational potentials of sub-elementary fermions, activated by $[\mathbf{C}] \overset{\mathbf{CVC}^{\pm}}{\rightarrow} [\mathbf{W}]$ transitions of $\mathbf{F}_{\updownarrow}^{\pm}$. The negative elastic recoil energy of [W] phase is compensated by corresponding positive increment of particle energy in its [C] phase. The nonuniform acceleration of particles can be accompanied by nonelastic recoil, resulting in energy dissipation in form of virtual short-living Bivacuum excitations or real photons formation by triplets of relativistic electrons, positrons or protons.

The origination of asymmetric $[torus \Updownarrow antitorus]_{as}$ dipoles or elementary fermions (unstable or stable) means their ability to move as respect to symmetric ones, corresponding to superfluid fraction of Bivacuum, with external group velocity $\mathbf{v}_{gr}^{ext} \equiv \mathbf{v} > 0$. The most probable trajectory of movement in the absence of external fields is a *hypocycloid*, resulting from rotation of asymmetric $[(\mathbf{BVF}^{\updownarrow})^{as} = [\mathbf{V}^{+} \Updownarrow \mathbf{V}^{-}]^{as} = \mathbf{F}_{\updownarrow}^{\pm}]^{i}$ on the inside bigger circle without slip.

We may consider the asymmetric [actual torus + complementary torus] of different radiuses depending on corresponding subquantum particles angular velocity and frequency (ω_C^+ and ω_C^-), corresponding to spatial image of [C] phase of sub-elementary particle, as a truncated cone, like on (Fig. 1 and Fig.2). Then, using vector analysis, the energy difference between the velocity fields: $\vec{\mathbf{v}}^{+}(r)$ and $\vec{\mathbf{v}}^{-}(r)$, corresponding to the actual torus and complementary antitorus, can be presented as:

$$E_{C\rightleftharpoons W} = \vec{\mathbf{n}}\hbar\omega_B = \vec{\mathbf{n}}\hbar(\omega_C^+ - \omega_C^-) = \frac{1}{2}\hbar[rot\,\vec{\mathbf{v}}^{+}(\mathbf{r}) - rot\,\vec{\mathbf{v}}^{-}(\mathbf{r})] \qquad 23c$$

where: $\vec{\mathbf{n}}$ is the unit-vector, common for both vortices; $\omega_{CVC} = (\omega_C^+ - \omega_C^-)$ is a frequency of quantum beats between actual and complementary states.

It is assumed here, that all of sub-quantum particles/antiparticles, forming actual and complementary vortices of [C] phase, have the same angular frequency: ω_C^+ and ω_C^-, correspondingly.

The scenario of duality and potential fields origination, described briefly in this section, will be illustrated and proved in this paper.

9 The total energy of sub-elementary fermions

We can easily transform formula (12a) to few following modes, without taking into account contributions of additional dynamic effects, accompanied $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsations of sub-elementary fermions, compensating each other in [C] and [W] phase:

$$\mathbf{E}_{tot} = \mathbf{mc}^2 = \mathbf{R_{tr}}\mathbf{E}_{rot}^{in} + (\mathbf{E}_B)_{tr}^{ext} = \mathbf{R_{tr}}(\mathbf{m}_0\mathbf{c}^2)_{rot}^{in} + (\mathbf{m}_V^+\mathbf{v}^2)_{tr}^{ext} \qquad 24$$

$$or:\ \mathbf{E}_{tot} = \mathbf{R_{tr}}\,(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot}^{in} + [(\mathbf{m}_V^+ - \mathbf{m}_V^-)\mathbf{c}^2]_{tr}^{ext} \qquad 24a$$

$$or:\ \mathbf{E}_{tot} = \hbar\boldsymbol{\omega}_{\mathbf{C}\rightleftharpoons\mathbf{W}} = \mathbf{R_{tr}}\,\hbar\boldsymbol{\omega}_0^{in} + \hbar\boldsymbol{\omega}_B^{ext} \qquad 24b$$

where: $\mathbf{R_{tr}} \equiv \sqrt{1-(\mathbf{v}/\mathbf{c})^2}$ is a coefficient, dependent on the *external* translational velocity ($\mathbf{v}$). We can see, that at $\mathbf{v} = \mathbf{0}$, $\mathbf{E}_{tot} = (\mathbf{m}_0\mathbf{c}^2)_{rot}^{in} = \hbar\boldsymbol{\omega}_0^{in}$. However, zero-point recoil vibrations, accompanied $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation are existing always even at the external translational velocity tending to zero (see eq.36).

A few presentations of internal rotational energy of sub-elementary particles at Golden mean conditions, inducing asymmetry, responsible for the rest mass and elementary charge origination, are:

$$\mathbf{E}_{rot}^{in} = (\mathbf{m}_0\mathbf{c}^2)_{rot} = (\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot}^{in} = [(\mathbf{m}_V^+ - \mathbf{m}_V^-)^{\phi}\mathbf{c}^2]_{rot}^{in} = \hbar\boldsymbol{\omega}_0^{in} \qquad 25$$

The contribution of the rest mass energy to total one ($\mathbf{E}_{tot}$) decreases with the external translational velocity increasing because $\mathbf{R_{tr}} \rightarrow 0$ at $\mathbf{v} \rightarrow \mathbf{c}$.

The formulas of external translational energy of particle, responsible for its de Broglie wave length ($\boldsymbol{\lambda}_B$) and frequency ($\boldsymbol{\nu}_B^{ext}$) are:

$$(\mathbf{E}_B)^{ext}_{tr} = (\overline{\mathbf{V}}^{ext} + \overline{\mathbf{T}}^{ext}_k)_{tr} = \mathbf{m}^+_V\mathbf{v}^2 = \frac{\mathbf{h}^2}{\mathbf{m}^+_V\lambda^2_B} = [(\mathbf{m}^+_V - \mathbf{m}^-_V)\mathbf{c}^2]^{ext}_{tr} = \hbar\omega^{ext}_B \qquad 26$$

We can see, that the carrying (reference) frequency of $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation:

$$\left[\omega^{in}_{\mathbf{C}\rightleftharpoons\mathbf{W}} = (\mathbf{m}_0\mathbf{c}^2)_{rot}/\hbar = \omega_0\right]^i \qquad 27$$

is equal to fundamental frequency of Bivacuum (eq.5) and is related to the rest mass of particle.

The modulation (interference) of this internal frequency ($\omega^{in}_{\mathbf{C}\rightleftharpoons\mathbf{W}}$), corresponding to Compton wave ($L_0 = \hbar/\mathbf{m}_0\mathbf{c}$) occur by the external frequency of de Broglie wave ($\omega^{ext} = 2\pi\nu_B$) :

$$(\nu_B)_{tr} = \mathbf{m}^+_V\mathbf{v}^2_{tr}/\mathbf{h} = \frac{\mathbf{h}}{\mathbf{m}\lambda^2_B} \qquad 27a$$

with length $\lambda_B = \mathbf{h}/\mathbf{p}^{ext}$, determined by the particle's external translational momentum ($\mathbf{p}^{ext} = \mathbf{m}^+_V\mathbf{v}^{ext}_{tr} \equiv \mathbf{mv}$).

Consequently, the experimentally evaluated frequency of de Broglie wave of the electron, proton, atom or molecule (ω^{ext}_B) is the *modulation frequency* of the internal frequency of $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation of their sub-elementary fermions. In nonrelativistic conditions ($\mathbf{v} << \mathbf{c}$), we have: $2\pi(\nu_B)_{tr} << \omega^{in}_{\mathbf{C}\rightleftharpoons\mathbf{W}}$, however, in relativistic case, the modulation frequency of de Broglie wave can be: $2\pi(\nu_B)_{tr} \geq \omega^{in}_{\mathbf{C}\rightleftharpoons\mathbf{W}}$. It follows from our theory, that corpuscle - wave duality is a complex dynamic process, involving the exchange interaction of elementary particles with Bivacuum and formation of virtual holograms or virtual replicas (VR) of particles.

The relativistic actual mass ($\mathbf{m}^+_V$) of particles increasing with the *external translational* velocity (at $\mathbf{v} \to \mathbf{c}$) is a result of of mass symmetry shift: $(\mathbf{m}^+_V - \mathbf{m}^-_V)^{ext}_{BVF^{\updownarrow}_{anc}}$ of the 'anchor' Bivacuum fermion ($\mathbf{BVF}^{\updownarrow}_{anc}$) of unpaired $\mathbf{F}^{\pm}_{\updownarrow}$ >.

10 The electromagnetic, gravitational potentials, virtual acoustic field and nonlocal informational spin field, excited by $[C \rightleftharpoons W]$ pulsations of elementary particles

The *local* emission of $\mathbf{CVC}^{\pm}$ at $[\mathbf{C} \to \mathbf{W}]$ transitions is accompanied by *recoil* energy of the 'anchor' Bivacuum fermion ($\mathbf{BVF}^{\updownarrow}_{anc}$). The divergent from $\mathbf{BVF}^{\updownarrow}_{anc}$ recoil elastic deformations propagate in superfluid matrix of Bivacuum in form of spherical elastic waves. They represent a longitudinal and transversal oscillations of huge number of Bivacuum fermions $\left(\sum^{\infty} \mathbf{BVF}^{\updownarrow}_{rec}\right)_{\parallel,\perp}$. The former, inducing the small charge-dipole symmetry shifts: $(\Delta\mathbf{e}_V = \mathbf{e}^+_V - \mathbf{e}^-_V)_{rec}$ of $\left(\sum^{\infty} \mathbf{BVF}^{\updownarrow}_{rec}\right)_{\parallel}$, much smaller than (19a), are responsible for electromagnetic potential ($\mathbf{V}_E$). The latter, related to transverse shifts of $\left(\sum^{\infty} \mathbf{BVF}^{\updownarrow}_{rec}\right)_{\perp}$, accompanied by their mass-dipole symmetry shifts: $(\Delta\mathbf{m}_V = \mathbf{m}^+_V - \mathbf{m}^-_V)_{rec}$, much smaller, than (19), stands for gravitational potential ($\mathbf{V}_G$).

By definition, the *torus* is a figure, formed by rotation of circle with radius $\mathbf{L}_{\mathbf{V}^{\pm}}$, around the axis, shifted from the center of circle on the distance $\pm\Delta\mathbf{L}_{\parallel,\perp}$. The vibrations of positions $(\pm\Delta\mathbf{L}_{\parallel,\perp})^{E,G}_{V^{\pm}}$ of $\mathbf{BVF}_{rec}$, induced by the elastic recoil energy of [W] phase, are accompanied by vibrations of square and volume of torus ($\mathbf{V}^+$) and antitorus ($\mathbf{V}^-$) of $\sum^{\infty} \langle(\mathbf{BVF}^{\updownarrow}_{rec})^i = [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]_{rec}\rangle$. They can be presented, correspondingly, as:

$$\Delta\mathbf{S}^{E,G}_{\mathbf{V}^{\pm}} = 4\pi^2(\pm\Delta\mathbf{L}_{\parallel,\perp})^{E,G}_{V^{\pm}} \cdot \mathbf{L}_{\mathbf{V}^{\pm}} \qquad 28$$

$$\Delta\mathbf{V}^{E,G}_{\mathbf{V}^{\pm}} = 4\pi^2(\pm\Delta\mathbf{L}_{\parallel,\perp})^{E,G}_{V^{\pm}} \cdot \mathbf{L}^2_{\mathbf{V}^{\pm}} \qquad 28a$$

The recoil energy of [W] phase can be elastic (reversible) and inelastic, i.e. irreversible, depending on the value of recoil energy and properties of Bivacuum. Dissipation of part of recoil energy of [W] phase due to inelastic interaction with Bivacuum decreases correspondingly the total energy/mass of elementary particles.

The propagation of triplets of elementary particles (triplets of asymmetric dual torus) in space (superfluid Bivacuum) with increasing translational velocity (**v**) increases the actual mass of triplets, equal to that of unpaired sub-elementary fermion in triplets in accordance to relativistic mechanics. Our model explains this effect as a result of increasing of asymmetry of the anchor Bivacuum fermion $\mathbf{BVF}^{\updownarrow}_{anc} = [\mathbf{V}^{+} \Updownarrow \mathbf{V}^{-}]^{i}_{anc}$ of unpaired $\mathbf{F}^{\pm}_{\updownarrow}$ in relativist triplets, as a part of its [W] phase (Fig.1).

The elastic longitudinal and transversal *recoil* energy of [W] phase of each sub-elementary particle/antiparticle, discussed above, is compensated in equilibrium conditions by the elastic virtual acoustic waves, named virtual pressure waves $(\mathrm{VPW}^{\pm})_{\parallel,\perp}$, which are also longitudinal and transversal.

The uncompensated energy of $(\mathrm{VPW}^{\pm})_{\parallel,\perp}$ can be presented, as the excessive virtual pressure ($\mathbf{\Delta VirP}^{\pm}$) in Bivacuum volume ($\mathbf{V}_{\mathbf{\Delta VP}}$), generated by the *external* translational dynamics of slightly asymmetric Bivacuum fermions around the $[C \rightleftharpoons W]$ pulsing particles:

$$\mathbf{\Delta VirP}^{\pm} = (\mathbf{VirP}^{+} - \mathbf{VirP}^{-})_{\parallel} + (\mathbf{VirP}^{+} - \mathbf{VirP}^{-})_{\perp} = \tag{28b}$$

$$where: \quad (\mathbf{VirP}^{+} - \mathbf{VirP}^{-})^{ext}_{\parallel} = \mathbf{V}_{\mathbf{\Delta VP}}\, \mathbf{n}_{BVF^{\uparrow}}\, \alpha[\mathbf{m}^{+}_{V}\mathbf{c}^{2} - \mathbf{m}^{-}_{V}\mathbf{c}^{2}]^{ext}_{rec} \tag{28c}$$

$$and: \quad (\mathbf{VirP}^{+} - \mathbf{VirP}^{-})_{\perp} = \mathbf{V}_{\mathbf{\Delta VP}}\, \mathbf{n}_{BVF^{\uparrow}}\, \beta[\mathbf{m}^{+}_{V}\mathbf{c}^{2} - \mathbf{m}^{-}_{V}\mathbf{c}^{2}]^{ext}_{rec} \tag{28d}$$

where: ($\mathbf{n}^{+}_{BVF^{\uparrow}}$ is the average density of Bivacuum fermions and antifermions;

$$\alpha[\mathbf{m}^{+}_{V}\mathbf{c}^{2} - \mathbf{m}^{-}_{V}\mathbf{c}^{2}]^{ext}_{\mathbf{W}} = (\alpha \mathbf{m}^{+}_{V}\mathbf{v}^{2})^{ext}_{\mathbf{C}} = \frac{\alpha \mathbf{h}^{2}}{\mathbf{m}^{+}_{V}\lambda^{2}_{B}} \tag{28e}$$

$$\beta[\mathbf{m}^{+}_{V}\mathbf{c}^{2} - \mathbf{m}^{-}_{V}\mathbf{c}^{2}]^{ext}_{\mathbf{W}} = (\beta \mathbf{m}^{+}_{V}\mathbf{v}^{2})^{ext}_{\mathbf{C}} = \frac{\beta \mathbf{h}^{2}}{\mathbf{m}^{+}_{V}\lambda^{2}_{B}} \tag{28f}$$

are the differences between energies (longitudinal and transversal) of Bivacuum torus and antitorus of the anchor $\mathbf{BVF}_{anc}$ of unpaired sub-elementary fermions in triplets (see 31c and 33), as a source of electric spherical waves. The bigger is this difference, the bigger is difference between energies of positive and negative virtual clouds (VC^{+} and VC^{-}), emitted - absorbed, as a result of transitions between excited and ground states of $\mathrm{BVF}^{\uparrow}$ and $\mathrm{BVF}^{\downarrow}$ (see 3a and 3b).

The electromagnetic and gravitational fine structure constants are, correspondingly (see eqs. 31c and 33):

$$\alpha = \mathbf{e}^{2}/\hbar\mathbf{c} \qquad and \qquad \beta^{i} = (\mathbf{m}^{i}_{0}/\mathbf{M}_{Pl})^{2}$$

In triplets of elementary particles (electrons and protons/neutrons) the uncompensated virtual pressure is generated by the unpaired sub-elementary fermion, like uncompensated electric and gravitational potentials and the excessive spin field. All kinds of corresponding waves are elastic in equilibrium systems, but may partially turn to inelastic ones in nonequilibrium conditions (section 18.3).

Let us consider the activation of the *massless virtual spin waves* (**VirSW**), as a carriers of phase/spin information and the angular magnetic moment. The reversible and local rotational part of energy of cumulative virtual clouds $(\mathbf{CVC}^{\pm})^{\circlearrowright}_{S=+1/2}$ or $(\mathbf{CVC}^{\pm})^{\circlearrowleft}_{S=-1/2}$, emitting as a result of $[\mathrm{C} \overset{CVC}{\rightarrow} W]$ transition, is presented by (25). Beside the energy, $\mathrm{CVC}^{\pm}$ has the angular momentum, equal to spins of unpaired $(\mathbf{F}^{\pm}_{\updownarrow})_{S=\pm 1/2}$:

$$\mathbf{S}_{\mathbf{CVC}^{\pm}} = \pm\frac{1}{2}\hbar = \pm\frac{1}{2}\mathbf{m}^{\pm}_{C}\,\mathbf{L}_{\mathbf{CVC}^{\pm}} \tag{29}$$

The $(\mathbf{CVC}^{\pm})^{\circlearrowright}_{S=+1/2}$ or $(\mathbf{CVC}^{\pm})^{\circlearrowleft}_{S=-1/2}$ activate the massless nonlocal *virtual spin waves of two corresponding polarization: VirSW*$^{\circlearrowright}$ *and VirSW*$^{\circlearrowleft}$ with properties of collective

Nambu-Goldstone modes. The VirSW represent oscillation of equilibrium of Bivacuum fermions with opposite spins:

$$\mathbf{VirSW} \sim \left[\mathbf{BVF}^{\uparrow}(\mathbf{V}^{+} \upuparrows \mathbf{V}^{-}) \overset{K_{BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}}}{\rightleftharpoons} \mathbf{BVF}^{\downarrow}(\mathbf{V}^{+} \downdownarrows \mathbf{V}^{-}) \right] \quad 29a$$

Corresponding nonlocal spin field ($\mathbf{I}_S$):

$$\mathbf{I}_S = grad(\mathbf{K}_{BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}}) \quad 29b$$

is a *carrier of information and angular momentum, but not the energy*, as far oscillation of $BVF^{\uparrow}(V^{+} \upuparrows V^{-}) \rightleftharpoons BVF^{\downarrow}(V^{+} \downdownarrows V^{-})$ do not accompanied by symmetry shifts between torus (V^{+}) and antitorus (V^{-}) of Bivacuum fermions. The oscillation of deviations of equilibrium constant, induced by $[C \rightleftharpoons W]$ transitions with angular frequency $(\omega^{in}_{C \rightleftharpoons W} = \omega_0 = 2\pi\nu_0 = m_0c^2/\hbar)^i$ can be described as:

$$\Delta\mathbf{K}_{BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}}(\mathbf{t}) = (\mathbf{K}_{BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}})_{\max} \sin(\omega_0^i t)$$

The excessive macroscopic virtual angular momentum ($\Delta\mathbf{S}$) of spin field ($\mathbf{I}_S$) in the volume $\mathbf{V}_S$, generated by unpaired sub-elementary fermions of elementary particles, we may expressed as:

$$\Delta\mathbf{S} = \mathbf{V}_S\,(\mathbf{n}^{+}_{BVF^{\uparrow}} - \mathbf{n}^{-}_{BVF^{\downarrow}})\hbar/\mathbf{2} = \mathbf{V}_S\,(\mathbf{n}_{BVF^{\uparrow}} - \mathbf{n}_{BVF^{\downarrow}})\frac{1}{2}\mathbf{L}_0\mathbf{m}_0\mathbf{c} \quad 29c$$

where: $(\mathbf{n}_{BVF^{\uparrow}} - \mathbf{n}_{BVF^{\downarrow}})$ is a difference of densities of Bivacuum fermions with opposite spins in the volume $\mathbf{V}_S$.

We introduce the notion of massless nonlocal Virtual wave guides (**VirWG**). They are generated as a superposition of standing **VirSW**, excited by the counterphase $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsations of particles of [S] - sender and [R] - receiver:

$$\mathbf{VirWG} = [\mathbf{VirSW}^{\circlearrowleft}_S \bowtie \mathbf{VirSW}^{\circlearrowleft}_R]$$

In accordance to known Helmholtz theorem: $\mathbf{F} = \mathbf{rot}\,\mathbf{A} + \mathbf{grad}\,\varphi$, each kind of vector field (**F**), tending to zero on the infinity, can be presented, as a sum of rotor of vector function **A**, determined in our model by rotating cumulative virtual cloud $(\mathbf{CVC}^{\pm})_{S=\pm 1/2}$ of [W] phase of sub-elementary fermions, notated as: $\mathbf{A} \equiv \mathbf{S}$ with $\mathbf{div}\,\mathbf{S} = \mathbf{0}$ and a gradient of some scalar function, which can be a sum of two or more scalar functions, like: $\varphi = \varphi_S + \varphi_E + \varphi_G$. Finally we get for the vector field:

$$\mathbf{F} = \mathbf{rot}\,\mathbf{S} + \mathbf{grad}\,(\varphi_S + \varphi_E + \varphi_G) = \quad 29d$$
$$= \mathbf{rot}\,\mathbf{S} + \mathbf{I}_S + \mathbf{V}_E + \mathbf{V}_G$$

where: $\mathbf{I}_S = grad\,\varphi_S = grad(K_{BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}})$ is spin field potential (29b);

$\mathbf{V}_E = grad\,\varphi_E = grad[\alpha|m_V^{+} - m_V^{+}|c^2] = grad[\alpha m_V^{+}\mathbf{v}^2]$ is the electric field potential;

$\mathbf{V}_G = grad\,\varphi_G = grad[\beta|m_V^{+} - m_V^{+}|c^2] = grad[\beta m_V^{+}\mathbf{v}^2]$ is the gravitational field potential.

The angular momentum (spin) of $\mathrm{CVC}^{\pm}$ activate the spin equilibrium shift of Bivacuum fermions and antifermions ($\mathbf{BVF}^{\uparrow} \rightleftharpoons \mathbf{BVF}^{\downarrow}$), representing a scalar function of spin-field.

Oscillations of $\varphi_S = K_{BVF^{\uparrow} \rightleftharpoons BVF^{\downarrow}}$, $\varphi_E = \alpha|m_V^{+} - m_V^{+}|c^2$ *and* $\varphi_G = \beta|m_V^{+} - m_V^{+}|c^2$, activated by the the recoil momentum of the anchor Bivacuum fermion ($\mathbf{BVF}^{\updownarrow}_{anc}$), propagate in space in form of virtual spherical waves. It is known, that general solution of the wave equation for any spherical wave is:

$$\varphi_{S,E,G} = \frac{1}{r}\mathbf{f}_1(\mathbf{ct} - \mathbf{r}) + \frac{1}{r}\mathbf{f}_2(\mathbf{ct} + \mathbf{r}) \quad 29e$$

where: f_1 and f_2 are arbitrary functions; $\frac{1}{r}\mathbf{f}_1(\mathbf{ct} - \mathbf{r})$ and $\frac{1}{r}\mathbf{f}_2(\mathbf{ct} - \mathbf{r})$ are the potentials of diverging wave and converging wave, correspondingly.

The in-phase $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation of pairs $[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]^{\tau}$ of triplets of coherent electrons and protons, accompanied by $CVC^{\pm}$ emission ⇌ absorption (Fig.3), modulates the basic Virtual Pressure Waves ($VPW^{\pm}$) of Bivacuum.

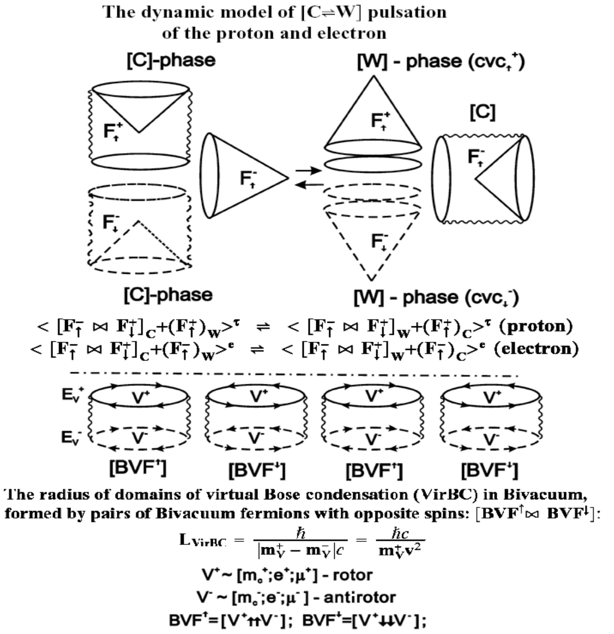

Fig.3. Dynamic model of $[C \rightleftharpoons W]$ pulsation of triplets of sub-elementary fermions/antifermions (e and τ) composing, correspondingly, electron and proton. The pulsation of pair $[F_{\uparrow}^{-} \bowtie F_{\downarrow}^{+}]$ is counterphase to pulsation of unpaired sub-elementary fermion/antifermion.

The superposition of standing modulated **VPW**$^{\pm}$ and **VirSW** forms the *virtual replica (VR) of matter* (see section 15). The hierarchy of VR of any material objects in Bivacuum contains the information about all dynamic and spatial parameters of corresponding hierarchic systems: from elementary particles to molecules, living organisms, etc. Due to virtuality, the relativist mechanics and, consequently, causality principle do not work for VR. Virtual replicas can evolve/self-organize themselves in both time direction: FUTURE and PAST using properties of Bivacuum as nonequilibrium active medium. In some sense complex VR works as a quantum supercomputer. The feedback reaction between metastable VR and sensitive detectors makes it possible registration of the time effects, corresponding to most probable future and past .

11 The total energy of elementary particles, considering their electric and gravitational potentials and corresponding virtual acoustic fields

Formally, *the [emission⇌ absorption] of virtual electromagnetic photons* in a course of $[C \rightleftharpoons W]$ pulsation of sub-elementary particles (fermions) can be described by known mechanism of the *electric and magnetic dipole radiation, induced by charges acceleration.* The intensity of *electric dipole radiation of each of sub-elementary fermions* may be expressed like:

$$\boldsymbol{\varepsilon}_{E.dip} = \frac{4e^2}{3c^3}\boldsymbol{\omega}_{C\rightleftharpoons W}^4(\mathbf{L}^{\pm})^2 = \frac{4}{3c^3}\boldsymbol{\omega}_{C\rightleftharpoons W}^4\mathbf{d}_{\mathbf{E}}^2 \qquad 30$$

where the frequency of $[C \rightleftharpoons W]$ pulsation, equal to that of dipole radiation is a sum of Golden mean internal (carrying) frequency contribution ($\mathbf{R_{tr}}\,\boldsymbol{\omega}_0^{in}$) and the external modulation frequency ($\boldsymbol{\omega}_B^{ext}$) of de Broglie wave (see 24b):

$$\boldsymbol{\omega}_{C\rightleftharpoons W} = \mathbf{R_{tr}}\,\boldsymbol{\omega}_0^{in} + \boldsymbol{\omega}_B^{ext} \qquad 30a$$

The angular frequency of $[C \rightleftharpoons W]$ pulsation of $[\mathbf{F}_{\updownarrow}^{\pm} >$ is equal to frequency of the electric dipole moment oscillation. The electric dipole moment $d_{\mathbf{F}_{\updownarrow}^{\pm}} = eL_0$. is equal to

$$d_{\mathbf{E}} = (\pm\Delta e L_{\cdot}^{\pm})^{\phi} = \phi e L_0 \qquad 30b$$

where from (19a): $(\pm\Delta e_{\cdot})^{\phi} = \phi e$; and the internal dimension of elementary particle $[\mathbf{F}_{\updownarrow}^{\pm} >$ is equal to its Compton radius: $(L^{\pm})^{\phi} = \hbar/(|m_C^+ - m_C^-|^{\phi} c) = \hbar/m_0 c = L_0$. The magnetic moment of sub-elementary fermions do not change in the process of $[C \rightleftharpoons W]$ pulsation in accordance to (6).

The intensity of $\varepsilon_{E.dip}$ is maximum in direction, normal to direction of $[C \rightleftharpoons W]$ pulsation and zero along this direction. On the distance $r >> L_0 = \frac{\hbar}{m_0 c} = (L^+ L^-)^{1/2}$, the dipole radiation in a course of [C ⇌ W] pulsation of the electrons, positrons or protons should be like from the point source.

The gravitational momentum changes of mass-dipole of sub-elementary particles in a course of [C ⇌ W] pulsation also has a permanent value, like magnetic one, independent on mass symmetry shift:

$$d_{\mathbf{G}} = \pm\Delta m L_{\cdot}^{\pm} = \pm|m_C^+ - m_C^-| \frac{\hbar}{\pm|m_C^+ - m_C^-|c} = \frac{\hbar}{c} = const \qquad 30c$$

Consequently, this semiclassical approach do not explain the gravitational radiation of pulsing particles.

11.1 *Mechanism of fields origination, following from our Unified theory*

The total energy and other properties of elementary particles $(\mathbf{E}_{\mathbf{C}\rightleftharpoons\mathbf{W}}^{tot})$ are determined by their impaired/uncompensated sub-elementary fermion in triplets. It can be presented, as a sum of **[W]** and **[C]** phase energies (see 24 - 24b):

$$\mathbf{E}_{\mathbf{C}\rightleftharpoons\mathbf{W}}^{tot} = \mathbf{m}_V^+ \mathbf{c}^2 = \hbar\omega_{\mathbf{C}\rightleftharpoons\mathbf{W}}^{tot} = \frac{1}{2}[\mathbf{E}_C \pm (\Delta\mathbf{E}_C)_{\mathbf{VPW}}] + \frac{1}{2}[\mathbf{E}_W \mp (\Delta\mathbf{E}_W)_{\mathbf{rec}}] \qquad 31$$

The variations of energy of corpuscular [C] phase $(\pm\Delta\mathbf{E}_C)$ are related to variations of particles internal rotational and external - translational group velocity and activation/modulation of virtual pressure waves $(\mathrm{VPW}^{\pm})_{\parallel,\perp}$ in Bivacuum. These [C] - phase energy variations in equilibrium conditions are compensated by the opposite variations of energy $(\mp\Delta\mathbf{E}_W)$ of the wave [W] phase, provided by the recoil energy.

In equilibrium reversible conditions: $[\pm\Delta\mathbf{E}_C \mp \Delta\mathbf{E}_W] = 0$. In non equilibrium conditions of the excessive energy flow: $[\pm\Delta\mathbf{E}_C \mp \Delta\mathbf{E}_W] \neq 0$.

The [W] phase of unpaired sub-elementary fermions exists in two forms:

1. Cumulative virtual cloud ($\mathbf{CVC}^{\pm}$) of subquantum particles, providing the wave properties of particle, like diffraction, interference, etc. The angular momentum of $\mathrm{CVC}^{\pm}$ excite the massless nonlocal virtual spin waves ($\mathrm{VirSW}^{\circlearrowleft}$ or $\mathrm{VirSW}^{\circlearrowright}$), carrying the phase (spin) information and the angular momentum;
2. The elastic deformations of superfluid matrix of Bivacuum and corresponding waves, induced by the internal recoil energy $(\mathbf{V}_E^{\phi} + \mathbf{V}_G^{\phi})_{rec}^{in}$, as a consequence of $[\mathbf{C} \overset{\mathbf{CVC}^{\pm}}{\rightarrow} \mathbf{W}]$ transitions of sub-elementary fermions and the external recoil energy $(\mathbf{V}_E + \mathbf{V}_G)_{rec}^{ext}$, provided by similar transitions of the anchor Bivacuum fermion $(\mathbf{BVF}_{anc}^{\updownarrow})$, are standing for fields origination.

The total energy of [W] phase, using (24-24b) and taking into account the recoil deviations, is:

$$\mathbf{E}_W = \mathbf{m}_V^+ \mathbf{c}^2 = \mathbf{R_{tr}}\Big[(\mathbf{m}_0 \boldsymbol{\omega}_0^2 \mathbf{L}_0^2)_{\mathbf{CVC}} \mp (\mathbf{V}_E^{\phi} + \mathbf{V}_G^{\phi})_{rec}\Big]_{rot}^{in} + \qquad 31a$$

$$+ \left[\frac{\mathbf{h}^2}{\mathbf{m}_V^+ \boldsymbol{\lambda}_B^2} \mp (\mathbf{V}_E + \mathbf{V}_G)_{rec}\right]_{tr}^{ext}$$

The energy of [C] phase of moving elementary particle, taking into account the kinetic energy deviations (opposite to recoil ones), can be presented as:

$$\mathbf{E}_C = \mathbf{m}_V^+\mathbf{c}^2 = \mathbf{R_{tr}}[(\mathbf{m}_V^+\mathbf{v}^2)^\phi \pm (\mathbf{T}_E^\phi + \mathbf{T}_G^\phi)]_{rot}^{in} + \quad \text{31b}$$
$$+ [\mathbf{m}_V^+\mathbf{v}^2 \pm (\mathbf{T}_E + \mathbf{T}_G)]_{tr}^{ext}$$

The latter expression means that the acceleration of translational motion of charged particle in [C] phase and increasing its translational kinetic energy will be accompanied by increasing of the negative recoil energy of [W] phase and vice verse. In the case of *particles vibrations in conditions of thermal equilibrium* the sum of the averaged energies of [C] and [W] phases, changing in counterphase manner, remains permanent and equal to the total energy of particle (30). In some special nonequilibrium conditions (see section 18.3) the increasing of probability of inelastic deformation of Bivacuum matrix, following by origination of additional real and virtual photons and electron - positron pairs, decreasing [W] phase energy without change the corpuscular [C] phase energy may be revealed experimentally, as a total energy/mass ($m_V^+c^2 = mc^2$) of particles decreasing.

The [$\mathbf{C} \rightleftharpoons \mathbf{W}$] pulsations of the anchor Bivacuum fermion ($\mathbf{BVF}_{anc}^\updownarrow$) represent periodical redistribution between the *external* kinetic [C] - phase and potential [W] phase energy of elementary particle (13) with frequency (27a), like in harmonic oscillator. The asymmetry of $\mathbf{BVF}_{anc}^\updownarrow$ is dependent on the external translational kinetic energy of particle and determines the properties of de Broglie wave of particle (energy, frequency and length).

The *external* contribution of longitudinal recoil energy of [W] phase of the anchor $\mathbf{BVF}_{anc}^\updownarrow$ to *electromagnetic potential of elementary particle* in eqs. 31 and 31a, can be expressed as a Coulomb interaction between the actual ($\mathbf{e}_+$) and complementary ($\mathbf{e}_-$) charges of torus and antitorus of $\mathbf{BVF}_{anc}^\updownarrow$, separated by the effective spatial parameter $\mathbf{L}_{\mathbf{ext}}^\pm$:

$$|\mp\mathbf{V}_E^{ext}|_{[W]} = \frac{\mathbf{e}_-}{\mathbf{L}_{\mathbf{ext}}^\pm} = \alpha(\mathbf{m}_V^+ - \mathbf{m}_V^-)_{\mathbf{BVF}_{anc}^\updownarrow}\mathbf{c}^2 \qquad (recoil) \quad \text{31c}$$

where, the electromagnetic fine structure constant is $\alpha = \mathbf{e}^2/\hbar\mathbf{c}$ $\quad(\mathbf{e^2} = \mathbf{e}_+\mathbf{e}_-)$; the additional curvature of anchor $\mathbf{BVF}_{anc}^\updownarrow$, dependent on particle external translational motion with velocity (**v**) is:

$$\mathbf{L}_{\mathbf{ext}}^\pm = \frac{\hbar}{(\mathbf{m}_V^+ - \mathbf{m}_V^-)_{\mathbf{BVF}_{anc}^\updownarrow}\mathbf{c}} = \frac{\hbar c}{\mathbf{m}_V^+\mathbf{v}^2}$$

The corresponding external additional translational kinetic energy of particle in [C] phase, responsible for activation of longitudinal virtual pressure waves (VPW^+ or $\mathrm{VPW}^-)_\parallel^{ext}$ in Bivacuum:

$$|\pm\mathbf{T}_E^{ext}|_{[C]} = \alpha\mathbf{m}_V^+\mathbf{v}^2 = \mathbf{m}_V^+\mathbf{v}_\parallel^2 = |\mp\mathbf{V}_E^{ext}|_{[W]} \qquad (VPW_\parallel^\pm)^{ext} \quad \text{31d}$$

At the GM conditions, pertinent for *internal rotations* of sub-elementary fermions, we have $|\mathbf{m}_V^+ - \mathbf{m}_V^-|_{\mathbf{vor}}^\phi = \mathbf{m}_0$ and formulas (31c and 31d) for internal opposite increments of the recoil energy and virtual press energy turns to:

$$|\mp(\mathbf{V}_E^{in})^\phi|_{[W]} = \frac{\mathbf{e}_+\mathbf{e}_-}{\mathbf{L_0}} = \alpha\,\mathbf{m}_0\mathbf{c}^2 = \alpha\,\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2 \qquad (recoil) \quad \text{32}$$

$$|\pm(\mathbf{T}_E^{in})^\phi|_{[C]} = \alpha(\mathbf{m}_V^+\mathbf{v}^2)^\phi = \left(\mathbf{m}_V^+\mathbf{v}_\parallel^2\right)^\phi = (\mathbf{m}_0/\phi)\alpha\phi\,\mathbf{c}^2 \qquad (VPW_\parallel^\pm)^\phi \quad \text{32a}$$

where the curvature/radius of rotation of sub-elementary particles around common axis (Fig.1) is equal to Compton radius ($\mathbf{L}_0$):

$$\mathbf{L}_{\mathbf{in}}^\phi = \mathbf{L}_0 = \frac{\hbar}{\mathbf{m}_0\mathbf{c}} = \frac{\hbar\mathbf{c}}{(\mathbf{m}_V^+\mathbf{v}_{\mathbf{vor}}^2)^\phi}$$

The longitudinal GM velocity of the anchor Bivacuum fermion ($\mathbf{BVF}_{anc}^\updownarrow$), squared is $(\mathbf{v}_\parallel^\phi)^2 = \alpha\phi\,\mathbf{c}^2$.

The Coulomb potentials of the electron and proton in hydrogen atom should be equal:

$$\alpha(\mathbf{m}_V^+\mathbf{v}^2)_{\mathbf{e}}^{\phi} = \alpha(\mathbf{m}_V^+\mathbf{v}^2)_{\mathbf{p}}^{\phi}$$

This relation is valid at the condition, when the difference in mass of the electron and proton in atom is compensated by the difference in their velocities of longitudinal vibrations:

$$\frac{(\mathbf{m}_V^+)_{\mathbf{e}}}{(\mathbf{m}_V^+)_{\mathbf{p}}} = \frac{(\mathbf{v}^2)_{\mathbf{p}}}{(\mathbf{v}^2)_{\mathbf{e}}} \quad 32c$$

The *external* transversal recoil energy of [W] phase $|\mp\mathbf{V}_G^{ext}|_{[W]}$, responsible for *gravitation* and corresponding additional kinetic energy $|\pm\mathbf{T}_G^{ext}|_{[C]}$ of [C] phase, exciting the transversal virtual pressure waves $(\mathrm{VPW}^+$ or $\mathrm{VPW}^-)_\perp$ are symmetric to 31c and 31d:

$$|\mp\mathbf{V}_G^{ext}|_{[W]} = \mathbf{G}\frac{\mathbf{m}_V^+\mathbf{m}_V^-}{\mathbf{L}_{\mathbf{ext}}^{\pm}} = \beta(\mathbf{m}_V^+ - \mathbf{m}_V^-)_{\mathbf{BVF}_{anc}^{\updownarrow}}\mathbf{c}^2 \quad 33$$

$$|\pm\mathbf{T}_G^{ext}|_{[C]} = \beta\mathbf{m}_V^+\mathbf{v}^2 = \mathbf{m}_V^+\mathbf{v}_\perp^2 \quad 33a$$

where the introduced in our theory gravitational fine structure constant: $\beta = (\mathbf{m}_0/\mathbf{M}_{Pl})^2$ is a ratio of rest mass to Plank mass, squared.

At the GM conditions, valid for the *internal* degrees of freedom, eqs. 33 and 33a turns to:

$$|\mp\mathbf{V}_G^{in}|_{[W]}^{\phi} = \mathbf{G}\frac{\mathbf{m}_0^2}{\mathbf{L}_0} = \beta\mathbf{m}_0\mathbf{c}^2 = (\mathbf{m}_V^+\mathbf{v}_\perp^2)^{\phi} = (\mathbf{m}_0/\phi)\beta\phi\,\mathbf{c}^2 \quad 34$$

$$|\pm\mathbf{T}_G^{in}|^{\phi} = \beta(\mathbf{m}_V^+\mathbf{v}^2)^{\phi} = \beta\,\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2 \quad 34a$$

where the transversal GM velocity of the anchor Bivacuum fermion $(\mathbf{BVF}_{anc}^{\updownarrow})$, squared is $(\mathbf{v}_\perp^{\phi})^2 = \beta\phi\,\mathbf{c}^2$.

The total *averaged* external energy of de Broglie wave, as a harmonic oscillator, is the averaged sum of [**C**] and [**W**] phase:

$$\mathbf{E}_{\mathbf{B}}^{ext} = \hbar\omega_{\mathbf{B}}^{ext} = (\mathbf{m}_V^+\mathbf{v}^2)^{ext} = \left(\overline{\mathbf{T}}_k^{ext}\right)_C + \left(\overline{\mathbf{V}}^{ext}\right)_W = \frac{1}{2}\left(\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}^2}\right)^{ext} + \frac{1}{2}(\mathbf{m}_V^+ - \mathbf{m}_V^-)_{\mathbf{BVF}_{anc}^{\updownarrow}}^{ext}\mathbf{c}^2 \quad 35a$$

The general formula for total energy of de Broglie wave, taking into account oscillations of the internal and external contributions, related with electric and gravitational potentials can be presented as:

$$\mathbf{E}_B^{tot} = \mathbf{m}_V^+\mathbf{c}^2 = \mathbf{R}_{\mathbf{tr}}^{ext}\left[(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot} \pm \left(\alpha\frac{\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2} + \beta\frac{\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)_{tr}\right]^{in} + \quad 35b$$

$$+\left[\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2} \pm \left(\alpha\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2} + \beta\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2}\right)\right]_{tr}^{ext}$$

The total energies of elementary particle are not exactly equal in **C** and **W** phase (31a and 31b). Corresponding anharmonism of $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ oscillation makes it possible the interaction of charged particles with external medium and fields.

The ratio of minimum (zero-point) internal group velocity of elementary particle vibrations to light velocity squared, corresponding to GM conditions and zero external velocity $(\mathbf{v}_{tr}^{ext} = 0)$, using (35b), can be presented as a sum of three contributions:

$$(\mathbf{v}_{\min}/\mathbf{c})_{tot}^2 = \boldsymbol{\phi} + \left(\mathbf{v}_{\parallel tr}^{\phi}/\mathbf{c}\right)^2 + (\mathbf{v}_{\perp tr}^{\phi}/\mathbf{c})^2 = \phi + \alpha\phi + \beta\phi = \quad 35c$$

$$= 0.61803398 + 4.51\cdot 10^{-3} + 1.07497\cdot 10^{-45} = 0.62254398$$

where: $(\mathbf{v}^2_{\min})_{rot} = \phi c^2$ is a minimum internal dual *rotational*velocity of sub-elementary particles, at Golden mean conditions in triplets (Fig.1).

For the other hand, the minimum internal *translational* vibrations (longitudinal and transversal), induced by [C$\rightleftharpoons$ *W*] pulsations, are characterized by:

$$(\mathbf{v}_{\min}/\mathbf{c})^2_{tr} = \left(\mathbf{v}^{\phi}_{\parallel tr}/\mathbf{c}\right)^2 + (\mathbf{v}^{\phi}_{\perp tr}/\mathbf{c})^2 = \alpha\phi + \beta\phi \cong 4.51 \cdot 10^{-3} \tag{36}$$

The longitudinal and transversal minimum velocities at Golden mean conditions, accompanied $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation of unpaired $\mathbf{F}^{\pm}_{\updownarrow}$ of triplets, are summarized below:

$$\mathbf{v}^{\phi}_{\parallel tr} = \mathbf{cz} = \mathbf{c}z = (\alpha\phi)^{1/2} = 0.201330447 \times 10^8\,\mathrm{m\ s^{-1}} \tag{36a}$$

$$where: \quad z = (\alpha\phi)^{1/2} = 6.71566 \cdot 10^{-2}$$

$$and \quad z^2 = \left(\frac{\mathbf{v}^{\phi}_{\parallel tr}}{c}\right)^2 = \alpha\phi = 4.51 \cdot 10^{-3}$$

$$\mathbf{v}^{\phi}_{\perp tr} = cx = c(\beta_e\phi)^{1/2} = 10^{-14}\,\mathrm{m\ s^{-1}} \tag{36b}$$

$$where: \quad x = (\beta_e\phi)^{1/2} = 3.27867 \cdot 10^{-23}$$

$$and \quad x^2 = \left(\frac{\mathbf{v}^{\phi}_{\perp tr}}{c}\right)^2 = \beta_e\phi = 1.07497 \cdot 10^{-45}$$

The set of new expressions, presented in this section, unify the extended special theory of relativity with quantum mechanics, fields theory and mechanism of corpuscle - wave duality of elementary particles.

11.2. *Mechanism of Electromagnetic attraction and repulsion, based on Unified theory (UT)*

The mechanism of electromagnetic (EM) interaction between two or more electrons or positrons in accordance to our theory is provided by the unpaired/uncompensated sub-elementary fermions $\mathbf{F}^{\pm}_{\updownarrow}\rangle$. This may be demonstrated on example of the electron $\langle[\mathbf{F}^{+}_{\uparrow} \bowtie \mathbf{F}^{-}_{\downarrow}] + \mathbf{F}^{-}_{\uparrow}\rangle$ and positron $\langle[\mathbf{F}^{-}_{\uparrow} \bowtie \mathbf{F}^{+}_{\downarrow}] + \mathbf{F}^{+}_{\uparrow}\rangle$ triplets. During two semiperiods of triplets of the electron or positron:

$$[(F^{+}_{\uparrow} \bowtie F^{-}_{\downarrow})_C + (\mathbf{F}^{\pm}_{\updownarrow})_W] \rightleftharpoons [(F^{+}_{\uparrow} \bowtie F^{-}_{\downarrow})_W + (\mathbf{F}^{\pm}_{\updownarrow})_C]$$

the corpuscular [C] and wave [W] phase of sub-elementary fermion and sub-elementary antifermion in pairs $[F^{-}_{\updownarrow} \bowtie F^{+}_{\updownarrow}]$ are realized in-phase and compensate the each other influence on Bivacuum almost totally.

The $[C \rightleftharpoons W]$ pulsation of unpaired $(F^{-}_{\updownarrow})$, counterphase to that of $[F^{-}_{\updownarrow} \bowtie F^{+}_{\updownarrow}]$, is accompanied by the electric potential excitation in Bivacuum due to described recoil effect in form of longitudinal reversible elastic deformation of its superfluid matrix.

In accordance to our model, the *electromagnetic repulsion and attraction* between two charged particles is a result of tendency of system to minimize the resulting density of longitudinal recoil waves (RecW$^{\pm}$), corresponding to [W] phase and that of excessive longitudinal virtual pressure waves (VPW$^{\pm}$), corresponding to [C] phase.

The excessive virtual pressures ($\mathbf{\Delta VirP}^{\pm}$), generated by two separated by distance (r) charges (1) and (2), are determined by the sum of densities of longitudinal increments of translational kinetic energies of Bivacuum fermions (BVF$^{\updownarrow}$) in [C] phase of unpaired $[\mathbf{F}^{\pm}_{\updownarrow}\rangle$ are:

$$\Delta\mathbf{VirP}_1^{\pm}(\mathbf{r})_{\mathbf{C}} = \left(\begin{array}{c} [\mathbf{VirP}^{+} - \mathbf{VirP}^{-}]_{x,y,z} \sim \frac{\vec{r}}{r}[\mathbf{n}_{+}\boldsymbol{\varepsilon}_{VC^{+}} - \mathbf{n}_{-}\boldsymbol{\varepsilon}_{VC^{-}}]_{x,y,z} \sim \\ \pm\frac{\vec{r}}{r}\mathbf{n}_{BVF}[\mathbf{R}_{tr}\alpha\,(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)^{in} + \boldsymbol{\alpha}(\mathbf{m}_V^{+}\mathbf{v}^2)^{ext}]_{x,y,z} \end{array} \right)_1^{[\mathbf{C}]} \quad 36c$$

$$\Delta\mathbf{VirP}_2^{\pm}(\mathbf{r})_{\mathbf{C}} = \left(\begin{array}{c} [\mathbf{VirP}^{+} - \mathbf{VirP}^{-}]_{x,y,z} \sim \frac{\vec{r}}{r}[\mathbf{n}_{+}\boldsymbol{\varepsilon}_{VC^{+}} - \mathbf{n}_{-}\boldsymbol{\varepsilon}_{VC^{-}}]_{x,y,z} \sim \\ \pm\frac{\vec{r}}{r}\mathbf{n}_{BVF}[\mathbf{R}_{tr}\alpha\,(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)^{in} + \boldsymbol{\alpha}(\mathbf{m}_V^{+}\mathbf{v}^2)^{ext}]_{x,y,z} \end{array} \right)_2^{[\mathbf{C}]}$$

where: $\vec{r}$ is a unit vector; r is a distance between particles. The excessive virtual pressures are dependent on the difference in density ($n_{\pm}$) and energy ($\varepsilon_{VC^{\pm}}$) of positive and negative virtual clouds (VC^{+} and VC^{-}); $\mathbf{n}_{BVF}$ is the average concentration of Bivacuum fermions.

The excessive virtual pressure, generated by the electrons and positrons, should be opposite, but equal by the absolute value: $\Delta VirP_1^{-} = -\Delta VirP_2^{+}$. Consequently, *in the case of attraction* of the opposite charges, the corresponding Bivacuum excessive virtual pressures nullify each other, when the charges comes closer ($r \to 0$):

$$\Delta\Delta\mathbf{VirP}_{1,2}^{\pm} = [\Delta\mathbf{VirP}_1^{-} + (-\Delta\mathbf{VirP}_2^{+})] \to \mathbf{0} \quad \textbf{at} \quad \mathbf{r} \to \mathbf{0} \quad 36d$$

In the case of repulsion between particles of the same charge, the increasing the distance between similar charges ($r \to \infty$) decreases the density of the excessive virtual pressure:

$$\Delta\Delta\mathbf{VirP}_{1,2}^{\pm} \to 0 \quad at \quad r \to \infty \quad 36e$$

The electromagnetic energy of each of recoil longitudinal elastic waves ($\mathbf{RecW}^{\pm}$) of unpaired sub-elementary fermions in [W] phase, described by the internal and external contributions (32 and 31c), taking into account the external translational factor ($\mathbf{R_{tr}}$), is:

$$(\mathbf{RecW}^{\pm})_{\mathbf{W}}^{1,2} \sim \frac{\vec{r}}{r}\mathbf{n_{BVF}}\,|\Delta\mathbf{E}_{\mathbf{W}}^{E}|^{1,2} = \frac{\vec{r}}{r}\mathbf{n_{BVF}}\,[\mathbf{R_{tr}}\,\alpha(\mathbf{m}_V^{+} - \mathbf{m}_V^{-})_{in}^{\phi}\mathbf{c}^2 + \alpha(\mathbf{m}_V^{+} - \mathbf{m}_V^{-})_{BVF_{anc}}^{ext}\mathbf{c}^2]^{1,2} \quad 36f$$

where: $\mathbf{n_{BVF}}$ is the average density of $BVF^{\updownarrow}$ in Bivacuum.

In the conditions of equilibrium and elastic effects in a system of interacting particles:

$$\Delta\mathbf{VirP}_{\mathbf{C}}^{\pm} \sim |\Delta\mathbf{E}_{\mathbf{C}}^{E}| = |-\Delta\mathbf{E}_{\mathbf{W}}^{E}| \sim (\mathbf{RecW}^{\pm})_{\mathbf{W}} \quad 36g$$

and $(\mathbf{m}_V^{+} - \mathbf{m}_V^{-})_{in}^{\phi} = m_0$. This means that Coulomb repulsion or attraction between charged particles are equal in both phase, provided, however by different mechanisms. The distant - dependent decreasing of the resulting Bivacuum symmetry shifts and energy density of the elastic waves $(\mathbf{RecW}^{\pm})_{\mathbf{W}}$, generated by the recoil effects of [W] phase, responsible for attraction/repulsion between charged particles can be described in similar way as 36d and 36e.

11.3 *Possible Mechanism of Gravitational Interaction in Unified Theory*

The gravitational interaction differs from electromagnetic one, because it is not dependent on the charge of particles, determined by charge of unpaired sub-elementary fermions. It is dependent on mass only, which is equal in all three sub-elementary fermions, forming triplets of elementary particles.

Consequently, the contribution to the total energy of particle, independent on charge, is responsible for gravitational interaction between particles.

A spherical gravitational waves may represent the transversal pulsation of positions of torus and antitorus of Bivacuum fermions (28a), activated by recoil energy with frequency of $[C \rightleftharpoons W]$ pulsation of sub-elementary particles. This excessive gravitational energy is determined by the transversal recoil energy (35d), independent on charge:

$$\Delta\boldsymbol{\varepsilon}_G^{\pm} \sim |\mathbf{E}_G|_{rec} = \mathbf{n}_{BVF}\left(\mathbf{R_{tr}^{ext}}\,(\beta\mathbf{m}_0\mathbf{c}^2)^{in} + \boldsymbol{\beta}|m_V^{+} - m_V^{-}|^{ext}\mathbf{c}^2\right)$$

where n_{BVF} is a density of Bivacuum fermions.

It is much smaller, than part of recoil virtual energy, responsible for electromagnetic interaction. By analogy with *Bjorkness hydrodynamic interaction*, we suppose, that $[C \rightleftharpoons W]$ pulsation of pairs: $[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]$ decreases the excessive virtual quanta pressure between particles ($\Delta\varepsilon_G^{\pm}$) more than outside of them, independently of their charge. This provides the gravitational attraction between particles.

In accordance to known hydrodynamic theory, the Bjorkness force has a reverse square distance dependence between pulsing bodies in liquid medium, as ($1/r^2$), like the gravitational force.

It is important, that the Bjorkness force could be positive and negative, depending on difference of phase of pulsations. In turn, this phase shift is dependent on relation of distance between bodies to acoustic (or gravitational in our case) elastic transversal virtual pressure $(\mathrm{VPW}^{\pm})_{\perp}$ wave length. If the length of acoustic (gravitational) waves, excited by cumulative effect of all elementary particles of pulsing particles of bodies, is less than the distance between bodies, the Bjorkness gravitational force is attractive. If the distance is much bigger than wave length, then the attraction between systems of pulsing particles turns to repulsion. This effect means antigravitation.

The large-scale honey-comb structure of the Universe, its huge voids, could be explained by the interplay of gravitational attraction and repulsion between clusters of galactics, depending on the distance between them.

Recently a strong experimental evidence appears, pointing to acceleration of the Universe expansion. This phenomena could be explained by increasing the antigravitation with increasing the distance between galactics. It confirms our hydrodynamic model of mechanism of gravitation.

The another approach to gravitation problem, following from our concept of Bivacuum, is related to expansion and contraction of volume of virtual domains with nonlocal properties (see section 1 and 2), mediated by Pauli repulsion force between Bivacuum fermions with similar *uncompensated* spin/energy: $[\mathbf{BVF}^{\uparrow} \Leftarrow\cdots\Rightarrow \mathbf{BVF}^{\uparrow}]$ and the attraction between Bivacuum fermions of the opposite spins: $[\mathbf{BVF}^{\uparrow} \Rightarrow\cdots\Leftarrow \mathbf{BVF}^{\uparrow}]$. The ratio between number of uncompensated $\mathrm{BVF}^{\updownarrow}$ and compensated in Cooper - like pairs can be modulated by the massless Virtual spin waves (VirSW). The modulated interplay between Bivacuum domains contraction and expansion can be responsible for the attractive dark mass and repulsion dark energy effects in the Universe.

11.4 *The space curvatures, related to electromagnetism and gravitation*

From (32 and 32a) we can see, that the space curvature, characteristic for electric potential of the electron at GM conditions is equal to the radius of the 1*st Bohr orbit* (a_B) in hydrogen atom:

$$\mathbf{L}_E^{\phi} = \mathbf{L}_{\parallel} = \frac{1}{\alpha}\frac{\hbar}{\mathbf{m}_0\mathbf{c}} = \frac{1}{\alpha}\mathbf{L}_0 = \frac{\hbar\mathbf{c}}{\left[\mathbf{m}_V^{+}\mathbf{v}_{\parallel tr}^2\right]^{\phi}} = a_B = 0.5291 \cdot 10^{-10}\, m \qquad 37$$

The curvature of Bivacuum, related to the recoil *transversal* zero-point vibrations of the anchor Bivacuum fermion, is defined by the value of *gravitational potential* at GM conditions (eq.34):

$$\left(\mathbf{V}_G^{in}\right)^{\phi} = \mathbf{G}\frac{\mathbf{m}_0^2}{\mathbf{L_0}} = \beta\mathbf{m}_0\mathbf{c}^2 = \beta\frac{\hbar c}{L_0} = \frac{\hbar\mathbf{c}}{[\mathbf{m}_V^{+}\mathbf{v}_{\perp tr}^2]^{\phi}} \qquad 37a$$

where: $[m_C^{+}]^{\phi} = m_0/\phi;\quad [\mathbf{v}_{\perp tr}^2]^{\phi} = \beta\phi c^2$

The corresponding radiuses of the electron's and proton's gravitational curvatures are:

$$(\mathbf{L}_G^\phi)^e = \frac{1}{\beta^e}\frac{\hbar}{m_0^e c} = \frac{\hbar c}{[m_C^+ \mathbf{v}_{\perp tr}^2]^\phi} = \frac{L_0^e}{\beta^e} = \quad 38$$

$$= a_G^e = \frac{3.86 \cdot 10^{-13}\,\mathrm{m}}{1.7385 \cdot 10^{-45}} = 2.22 \cdot 10^{32}\, m = 2.34 \cdot 10^{16}\ \mathit{lightyears}$$

$$(\mathbf{L}_G^\phi)^p = \frac{1}{\beta^p}\frac{\hbar}{m_0^p c} = \frac{\hbar c}{[m_C^+ \mathbf{v}_{\perp tr}^2]^\phi} = \frac{L_0^p}{\beta^p} = \quad 38a$$

$$= a_G^p = \frac{21 \cdot 10^{-17}\,\mathrm{m}}{5.86 \cdot 10^{-39}} = 4 \cdot 10^{22}\, m = 3.79 \cdot 10^{6}\ \mathit{lightyears} \quad 38b$$

where: $\beta^e = (m_0^e/M_{Pl})^2 = 1.7385 \cdot 10^{-45}$; $\beta^p = (m_0^p/M_{Pl})^2 = 5.86 \cdot 10^{-39}$ are the introduced in our theory gravitational fine structure constant, different for electrons and protons; $M_{Pl} = (\hbar c/G)^{1/2} = 2.17671 \cdot 10^{-8}\, kg$ is a Plank mass; $m_0^e = 9.109534 \cdot 10^{-31}\, kg$ is a rest mass of the electron; $m_0^p = 1.6726485 \cdot 10^{-27}\, kg = m_0^e \cdot 1.8361515 \cdot 10^{3}\, kg$ is a rest mass of proton; the length of 1 light year is $9.46 \cdot 10^{15}\, m$.

The new parameters (a_G^e and a_G^p), by the analogy with (a_B) can be named as the 1*st radius of the circular gravitational standing wave of the electron and proton, correspondingly.*

It is tempting to put forward a conjecture, that the maximum diameter of our expanding with acceleration Universe is determined by the gravitational curvature radius of the free electrons: $a_G^e = 2.34 \cdot 10^{16}\, \mathit{lightyears}$, coinciding with the curvature radius of the lowest energy of $e-$ neutrino at quantum number at $n = 1$, in accordance to our formula 39b. In such condition of super-low energy/matter density all the matter may change to low energy photons and neutrino, like the relict ones. As a result, the secondary Bivacuum turns again to primordial one with minimum energetic gap between torus and antitorus of Bivacuum fermions ($\mathrm{BVF}^{\updownarrow}$). This means the infinitive dimension of virtual Bose condensation domain of pairs of dipoles $[BVF^{\uparrow} \bowtie BVF^{\downarrow}]$, making Bivacuum highly nonlocal and able for spontaneous but space-time correlated cosmic large - scale fluctuations of symmetry and energy. It is something, like the electric breakdown in condensers, when the separation between oppositely charged plates becomes too small. This breakdown of primordial Bivacuum corresponds to born of the new large-scale 'hot' Universe after death the old 'cold' one. In such a model we do not need the concept of Big Bang, starting from singularity.

The gravitational curvature radius of proton, equal to $a_G^p = 3.79 \cdot 10^{6}\, \mathit{lightyears}$ may have the same importance in cosmology, like the electromagnetic curvature the electron, equal to 1st orbit radius of the hydrogen atom: $L_E^\phi = a_B = 0.5291 \cdot 10^{-10}\, m$ in atomic physics. For example very good correlation is existing between a_G^p and the radius of of Local group of galactics, like Milky way, Andromeda galaxy and Magellan clouds, equal approximately to $3 \cdot 10^{9}$ light years. The radius of Vigro cluster of galactics is also close to a_G^p.

11.5 *Neutrino and Antineutrino in Unified Model*

We put forward a conjecture, that neutrino or antineutrino of three lepton generation, represents a *stable non elastic* Bivacuum symmetry excitations, accompanied the creation of the electron's or positron's. *It is a result of compensation principle of local symmetry violation by the non-local one.*

However, the neutrinos, in contrast to transversal spherical gravitational waves in Bivacuum, could be a result of formation of channels by virtual standing waves between two elementary sources of neutrino and antineutrino. We apply here to one of the more general principle of Nature, that only standing waves of similar origin formation, is the most important condition of excitations stability.

This kind of spatially directed gravitational wave guide (GraWG) has common features with Virtual waveguide (VirWG), formed by standing virtual spin waves (VirSW), proposed earlier (see 29c).

The proposed *photon model* (Fig.2) is the example, when a standing waves stabilization principle, and principle of compensation of the local symmetry violation by nonlocal one - take a place in the volume of the same particle, providing its propagation in space with light velocity and the *resulting rest of mass*, equal to zero.

The quantized energy of neutrinos and antineutrinos is related to the rest mass of corresponding generations of the electron and positron $(\pm m_0^{e,\mu,\tau})$ in following manner (see 34):

$$E_{e,\mu,\tau}^{\nu,\widetilde{\nu}} = [m_C^+ \mathbf{v}_{\perp tr}^2]_{e,\mu,\tau}^{\nu,\widetilde{\nu}} = \pm\beta_{e,\mu,\tau}(m_0^{e,\mu,\tau})c^2\left(\frac{1}{2}+n\right) = \pm\Delta(m_V^{e,\mu,\tau})c^2\left(\frac{1}{2}+n\right) \qquad 39$$

where $(\pm m_0^{e,\mu,\tau})$ are the rest mass of $[i = e,\mu,\tau]$ generations of electrons and positrons; $\beta_{e,\mu,\tau} = (m_0^{e,\mu,\tau}/M_{Pl})^2$ is a gravitational fine structure constants, introduced in our theory of gravitation (Kaivarainen, 2002); $\pm\Delta(m_V^{e,\mu,\tau})c^2 = \pm\beta_{e,\mu,\tau}(m_0^{e,\mu,\tau})c^2$ are the amplitude of Bivacuum symmetry vibrations, corresponding to three neutrino flavors $[e,\mu,\tau]$ at Golden mean conditions.

The charge of neutrino/antineutrino $(\pm e_\nu)$, proportional to symmetry shift: $\pm\Delta(m_V^{e,\mu,\tau}) = \pm\beta_{e,\mu,\tau}(m_0^{e,\mu,\tau})$ (see 19b) is very close to zero:

$$\pm e_\nu = \pm\beta_{e,\mu,\tau}e_0 \cong 0 \qquad 39a$$

The evidence of neutrino flavor oscillation: $e \rightleftharpoons \mu \rightleftharpoons \tau$ in certain conditions has been recently obtained in Sudbury Neutrino Observatory (SNO, 2002). This means possibility of collective quantum transitions between symmetry shifts of secondary Bivacuum: $\Delta(m_V^e) \rightleftharpoons \Delta(m_V^\mu) \rightleftharpoons \Delta(m_V^\tau)$, as a result of conversions (oscillations) between three basic generation of cell-dipoles $(\mathrm{BVF}^\pm)^i$ with three corresponding resulting mass: $(m_0^e) \rightleftharpoons (m_0^\mu) \rightleftharpoons (m_0^\tau)$, where $m_0^i = \sqrt{(m_C^+ m_C^-)^i}$.

It is known,that neutrinos $(\nu_e;\nu_\mu;\nu_\tau)$ always originates in pairs with positrons $(e^+;\mu^+;\tau^+)$ and antineutrinos $(\widetilde{\nu}_e;\widetilde{\nu}_\mu;\widetilde{\nu}_\tau)$ in pairs with electrons $(e^-;\mu^-;\tau^-)$. In accordance to our approach this confirms our idea that the nonlocal symmetry shift of huge number of $\mathbf{BVF}^\updownarrow \equiv [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]$ compensate the local symmetry shift, accompanied the origination of elementary particles $\langle [F_\uparrow^- \bowtie F_\downarrow^+] + F_\updownarrow^\pm \rangle$.

Neutrino and antineutrino may be considered, as asymmetric stable excitations in domains of Bivacuum in state of virtual Bose condensation (VirBC) with properties of nonlocality. The characteristic radius of such excited states, characterizing the neutrino curvature, is equal to:

$$\mathbf{L}_{\nu_{e,\mu,\tau}}^{(n)} = \frac{\hbar}{\mathbf{c}[\boldsymbol{\beta}\mathbf{m}_0]_{e,\mu,\tau}(\frac{1}{2}+\mathbf{n})} \qquad 39b$$

Obviously, the neutrino/antineutrino directly participate in gravitational (G) interaction between two or more bodies. The energy of G - interaction should be dependent on density energy of neutrinos and their generation.

12 Calculation of magnetic moment of the electron, based on Unified theory

In this section the quantitative evidence in proof of our Unified theory is presented. The minimum charge of unpaired sub-elementary fermion $(\mathbf{F}_\updownarrow^\pm)$ of electron/positron at GM conditions, *without taking into account the recoil effects*, is determined by (19b):

$$\mathbf{e}^\phi \equiv |\Delta\mathbf{e}_\pm|^\phi = |\mathbf{e}_+ - \mathbf{e}_-|^\phi = |\mathbf{e}_+|^\phi \boldsymbol{\phi}^2 = \boldsymbol{\phi}^{3/2}\mathbf{e}_0 = \boldsymbol{\phi}^{3/2}\,|\mathbf{e}_+\mathbf{e}_-|^{1/2} \qquad 40$$

The difference between the *total magnetic moment of the electron:*

$$\boldsymbol{\mu}_{tot} = (\mathbf{e}_{tot})\hbar/(2\mathbf{m}_0\mathbf{c})$$

and the Bohr magneton: $\boldsymbol{\mu}_B = |\mathbf{e}|^\phi\,\hbar/(2\mathbf{m}_0\mathbf{c})$ can be defined by small additional increment between the actual and complementary charges: $(\Delta\mathbf{e}_\pm)_{rec} = (|e_+| - |e_-|)_{rec} \gtrsim 0$, induced by *recoil kinetic* energy of the unpaired *anchor site* $(\mathrm{BVF}^\updownarrow)_{anc}$ of the electron or positron at

$[\mathbf{C} \overset{\mathbf{CVC}^{\pm}}{\rightarrow} \mathbf{W}]$ transitions.

The total charge can be presented as:

$$\mathbf{e}_{tot} = (|\mathbf{\Delta e}_{\pm}|^{\phi} + |\mathbf{\Delta e}_{\pm}|_{rec}) \quad 40a$$

where the additional recoil increment of charge is: $|\mathbf{\Delta e}_{\pm}|_{rec} << |\mathbf{\Delta e}_{\pm}|^{\phi}$.

The translational (longitudinal and transversal) recoil momentum and energy of unpaired sub-elementary fermion (23b), accompanied its $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation is determined by the recoil velocity squared:

$$\mathbf{v}_{0,tr}^2 = (\mathbf{v}_0)_{\parallel,tr}^2 + (\mathbf{v}_0)_{\perp,tr}^2 = \mathbf{c}^2(\alpha\phi + \beta\phi) \quad 40b$$

Using (15a and 40b), the ratio of μ_e to the Bohr magneton μ_B may be presented as:

$$\frac{\mu_{tot}}{\mu_B} = \frac{\mathbf{e}_{tot}}{|\mathbf{e}|^{\phi}} = 1 + \frac{|\mathbf{\Delta e}_{\pm}|_{rec}}{|\mathbf{e}|^{\phi}} = \frac{1}{[\mathbf{1} - [\mathbf{v}_{0,tr}/\mathbf{c}]^2]^{1/4}} = \frac{1}{[1 - \alpha\phi - \beta\phi]^{1/4}} \quad 40c$$

where: $\alpha\phi = 4.51 \cdot 10^{-3} >>> \beta^e\phi = 1.07497 \cdot 10^{-45}$.

The actual magnetic moment of the electron, calculated using analytical expression (I-5) at Golden mean conditions ($\mu_{act} = 1.001140\,\mu_B$) coincides with experimental value ($\mu_{\exp} = 1.001159\,\mu_B$) very well. This is a good evidence in proof of our Unified model.

The magnetic moment of the electron can be evaluated also by conventional quantum electrodynamics (QED), using perturbation theory (Feynman, 1985). However, such approach is not such elegant as the analytical one.

13 The Principle of least action, as a consequence of influence of Bivacuum 'Harmonization energy and force' on matter

Let us analyze the formula of *action* in Maupertuis-Lagrange form:

$$\mathbf{S}_{ext} = \int_{t_0}^{t_1} \mathbf{2T}_k^{ext} \cdot \mathbf{t} \quad 41$$

The *principle of Least action*, choosing one of few possible trajectories of changing of system from one configuration to another at the permanent total energy of system of elementary particles: $\mathbf{E}_{tot} = \mathbf{m}_V^+\mathbf{c}^2 = const$ has a form:

$$\Delta\mathbf{S}_{ext} = 0 \quad 41a$$

This means, that the optimal trajectory of particle corresponds to minimum variations of the external energy of it wave B.

The time interval: $\mathbf{t} = \mathbf{t}_1 - \mathbf{t}_2 = \mathbf{n}\mathbf{t}_B$ is equal or bigger than period of the external (modulation) frequency of wave B ($\mathbf{t}_B = 1/\mathbf{\nu}_B$):

$$\mathbf{t} = \mathbf{t}_1 - \mathbf{t}_2 = \mathbf{n}\mathbf{t}_B = \mathbf{n}/\mathbf{\nu}_B \quad 41b$$

Using eqs.(6a and 6b and 12a), we get for the action:

$$\mathbf{S}_{ext} = 2\mathbf{T}_k^{ext} \cdot \mathbf{t} = \mathbf{m}_V^+\mathbf{v}^2 \cdot \mathbf{t} = (\mathbf{1} + \mathbf{R_{tr}})[\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2]\cdot\mathbf{t} = \quad 41c$$

$$or: \quad \mathbf{S}_{ext} = \mathbf{m}_V^+\mathbf{v}^2 \cdot \mathbf{t} = (\mathbf{1} + \mathbf{R_{tr}})\,\mathbf{HaE} \cdot \mathbf{t}$$

where the translational coefficient: $\mathbf{R_{tr}} = \sqrt{1 - (\mathbf{v}/\mathbf{c})^2}$ 41d

$(\mathbf{v})$ is the resulting external translational velocity.

We introduce here the important notions of Harmonization energy and Harmonization force of Bivacuum, as:

$$\mathbf{HaE} = \mathbf{E}_{tot} - \mathbf{E}_{rot}^{in} = \hbar\omega_{\mathbf{HaE}} = [\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2] = \frac{\mathbf{m}_V^+\mathbf{v}^2}{\mathbf{1}+\mathbf{R_{tr}}} = \mathbf{HaF}\cdot\lambda_{HaE} \qquad 41e$$

the frequency (ω_{HaE}) and wave length (λ_{HaE}) of Bivacuum Harmonization energy are:

$$\omega_{HaE} = (\mathbf{m}_V^+ - \mathbf{m}_0)\mathbf{c}^2/\hbar = [\omega_{\mathbf{C}\rightleftharpoons\mathbf{W}} - \omega_0] \qquad 41f$$

$$\lambda_{HaE} = \frac{2\pi\mathbf{c}}{\omega_{\mathbf{C}\rightleftharpoons\mathbf{W}} - \omega_0} \qquad 41g$$

The Harmonization force (HaF) of Bivacuum, driving the matter to Golden mean conditions, can be expressed as:

$$\mathbf{HaF} = \mathbf{HaE}/\lambda_{HaE} = \frac{[\omega_{\mathbf{C}\rightleftharpoons\mathbf{W}} - \omega_0]^2}{2\pi\mathbf{c}} = \frac{\left[\mathbf{E}_{\mathbf{C}\rightleftharpoons\mathbf{W}} - \mathbf{E}_0\right]^2}{\hbar\mathbf{c}} = \qquad 42$$

$$or: \quad \mathbf{HaF} = \frac{1}{\hbar\mathbf{c}}\left(\frac{\mathbf{m}_V^+\mathbf{v}^2}{\mathbf{1}+\mathbf{R_{tr}}}\right)^2 \qquad 42a$$

The influence of HaF of Bivacuum on matter is a result of induced resonance between virtual pressure waves ($VPW^{\pm}$) of Bivacuum with fundamental frequency ($\omega_0 = \mathbf{m}_0\mathbf{c}^2/\hbar)^{e,\mu,\tau}$ and $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation of elementary particles. Under the action of **HaE** and **HaF** on particles, the resulting frequency ($\omega_{\mathbf{C}\rightleftharpoons\mathbf{W}}$) of $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation tends to that of Bivacuum (ω_0):

$$\mathbf{HaE} = \mathbf{E}_{\mathbf{C}\rightleftharpoons\mathbf{W}} - \mathbf{E}_0 = \hbar(\omega_{\mathbf{C}\rightleftharpoons\mathbf{W}} - \omega_0) = (\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2) \to 0 \qquad 43$$

We can see from (41c) that just the Bivacuum Harmonization energy and force action is responsible for realization of fundamental principle of least action: $\Delta\mathbf{S} \to \mathbf{0}$ at $\mathbf{HaE} \to \mathbf{0}$.

The system [Bivacuum + Matter] has a properties of the active medium, able to self-organization under HaF influence.

14 The new approach to problem of time

It follows from the right part of (41- 41d) that the action of HaF and HaE on particles reduces their external translational kinetic energy, minimizing the *action (S)*:

$$\mathbf{S} = 2\mathbf{T}_k^{ext}\cdot\mathbf{t} = \mathbf{m}_V^+\mathbf{v}^2\cdot\mathbf{t} \to \mathbf{0} \qquad 44$$

$$\mathbf{S} = [(\mathbf{1}+\mathbf{R_{tr}})(\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2)]\cdot\mathbf{t} = [(\mathbf{1}+\mathbf{R_{tr}})\mathbf{HaE}]\cdot\mathbf{t} \to \mathbf{0} \qquad 44a$$

where the translational factor $\mathbf{R_{tr}} = \sqrt{1-(\mathbf{v}/\mathbf{c})^2}$ is tending to zero at $\mathbf{v} \to \mathbf{c}$.

Applying the Principle of least action: $\Delta\mathbf{S} = 0$ to (44 and 44a), we get the original formula interrelating the dimensionless pace of time with pace of the external translational kinetic energy change and that of Harmonization energy of Bivacuum:

$$\frac{\mathbf{dt}}{\mathbf{t}} = -\frac{\mathbf{d}(\mathbf{m}_V^+\mathbf{v}^2)_{tr}^{ext}}{(\mathbf{m}_V^+\mathbf{v}^2)_{tr}^{ext}} = -\frac{\mathbf{d}[\mathbf{T}_k^{ext}]}{\mathbf{T}_k^{ext}} \qquad 45$$

$$\mathbf{or}: \quad \frac{\mathbf{dt}}{\mathbf{t}} = -\frac{\mathbf{d}[(\mathbf{1}+\mathbf{R_{tr}})(\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2)]}{(\mathbf{1}+\mathbf{R_{tr}})[\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2]} = -\frac{\mathbf{d}[(\mathbf{1}+\mathbf{R_{tr}})\mathbf{HaE}]}{(\mathbf{1}+\mathbf{R_{tr}})\mathbf{HaE}} \qquad 45a$$

The variations of kinetic energy in the process of $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsation determines the electromagnetic and gravitational potentials (see 31b):

$$\Delta\mathbf{T}_k^{ext} = |\mathbf{T}_E + \mathbf{T}_G| = |(\alpha+\beta)\mathbf{m}_V^+\mathbf{v}^2| = \mathbf{E}_E + \mathbf{E}_G \qquad 46$$

$$\mathbf{or}: \quad \Delta\mathbf{T}_k^{ext} = \Delta[(\mathbf{1}+\mathbf{R_{tr}})\mathbf{HaE}] \qquad 46a$$

Consequently, from 45 and 45a we get for dimensionless pace of time for closed coherent system of particles (i.e. with energy exchange, but not with mass exchange with surrounding medium):

$$\left[\frac{\mathbf{dt}}{\mathbf{t}} = \mathbf{d}\ln\mathbf{t} = -\mathbf{d}\,\mathbf{ln}(\mathbf{T_{kin}}) = -\mathbf{d}\,\mathbf{ln}(\mathbf{E_E}+\mathbf{E_G}) = -\,\mathbf{d}\,\mathbf{ln}[(\alpha+\beta)\mathbf{m}_V^+\mathbf{v}^2]\right]_{x,y,z} \qquad 47$$

$$\mathbf{or}:\quad [\mathbf{dt/t} = \mathbf{d}\mathbf{lnt} = -\mathbf{d}\ln[(\mathbf{1}+\mathbf{R_{tr}})\,\mathbf{HaE}]_{x,y,z} \qquad 47a$$

Similar relation between pace of time and kinetic energy pace of change for free particle we can get easily from the principle of uncertainty in coherent form:

$$(\mathbf{T}_{kin}\mathbf{t})_{x,y,z} = \mathbf{h} \;\rightarrow\; \left[\frac{\mathbf{dt}}{\mathbf{t}} = -\mathbf{d}\,\mathbf{ln}(\mathbf{T_{kin}})\right]_{x,y,z} \qquad 48$$

The dimensionless pace of time ($\mathbf{dt/t}$*) for any closed system of particles is a measure of these particles average kinetic energy pace of change:* $-\mathbf{d}[\mathbf{T}_k^{ext}]/\mathbf{T}_k^{ext}$*, however with opposite sign.*

It is related to the pace of the external translational longitudinal and transverse contributions to kinetic energy change of system, responsible for electromagnetic and gravitational potentials, correspondingly. The 3D anisotropy of the external translational velocity and kinetic energy distribution of particles in closed system determines similar anisotropic spatial distribution of pace of time.

Using these relation (45), the internal time itself for closed system of particles can be presented via particles acceleration and velocity:

$$\left[\mathbf{t}_{in} = -\frac{\mathbf{m}_V^+\mathbf{v}^2}{\mathbf{d}(\mathbf{m}_V^+\mathbf{v}^2)/\mathbf{dt}} = -\frac{\mathbf{m}_0\mathbf{v}^2}{\sqrt{1-(\mathbf{v/c})^2}}\;\frac{1}{\mathbf{m}_0\frac{\mathbf{d}}{\mathbf{dt}}\left[\mathbf{v}^2/\sqrt{1-(\mathbf{v/c})^2}\right]}\right]_{x,y,z} \qquad 50$$

or:

$$\left[\mathbf{t}_{in} = -\frac{\mathbf{v}}{\mathbf{dv/dt}}\,\frac{1-(\mathbf{v/c})^2}{2-(\mathbf{v/c})^2} = \frac{\mathbf{v}}{\mathbf{dv/dt}}\,\frac{\mathbf{R_{tr}^2}}{1+\mathbf{R_{tr}^2}}\right]_{x,y,z} \qquad 51$$

where the translational factor: $\mathbf{R_{tr}} = \sqrt{1-(\mathbf{v/c})^2}$

The definition of time, based on formula (50) could be as follows: the internal time for each selected closed system of particles is a parameter, characterizing the average velocity and acceleration of these particles, i.e. this system dynamics. The acceleration of particles means negative time and deceleration - the positive time of this system.

Multiplying the left part of (51) on $(\mathbf{m}_0/\mathbf{m}_0)^2$ and using relation: $(\mathbf{m}_V^+)^2 = (\mathbf{m}_0)^2/1-(\mathbf{v/c})^2$, we get the new formula for internal time of closed system:

$$\left[\mathbf{t}_{in} = -\frac{\mathbf{v}}{\mathbf{dv/dt}}\,\frac{(\mathbf{m}_0/\mathbf{m}_V^+)^2}{2-(\mathbf{v/c})^2} = -\frac{\mathbf{v}}{\mathbf{dv/dt}}\,\frac{(\mathbf{m}_0\mathbf{c}^2/\mathbf{m}_V^+\mathbf{c}^2)^2}{1+\mathbf{R}_{tr}^2} = -\frac{\mathbf{v}}{\mathbf{F}_{in}}\,\frac{\mathbf{m}_0^2/\mathbf{m}_V^+}{1+\mathbf{R}_{tr}^2}\right]_{x,y,z} \qquad 51a$$

where the characteristic internal force of the closed system is: $\mathbf{F}_{in} = \mathbf{m}_V^+(\mathbf{dv/dt})$

The pace of time, following from formula (51), is:

$$\left[\left(\frac{\mathbf{dt}}{\mathbf{t}} = \mathbf{d}\ln\mathbf{t}\right)_{in} = -\frac{\mathbf{1}}{d\mathbf{v/v}}\,\frac{1-(\mathbf{v/c})^2}{2-(\mathbf{v/c})^2}\right]_{x,y,z} \qquad 51b$$

We can see from 51a, that the time is positive, if the particles motion is slowing down ($\mathbf{dv/dt} < \mathbf{0}$) and vice verse. The alternation of sign of acceleration $[+(\mathbf{dv/dt}) \rightleftharpoons -(\mathbf{dv/dt})]_{x,y,z}$ should be accompanied by alternation of time (48b) and sign of its pace (47). The pendulum and any kind of reversible vibrations are examples of such kind of dynamics.

In the absence of acceleration ($\mathbf{dv/dt} = \mathbf{0}$), the time turns to infinitive and its 'pace' to zero ($\mathbf{dt/t} = \mathbf{0}$). At $\mathbf{v} = \mathbf{c} = \mathbf{const}$, we get the uncertainty for time: $\mathbf{t} = \mathbf{0/0}$. The similar result, we get at the external translational velocity: $\mathbf{v} = \mathbf{0} = \mathbf{const}$ equal to zero. This condition corresponds to that of primordial Bivacuum in absence of matter and fields, when the Bivacuum fermions (BVF) are totally symmetric and their torus (V^+) and antitorus (V^-) compensate each other:

$$\Delta \mathbf{m}_{BVF} = (\mathbf{m}_V^+ - \mathbf{m}_V^-) = 0; \qquad \mathbf{m}_V^+ = \mathbf{m}_V^- = \mathbf{m}_0 \tag{52}$$

$$\Delta \mathbf{e}_{BVF} = (\mathbf{e}_V^+ - \mathbf{e}_V^-) = 0 \tag{52a}$$

Multiplying the left and right parts of (51a) on the internal characteristic velocity of system (**v**), we get the formula for characteristic internal spatial dimension of system:

$$\left[\mathbf{d}_{in} = \mathbf{t}_{in}\mathbf{v} = \lambda_B^2 \frac{m_0 \mathbf{v}^4/h^2}{\mathbf{dv/dt}\,[1+R^2]} \right]_{x,y,z} \tag{52b}$$

For systems of virtual particles, like Hologram like complex Virtual Replicas (VR), the notion of real time and, consequently, space loose a sense. The internal virtual time and space of VR should have a discreet values, corresponding to its metastable states (virtual holograms), determined by conditions of virtual standing waves, forming VR.

15 Quantum entanglement between coherent elementary particles

For explanation of the instant nonlocal quantum entanglement between two or more particles we will use the notion of massless *Virtual spin waves (VirSW)*, excited by the angular momentum ($Spin = \pm\hbar = \pm L_0 m_0 c$) of cumulative virtual clouds ($CVC^{\pm}$) with localized energy $(\hbar\omega_0^{in} = m_0 c^2)^{e,\tau}$ of each of sub-elementary particles in triplets $\langle [F_\uparrow^- \bowtie F_\downarrow^+] + F_\updownarrow^\pm \rangle^{e,\tau}$ in their [W] phase. The VirSW represents the oscillation of dynamic equilibrium between Bivacuum fermions of opposite spins: $[BVF^\uparrow \rightleftharpoons BVF^\downarrow]$, without changing their energy. We put forward a conjecture, that VirSW, exited by $CVC^{\pm}$ of two or more sub-elementary unpaired fermions $F_\updownarrow^\pm\rangle$ of [S]ender and [R]eceiver, are able to form the *nonlocal virtual wave-guides (VirWG)* with internal magnetic field and refraction index much higher than the external ones ($\mathbf{H}_{in} >> \mathbf{H}_{ext}$; $n_{in} > n_{ext}$). The experimental data are existing, indeed, pointing to change of vacuum refraction index in strong magnetic fields (Ginsburg, 1987).

The standing Virtual spin waves (VirSW), excited by the counterphase $[C \rightleftharpoons W]$ pulsation of unpaired sub-elementary particle $F_\updownarrow^\pm\rangle$ of Sender [S] and Receiver [R] form virtual wave-guide $VirWG_{F_\updownarrow^\pm\rangle}$ between [S] and [R]:

$$[\mathbf{VirSW}_{F_\updownarrow^\pm\rangle}^S \rightleftharpoons \mathbf{VirSW}_{F_\updownarrow^\pm\rangle}^R] \equiv (\mathbf{VirWG})_{F_\updownarrow^\pm\rangle}^{S,R} \tag{53}$$

The Virtual spin waves, excited by $[C \rightleftharpoons W]$ pulsation of pair $[F_\uparrow^- \bowtie F_\downarrow^+]$ of triplets $\langle [F_\uparrow^- \bowtie F_\downarrow^+] + F_\updownarrow^\pm \rangle$ can form a pair of $[\mathbf{VirWG}^{\circlearrowright} \bowtie \mathbf{VirWG}^{\circlearrowleft}]_{F_\uparrow^- \bowtie F_\downarrow^+}$, which participate in Virtual Replica of matter formation. However, the angular momentum and energy of virtual photons, channelled by this pair, almost totally compensate each other.

The $VirWG^{S,R}$, formed by two uncompensated $F_\updownarrow^\pm\rangle$ of [S] and [R] is most effective as a phase/information conductor between remote elementary particles of the same frequency and counterphase $[C \rightleftharpoons W]$ pulsation.

The phase of $[C \rightleftharpoons W]$ oscillations of sub-elementary fermions and their spins are directly interrelated and change of spin means change a phase and vice verse.

It looks possible, that the real and virtual photons, as a part of CVC energy, can propagate via $VirWG^{S,R}$. The Faraday cage can't shield such kind of EM field, tunnelling throw Bivacuum virtual wave-guide, as well as the transmission of virtual angular momentum.

The anisotropic amplitude probability $(A_{C \rightleftharpoons W})_{x,y,z}$ of resonant exchange interaction between **two** particles: 'sender (S)' and 'receiver (R)' may be qualitatively described, using well known model of *damped harmonic oscillator* interacting with external alternating field:

$$[\mathbf{A}_{C \rightleftharpoons W}]_{x,y,z} \sim \left[\frac{1}{(\mathbf{m}_C^+)_R} \frac{[\mathbf{HaF}]_{x,y,z}}{\boldsymbol{\omega}_R^2 - \boldsymbol{\omega}_S^2 + \mathrm{Im}\,\boldsymbol{\gamma\omega}_S} \right]_{x,y,z} \tag{54}$$

where, using (24 - 24b), we get for frequencies of $C \rightleftharpoons W$ pulsation of sub-elementary particles of Sender ($\boldsymbol{\omega}_S$) and Receiver ($\boldsymbol{\omega}_R$), including the internal carrying frequency ($\boldsymbol{\omega}_0^{in} = \mathbf{m}_0\mathbf{c}^2/\hbar$), coinciding with fundamental frequency of Bivacuum (2b) and modulation frequency, determined by the external energy of particle $\boldsymbol{\omega}_B^{ext} = (\mathbf{m}_V^{+}\mathbf{v}^2)_{tr}^{ext}/\hbar$:

$$\boldsymbol{\omega}_R = \boldsymbol{\omega}_{\mathbf{C}\rightleftharpoons\mathbf{W}} = \mathbf{R_{tr}}\,\boldsymbol{\omega}_0^{in} + (\boldsymbol{\omega}_B^{ext})_R \quad 55$$

$$\boldsymbol{\omega}_S = \boldsymbol{\omega}_{\mathbf{C}\rightleftharpoons\mathbf{W}} = \mathbf{R_{tr}}\,\boldsymbol{\omega}_0^{in} + (\boldsymbol{\omega}_B^{ext})_S \quad 55a$$

γ is a damping coefficient due to *decoherence effects*, generated by local fluctuations of Bivacuum deteriorating the phase/spin transmission via VirWG; $(m_C^{+})_R$ is the actual mass of particle (R); $[HaF]_{x,y,z}$ is a spatially anisotropic *Harmonization force of Bivacuum* (42 and 42a) because of anisotropy of external velocity $(\mathbf{v})_{x,y,z}$:

$$\mathbf{HaF}_{x,y,z} = \frac{1}{\hbar\mathbf{c}}\left(\frac{\mathbf{m}_V^{+}\mathbf{v}^2}{\mathbf{1}+\mathbf{R_v}}\right)^2_{x,y,z} \quad 56$$

The influence of Harmonization force of Bivacuum with fundamental Golden mean frequency $\omega_0 = m_0c^2/\hbar$ stimulates the synchronization of (S) and (R) pulsations, i.e. $\omega_R \rightarrow \omega_S \rightarrow \omega_0$. This frequency is the same in any points of space, including those of (S) and (R). However the phase of corresponding virtual pressure waves ($\mathrm{VPW}^{\pm}$), influencing the phase of $C \rightleftharpoons W$ pulsation, can be different.

The *nonlocal* interaction via VirWG channel between two coherent elementary particles includes the change a phase of $C \rightleftharpoons W$ pulsation of sub-elementary particles of Receiver immediately after changing the phase (spin) of Sender. The existence of VirWG (53) between particles and external modulation of their phase/spin could be the main element of natural quantum computers, providing the instant/nonlocal spin-phase-information transmission.

Equalizing of the total energy and resulting frequency of $C \rightleftharpoons W$ pulsation of sub-elementary particles of (S) and (R) is a result of action the Harmonization energy (41e, 43) and force (42) of Bivacuum on matter. The effectiveness of nonlocal interaction between two or more distant elementary particles (entanglement) is dependent on synchronization of their $[C \rightleftharpoons W]$ pulsations frequency and 'tuning' the phase of these pulsations via action of virtual wave-guide $(\mathbf{VirWG})^{S,R}$ between Sender and Receiver.

The mechanism, proposed, may explain theoretical (Einstein, et all. 1935; Cramer, 1986) and experimental evidence in proof of nonlocal interaction between coherent elementary particles (Aspect and Gragier, 1983), atoms and even between remote coherent clusters of molecules in form of mesoscopic Bose condensation (mBC) (Kaivarainen, 2001a; 2003b).

Our Unified theory predicts, that the same mechanism may provide the distant quantum entanglement between macroscopic systems, including biological ones, if $[C \rightleftharpoons W]$ pulsations of their particles are 'tuned' to each other by the above mentioned mechanisms and they have close spatial polarization (orientation) and symmetry of their Virtual replicas (Kaivarainen, 2003 *a,b).*

16 The Virtual Replica (VR) of matter in Bivacuum

It is important to outline two important consequences, following from our model of elementary particles and their exchange interaction with Bivacuum in the process of $[\mathbf{C} \rightleftharpoons \mathbf{W}]$ pulsations.

1. *Symmetric energy distribution between sub-elementary fermions, forming elementary particles.*

To keep a structure of triplets of sub-elementary particles $\langle[\mathbf{F}_\uparrow^{-} \bowtie \mathbf{F}_\downarrow^{+}] + \mathbf{F}_\updownarrow^{\pm}\rangle$ stable and energetically symmetric, the changes of the total energy of unpaired sub-elementary fermion: $\boldsymbol{\Delta}\mathbf{E}_{\mathbf{F}_\updownarrow^{\pm}}$ resulting, for example from zero-point oscillations and thermal vibrations of atoms and molecules (see 24), should be accompanied by similar changes in the absolute energies of sub-elementary particle and antiparticle in pair $[\mathbf{F}_\uparrow^{-} \bowtie \mathbf{F}_\downarrow^{+}]$:

$$\Delta\mathbf{E}^{\mathbf{F}_{\updownarrow}^{+}}_{\mathbf{F}_{\uparrow}^{-}\bowtie\mathbf{F}_{\downarrow}^{+}} = \left|-\Delta\mathbf{E}^{\mathbf{F}_{\uparrow}^{-}}_{\mathbf{F}_{\uparrow}^{-}\bowtie\mathbf{F}_{\downarrow}^{+}}\right| = \left|\pm\Delta\mathbf{E}^{\mathbf{F}_{\updownarrow}^{\pm}}_{\langle[\mathbf{F}_{\uparrow}^{-}\bowtie\mathbf{F}_{\downarrow}^{+}]+\mathbf{F}_{\updownarrow}^{\pm}\rangle}\right| \qquad 57$$

The total energy of each sub-elementary fermion (eq. 35), taking into account oscillations of its internal and external contributions, opposite by sign in [C] and [W] phase, but equal by absolute values in equilibrium conditions is the average sum of energies of [C] and [W] phase:

$$\mathbf{E}_{tot} = \mathbf{mc}^2 = \frac{1}{2}[(\mathbf{E}_C \pm \Delta\mathbf{E}_C) + (\mathbf{E}_W \mp \Delta\mathbf{E}_W)] \qquad 58$$

1. *The total energy of [C] phase*, using formulas of section (11.1), is

$$\mathbf{E}_C^{tot} = \mathbf{R}_{\mathbf{tr}}^{ext}[(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot} \pm \alpha(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot} + \beta(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot}]^{in} + \\ + [\mathbf{m}_V^+\mathbf{v}^2 \pm (\alpha\mathbf{m}_V^+\mathbf{v}^2 + \beta\mathbf{m}_V^+\mathbf{v}^2)]_{tr}^{ext} \qquad 58a$$

where the sum of internal and external contributions, responsible for excitation of *longitudinal* virtual pressure waves $(\mathrm{VPW}^{\pm})_{\parallel}$ in Bivacuum, as part of Virtual replica (VR) is:

$$\mathbf{E}_C^E = \pm\mathbf{R}_{\mathbf{tr}}^{ext}\,\alpha(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot}^{in} \pm \alpha(\mathbf{m}_V^+\mathbf{v}^2)_{tr}^{ext} \qquad (VPW^{\pm})_{\parallel} \qquad 58b$$

the sum of internal and external contributions, responsible for excitation of *transversal* virtual pressure waves $(\mathrm{VPW}^{\pm})_{\perp}$ in Bivacuum, as part of Virtual replica (VR) is:

$$\mathbf{E}_C^G = \pm\mathbf{R}_{\mathbf{tr}}^{ext}\,\beta(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot}^{in} \pm \beta(\mathbf{m}_V^+\mathbf{v}^2)_{tr}^{ext} \qquad (VPW^{\pm})_{\perp} \qquad 58c$$

2. *The total energy of [W] phase* of the same particle is:

$$\mathbf{E}_W = \mathbf{R}_{\mathbf{tr}}^{ext}\left\{\left(\frac{\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right) \mp \left[\left(\alpha\frac{\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right) + \left(\beta\frac{\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)\right]\right\}_{rot}^{in} + \\ + \left\{\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2} \mp \left[\alpha\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2} + \beta\frac{\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2}\right]\right\}_{tr}^{ext} \qquad 59$$

where the sum of internal and external contributions, responsible for excitation of *longitudinal* elastic recoil waves $(\mathrm{RW}^{\pm})_{\parallel}$ in Bivacuum superfluid matrix, standing for electromagnetism, as a part of Virtual replica (VR) is:

$$\mathbf{E}_W^E = \mp\mathbf{R}_{\mathbf{tr}}^{ext}\left[\left(\frac{\alpha\,\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)_{rot}\right]^{in} \mp \left(\frac{\alpha\,\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2}\right)_{tr}^{ext} \qquad (\mathrm{Re}\,cW^{\pm})_{\parallel} \qquad 59a$$

the sum of internal and external contributions, responsible for excitation of *transversal* elastic recoil waves $(\mathrm{RW}^{\pm})_{\perp}$ in Bivacuum superfluid matrix, responsible for gravitation, as a part of Virtual replica (VR) is:

$$\mathbf{E}_W^G = \mp\mathbf{R}_{\mathbf{tr}}^{ext}\left[\left(\frac{\beta\,\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)_{rot}\right]^{in} \mp \left(\frac{\beta\,\mathbf{h}^2}{\mathbf{m}_V^+\boldsymbol{\lambda}_B^2}\right)_{tr}^{ext} \qquad (\mathrm{Re}\,cW^{\pm})_{\perp} \qquad 59b$$

In conditions of equilibrium the energy of corpuscular [C] phase is equal to energy of wave [W] phase:

$$\pm\Delta\mathbf{E}_C = \mathbf{E}_C^E + \mathbf{E}_C^G = \mathbf{E}_W^E + \mathbf{E}_W^G = \pm\Delta\mathbf{E}_W \qquad 59c$$

The internal contributions in (58a - 59b) are responsible for rotational energy and the angular momentum transmission and the external ones - for translational energy and momentum.

The contributions to VR of unpaired $\mathbf{F}_{\updownarrow}^{\pm}\rangle$ are most effective ones in the Bivacuum mediated interactions between remote systems. It true, especially if one or both of these systems are in nonequilibrium states, characterized by nonuniform accelerations. The latter makes possible the inelastic effects, accompanied by irreversible energy dissipation, the disjoining of radiation from its source, making possible a distant transmission of energy and angular momentum between systems of [S]ender/[S]ource and [R]eceiver.

2. *Formation of Virtual Replica (VR) or Virtual Hologram of material object (phantom) in Bivacuum.*

The energy increments of sub-elementary particle and sub-elementary antiparticles in pairs $[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]$ are equal and opposite by sign to each other. Consequently, their sum is zero:

$$\Delta E_{\mathbf{F}_{\uparrow}^{-}\bowtie\mathbf{F}_{\downarrow}^{+}}^{\mathbf{F}_{\uparrow}^{+}} + \left(-\Delta E_{\mathbf{F}_{\uparrow}^{-}\bowtie\mathbf{F}_{\downarrow}^{+}}^{\mathbf{F}_{\uparrow}^{-}}\right) = 0 \qquad 60$$

and they have no contribution to resulting energy of triplets, determined by the unpaired sub-elementary fermion $F_{\updownarrow}^{\pm}\rangle$. However, the pairs pulsation may influence and modulate the probability of transitions between the excited (j,k) and ground states of Bivacuum fermion and antifermions of opposite energy $(\mathrm{BVF}^{\uparrow}$ and $\mathrm{BVF}^{\downarrow})_{j,k}$. These transitions, in turn, are accompanied by virtual clouds and anticlouds (VC^{+} and VC^{-}) emission, following by excitation of Virtual pressure waves (VPW^{+} and VPW^{-}) of corresponding energy (see eqs. 3a and 3b). Just these waves, amplitude modulated by coherent particles of matter represents the main component of the object Virtual Replica (VR).

The $[C \rightleftharpoons W]$ pulsation of pair $[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]$, accompanied by reversible [emission ⇌ absorption] of cumulative virtual clouds CVC^{+} and CVC^{-} , virtual pressure waves $(VPW^{+}$ and $VPW^{-})_{\parallel,\perp}$ excitation and, corresponding longitudinal and transversal recoil energy $(\mathbf{E}_{rec} = \mathbf{E}_{E} + \mathbf{E}_{G})$, responsible for electric and gravitational potentials, can be presented as:

$$[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]_{C} \underset{[\mathbf{E}_{CVC^{+}}+\mathbf{E}_{CVC^{-}}]+\mathbf{T}_{VPW}}{\overset{[\mathbf{E}_{CVC^{+}}+\mathbf{E}_{CVC^{-}}]-\mathbf{V}_{rec}}{\Longleftarrow\!=\!=\!=\!=\!=\!=\!\Longrightarrow}} [\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}]_{W} \qquad 61$$

The absolute values of energy of [C] and [W] phase of each of sub-elementary fermion and antifermion in pairs $[\mathbf{F}_{\uparrow}^{-}\bowtie \mathbf{F}_{\downarrow}^{+}]$, compensating each other, are described, like the unpaired one by eqs. 58 and 59.

The external translational kinetic energy of particle is directly related to its de Broglie wave length $(\boldsymbol{\lambda}_{B} = \mathbf{h}/\mathbf{m}_{V}^{+}\mathbf{v})$:

$$\frac{1}{2}(\mathbf{m}_{V}^{+}\mathbf{v}^{2})_{ext} = \frac{\mathbf{h}^{2}}{2\mathbf{m}_{V}^{+}\boldsymbol{\lambda}_{B}^{2}} \qquad 62$$

The fractions of cumulative virtual clouds: $CVC^{\pm}$, standing for longitudinal and transversal virtual pressure waves $\mathbf{VPW}_{\parallel,\perp}^{\pm}$ with carrying (reference) frequency $\boldsymbol{\omega}_0 = \mathbf{m}_0\mathbf{c}^2/\hbar$, can be modulated by vibrations of atoms and molecules with frequency $(\omega)_{ext}$. The interference between a reference waves $\mathbf{VPW}_{\parallel,\perp}^{\pm}$ with Compton length $(\boldsymbol{\lambda}_0 = \mathbf{h}/\mathbf{m}_0\mathbf{c})$ and de Broglie wave of particle $(\boldsymbol{\lambda}_{B} = \mathbf{h}/\mathbf{m}_{V}^{+}\mathbf{v})$ produce the holographic-like image, as a *local* Virtual Replica (VR) of each vibrating particle.

The interference patterns of de Broglie waves (waves B) of atoms and molecules of condensed matter, their protons, neutrons and electrons with reference virtual pressure waves $(\mathbf{VPW}_{\mathbf{C}\rightleftharpoons\mathbf{W}}^{\pm})$, excited by $[C\rightleftharpoons W]$ pulsations of elementary particles, are dependent on combinations of frequencies of molecular librations (Ω_{lb}) and translations (Ω_{tr}) in the volumes of [S] and [R]:

$$[\boldsymbol{\omega}_{VPW^{\pm}}(\mathbf{S})] = [\mathbf{q}\boldsymbol{\omega}_{C\rightleftharpoons W} + \mathbf{r}\boldsymbol{\Omega}_{lb} + \mathbf{g}\boldsymbol{\Omega}_{tr}]_{S} \qquad 62a$$

$$[\boldsymbol{\omega}_{VPW^{\pm}}(\mathbf{R})] = [\mathbf{q}\boldsymbol{\omega}_{C\rightleftharpoons W} + \mathbf{r}\boldsymbol{\Omega}_{lb} + \mathbf{g}\boldsymbol{\Omega}_{tr}]_{R} \qquad 62b$$

$$p,q,g = 1,2,3\ldots(\text{integer numbers})$$

It is important, that the carrying (reference) frequency of $\mathbf{VPW}_{\mathbf{C}\rightleftharpoons\mathbf{W}}^{\pm}$, excited by $[\mathbf{C} \rightleftharpoons \mathbf{W}]$

pulsation of particles, is equal to fundamental frequency of Bivacuum $\mathbf{VPW}_0^{\pm}$ - a common reference frequencies of the Universe (eq.2b). This makes possible replication of the local VR of particles of the object in other, than volume of particles volumes of space in form of *virtual standing waves.* The superpositions of individual local *micro VR* of the electrons, protons, neutrons and atoms/molecules, formed by these elementary particles, stands for the total internal *macro VR* of the object ($\mathbf{VR}_{tot}^{in}$) in the volume of this object.

The overall shape of the total internal virtual replica (VR_{tot}^{in}) of the object, as a result of interference of virtual replicas of its elements, should be close to shape of the object, including the human's body. The latter corresponds to notion of the "*ether body*" in Eastern philosophy:

$$\textbf{Ether Body} \equiv \mathbf{VR}_{tot}^{in} = \sum \mathbf{VR}^{in} \qquad 63$$

The ability of this macro VR, as a virtual hologram, for replication in space is possible due to interference of primary $\mathbf{VR}_{tot}^{in}$, with Bivacuum virtual pressure wave ($\mathbf{VPW}_0^{\pm}$) of the same reference frequency. This ability can be realized in formation of the total *external virtual replica f macroscopic object* ($\mathbf{VR}_{tot}^{ext}$).

The *external* VR_{tot}^{ext} contains two modulated by de Broglie waves of particles of matter inseparable components - distant and nonlocal:

1) the *distant component* in form of interference pattern of Bivacuum Virtual Pressure Waves (VPW^+ and VPW^-) with de Broglie waves of elementary particles, atoms and molecules. These waves are excited by [C] phase of particle and positive or negative difference between their density energy provide the repulsion or attraction effects between [S] and [R];

2) the *nonlocal* ($\mathbf{VR}_{nl}^{ext}$), is realized via massless virtual spin waves ($\mathbf{VirSW}^{\uparrow}$ or $\mathbf{VirSW}^{\downarrow}$), excited by cumulative virtual clouds $\mathbf{CVC}^{\circlearrowright}$ or $\mathbf{CVC}^{\circlearrowleft}$, rotating with frequency: $\boldsymbol{\omega}_0 = \mathbf{m}_0\mathbf{c}^2/\hbar$ clockwise or anticlockwise. These waves are carriers of the angular momentum: $\mathbf{S} = \pm\frac{1}{2}\hbar = \pm\frac{1}{2}\mathbf{L}_0\mathbf{m}_0\mathbf{c}$ and are responsible also for informational or spin field origination (see eq.29b). Superposition of big number of **VirSW** with the same spin, activated by the in-phase [$\mathbf{C} \rightleftharpoons W$] pulsations of the coherent fermions may act as a macroscopic carrier of the angular moment. The pairs of standing VirSW can form a net of virtual wave-guides (VirWG) between elementary particles of [S]ender and [R]eceiver with counterphase [$\mathbf{C} \rightleftharpoons \mathbf{W}$] pulsation.

The amplitude of virtual waves, forming VR of macroscopic object, is determined by number of coherent atoms and molecules in clusters (mesoscopic Bose condensate - mBC) (Kaivarainen, 2001).

The longitudinal and transversal vibrations of torus ($\mathbf{V}^+$) and antitorus ($\mathbf{V}^-$) of Bivacuum dipoles ($\mathbf{BVF}^{\updownarrow} = \mathbf{V}^+ \Updownarrow \mathbf{V}^-$), excited by the recoil energy of unpaired sub-elementary particles (see 28 and 28a), may contribute to VR in form of virtual electric and gravitational standing waves (see Table. 1). The influence of external electromagnetic and gravitational fields on small uncompensated charges and mass of slightly asymmetric $\mathbf{BVF}^{\updownarrow} = [\mathbf{V}^+ \Updownarrow \mathbf{V}^-]$ may perturb the VR properties of material objects.

The total external/nonlocal virtual replica of macroscopic object, including human body, which can be spatially separated from he original body, may correspond to Eastern ancient notion of the "*astral body*":

$$\textbf{Astral Body} \equiv \mathbf{VR}_{tot}^{ext} = \sum \mathbf{VR}_{dis}^{ext} + \sum \mathbf{VR}_{nl}^{ext} \qquad 64$$

The nonlocal and distant $\mathbf{VR}_{nl}^{ext}$ *and* $\mathbf{VR}_{dis}^{ext}$ are responsible for the *phase/angular momentum and amplitude/energy* transmission between [S] and [R], correspondingly, in the process of Bivacuum mediated interactions.

17 Bivacuum mediated remote interaction between macroscopic objects

In accordance to our approach, the remote interaction between macroscopic Sender [S] and Receiver [R] can be realized, as a result of superposition of nonlocal and distant components of their Virtual Replicas (VR) or virtual holograms, described in previous section.

The energy and angular momentum remote exchange between [S] and [R] is possible, if [S] is open or closed system, exchanging with surrounding medium by energy and mass or by energy only. However, the additional asymmetry of Bivacuum fermions, necessary for distant interaction can be induced also by the objects of asymmetric shape, like pyramids and cones, creating strongly anisotropic Virtual replicas, perturbing symmetry of Bivacuum fermions.

Nonequilibrium processes in systems - [S], accompanied by nonuniform acceleration of particles, like evaporation, heating, cooling, melting, boiling etc. may induce the nonelastic process in the volume of [R]eceiver, accompanied [C$\rightleftharpoons$ *W*] pulsation of its particles.

The following unconventional effects can be anticipated in study the interaction between macroscopic nonequilibrium [S]ender and sensitive detector of Bivacuum perturbation [R]eceiver, if our theory is right:

I. Weak repulsion and attraction between [S] and [R] of nonelectromagnetic and non-gravitational nature in conditions, providing the excessive virtual pressure of Virtual pressure waves ($VPW^{\pm}$);

II. Nonlocal transmission of the macroscopic angular momentum and energy between remote [S] and [R];

III. Increasing the probability of thermal fluctuations in the volume of [R] due to decreasing of Van der Waals interactions because of charges screening effects, induced by virtual replica of [S];

IV. Small changing of mass of [R] in conditions, increasing the probability of the inelastic recoil effects;

V. Registration of metastable virtual particles (photons, electrons, positrons), as a result of Bivacuum symmetry perturbations.

The first class (I) *of phenomena* can be explained by the excessive virtual pressure ($\pm\Delta\mathbf{VirP}^{\pm}$) or its underinflation in [C] phase of particles, as respect to recoil energy of their [W] phase. The sum of internal and external contributions, responsible for excitation of *rotational-translational longitudinal* virtual pressure waves $(VPW^{\pm})_{\parallel}$ in Bivacuum (58b), as part of Virtual replica (VR) is:

$$\mathbf{E}_C^E = \pm\mathbf{R}_{\mathbf{tr}}^{ext}\alpha(\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)_{rot}^{in} \pm \alpha(\mathbf{m}_V^+\mathbf{v}^2)^{ext} \qquad (VPW^{\pm})_{\parallel} \qquad 65$$

where, the external translational factor: $\mathbf{R}_{\mathbf{tr}}^{ext} = \sqrt{1-(\mathbf{v}/\mathbf{c})^2}$. It decreases the rest mass internal energy contribution with increasing the external translational velocity **(v)** and kinetic energy.

The opposite by sign energy of recoil waves ($RecW^{\pm}$) in Bivacuum matrix, excited by [W] phase of the same particle (59a), is:

$$\mathbf{E}_W^E = \mp\mathbf{R}_{\mathbf{tr}}^{ext}\left(\frac{\alpha\,\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)_{rot}^{in} \mp \alpha(\mathbf{m}_V^+ - \mathbf{m}_V^-)^{ext}\mathbf{c}^2 \qquad (\mathrm{Re}cW^{\pm})_{\parallel} \qquad 65a$$

In nonequilibrium conditions in a system of *neutral* particles the virtual pressure energy of [C] phase may not be compensated by the recoil energy of [W] phase, providing the repulsion or attraction between [S] and [R]:

$$(\Delta\mathbf{VirP}_{\mathbf{C}}^{\pm})\sim|\Delta\mathbf{E}_{\mathbf{C}}^E|) \lesseqgtr (|-\Delta\mathbf{E}_{\mathbf{W}}^E|\sim(\mathbf{RecW}_{\mathbf{W}}^{\pm}) \qquad 66$$

where the excessive virtual pressure of Sender can be expressed as (36c):

$$\Delta\mathbf{VirP}_{\mathbf{C}}^{\pm} = \begin{pmatrix} [\mathbf{VirP}^{+}-\mathbf{VirP}^{-}]_{x,y,z}\sim\frac{\vec{r}}{r}[\mathbf{n}_{+}\boldsymbol{\varepsilon}_{VC^{+}}-\mathbf{n}_{-}\boldsymbol{\varepsilon}_{VC^{-}}]_{x,y,z}\sim \\ \pm\frac{\vec{r}}{r}\mathbf{n}_{BVF}[\mathbf{R}_{tr}\alpha(\mathbf{m}_{\mathbf{V}}^{+}\mathbf{v}^2)^{\phi}+\boldsymbol{\alpha}(\mathbf{m}_V^{+}\mathbf{v}^2)^{ext}]_{x,y,z}\end{pmatrix}_{\mathbf{Sender}}^{[\mathbf{C}]} \qquad 66a$$

where: $\mathbf{n}_{+}$ and $\mathbf{n}_{-}$ are densities of Bivacuum fermions with opposite circular polarization;

$\mathbf{\varepsilon}_{VC^+}$ and $\mathbf{\varepsilon}_{VC^+}$ are energies of virtual clouds or VPW$^\pm$ of opposite polarization and energy.

The recoil energy, following $[C \rightarrow W]$ transition in the volume of Sender, is (36f):

$$(\mathbf{RecW}^{\pm}_{\mathbf{W}}) \sim \frac{\vec{r}}{r}\mathbf{n_{BVF}}\,|\Delta\mathbf{E}^{E}_{\mathbf{W}}| = \frac{\vec{r}}{r}\mathbf{n_{BVF}}\,[\mathbf{R_{tr}}\,\alpha(\mathbf{m}^{+}_{V} - \mathbf{m}^{-}_{V})^{\phi}_{in}\mathbf{c}^2 + \alpha(\mathbf{m}^{+}_{V} - \mathbf{m}^{-}_{V})^{ext}_{BVF_{anc}}\mathbf{c}^2]^{1,2}_{\mathbf{Sender}} \qquad 66b$$

In such a case the excessive nonelectromagnetic *repulsion at condition:*

$$\mathbf{\Delta VirP}^{\pm}_{\mathbf{C}} > (\mathbf{RecW}^{\pm})^{1,2}_{\mathbf{W}}$$

or attraction at the opposite condition:

$$\mathbf{\Delta VirP}^{\pm}_{\mathbf{C}} < (\mathbf{RecW}^{\pm})^{1,2}_{\mathbf{W}}$$

may occur between neutral particles, forming macroscopic [S] and [R].

The second class (II) of phenomena is mediated by systems of nonlocal/instant virtual spin waves (VirSW) and formed by them virtual wave guides ($\mathbf{VirWG} \equiv \mathbf{VirSW}^{\circlearrowleft}_{S} \rightleftharpoons \mathbf{VirSW}^{\circlearrowleft}_{R}$) between [S] and [R]. These systems can be responsible for:

1) the virtual signals (phase/spin) instant transmission between [S] and [R], meaning the informational exchange, like in quantum computers;

2) the modulation of repulsion or attraction between Bivacuum fermions (BVF$^\updownarrow$) with parallel and antiparallel spin orientation, provided by Pauli principle and spin-spin exchange interaction, correspondingly. This kind of interaction in huge cosmic volumes of domains of virtual Bose condensate (see section 2) can be also nonlocal/instant;

3) the excessive VirSW of [S], as a carrier of the angular momentum, in combination with excessive rotational energy of Virtual pressure waves (VPW$^\pm$), can induce the rotational motion of [R]. The macroscopic rotational effect of VirSW^S is dependent on the difference between densities of elementary particles of [S] with opposite spin orientations and between density energies of virtual pressure waves of the opposite circular polarization (see eq.66a).

The excessive angular momentum may be expressed like (29c):

$$\Delta\mathbf{S} = \mathbf{V}_S\,(\mathbf{n}^{+}_{BVF\uparrow} - \mathbf{n}^{-}_{BVF\downarrow})\hbar/\mathbf{2} = \mathbf{V}_S\,(\mathbf{n}_{BVF\uparrow} - \mathbf{n}_{BVF\downarrow})\frac{1}{2}\mathbf{L}_0\mathbf{m}_0\mathbf{c} \qquad 66c$$

where: $(\mathbf{n}_{BVF\uparrow} - \mathbf{n}_{BVF\downarrow})$ is a difference of densities of Bivacuum fermions with opposite spins in the volume $\mathbf{V}_S$.

The third class (III) of phenomena is a consequence of the additional symmetry shift in Bivacuum fermions (BVF$^\updownarrow$), induced by superposition of two or more Virtual Replicas [VR$^S \bowtie$ VR^R], which is accompanied by increasing of Bivacuum fermions (BVF$^\updownarrow$) uncompensated charge. This effect of Bivacuum permittivity ε_0 and permeability μ_0 change, interrelated as: $\varepsilon_0 = 1/(\mu_0 c^2)$ can be responsible for the charges screening effects in volume of [R] induced by [S], weakening the Coulomb interactions. It may be registered by spectral Lamb shifts of atoms and decreasing of Van der Waals interactions between molecules of [S] and [R]. The latter can be detected by increasing the probability of defects/structure deformations and cavitational fluctuations in solid and liquid states of Receiver.

The (IV*) class of phenomena*: the change a mass of [R] of inelastic body may be a result of decreasing the total actual mass/energy of the rigid inelastic object (31) due to increasing the contribution of the recoil effects:

$$\mathbf{E}^{tot}_{\mathbf{C}\rightleftharpoons\mathbf{W}} = \mathbf{m}^{+}_{V}\mathbf{c}^2 = \hbar\omega^{tot}_{\mathbf{C}\rightleftharpoons\mathbf{W}} = \frac{1}{2}[\mathbf{E}_C \pm (\Delta\mathbf{E}_C)_{\mathbf{VPW}}] + \frac{1}{2}[\mathbf{E}_W \mp (\Delta\mathbf{E}_W)_{\mathbf{rec}}] \qquad 66d$$

The variations of energy of corpuscular [C] phase ($\pm\Delta\mathbf{E}_C$) are related to variations of particles internal and external group velocity and activation/modulation of virtual pressure waves $(\mathrm{VPW}^{\pm})_{\parallel,\perp}$ in Bivacuum. These [C] - phase energy variations in equilibrium conditions are compensated by the opposite variations of the recoil energy ($\mp\Delta\mathbf{E}_W$) of the wave [W] phase, accompanied $CVC^{\pm}$ emission at [C→ *W*] transition of particles (59b):

The sum of internal and external contributions, responsible for excitation of *longitudinal* elastic recoil waves $(RW^{\pm})_{\parallel}$ in Bivacuum superfluid matrix, as a part of Virtual replica (VR) is described by (66b): $(\mathbf{RecW}^{\pm})_{\mathbf{W}} \sim \frac{\vec{r}}{r}\mathbf{n}_{\mathbf{BVF}}\,|\Delta\mathbf{E}_{\mathbf{W}}^{E}|$.

The probability of the recoil effects can be enhanced by heating the rigid object or by striking it by another hard object. The inelastic lost of energy of test system of particles in their [W] phase under such treatment, is a result of transferring part of total energy of particles to Virtual replica of this object. This process can be registered experimentally by mass decreasing, if the relaxation time of energy exchange between treated object and its Virtual replica is long enough. In any case, the Matter - Bivacuum energy exchange should be reversible in conditions of equilibrium.

It will be demonstrated in next sections, that all discussed here nontrivial consequences of our Unified theory are already confirmed experimentally. It is important to note, that almost all of them are not compatible with existing today paradigm.

The direct approach to evaluate Bivacuum perturbation in the volume of Virtual replica of nonequilibrium or spatially asymmetric system (like pyramid) is to do a precise measurement of Casimir effect (Lamoreaux, 1997; Mohideen and Roy, 1998), very sensitive to vacuum virtual pressure. The value and sign of Casimir effect is determined by difference between the external and internal effective virtual pressure, measuring the attraction force between two close conducting plates.

This kind of [S ⇔ R] interaction, mediated by superposition of nonlocal and distant VR (64), can be modulated by external EM or ultrasound fields, activating the selected vibrations of molecules of [S]. The perturbation of Bivacuum symmetry itself in strong static fields also should influence Bivacuum meditated remote interaction between [S] and [R].

Spatial stability of complex systems means that superposition of reference waves of elementary particles $\mathbf{VPW}^{\pm}_{\mathbf{C}\rightleftharpoons\mathbf{W}}$ with de Broglie waves of atoms/molecules, composed from these particles, forms a hologram - like 3D standing virtual waves (VR^{in}) (formula 63) with location of nodes in the most probable positions of corpuscular phase of the atoms and molecules in condensed matter. The coherent atoms/molecules thermal oscillation in composition of clusters, representing mesoscopic Bose condensate (Kaivarainen, 2001b,c), should be strictly correlated with coherent $[C \rightleftharpoons W]$ pulsations of their elementary particles due to combinational resonance. The energy exchange between different hierarchical levels of condensed matter also is possible.

The nonlocal cosmophysical flicker noise, modulating Virtual replica of the target/detector, can be responsible for so-called macroscopic fluctuations (Shnoll, 2001). This flicker noise, in accordance to our Unified model, is a result of beats/interference between harmonics of Virtual Replicas (VR) of the Earth, Moon, Sun and VR of detectors. Like the Schumann resonance, this may enhance the correlation of quantum dynamics and entanglement between Sender and Receiver (detector) because of feedback reaction between the material object and Virtual Replica of this object.

Different kinds of superposition of standing waves between Virtual Replicas $(VR)_{S,R}$ of Sender [S] and Receiver [R] which may participate in the interaction, are presented in Table 1.

TABLE 1
Different kinds of standing waves, excited by [$C \rightleftharpoons W$] pulsation of sub-elementary fermion and antifermion pairs $[\mathbf{F}_{\downarrow}^{+} \bowtie \mathbf{F}_{\uparrow}^{-}]$ of triplets of Sender and Receiver:

$$\langle[\mathbf{F}_{\downarrow}^{+} \bowtie \mathbf{F}_{\uparrow}^{-}]_{\mathbf{C}}+(\mathbf{F}_{\updownarrow}^{\pm})_{\mathbf{W}}\rangle_S \backsimeq \langle[[\mathbf{F}_{\downarrow}^{+} \bowtie \mathbf{F}_{\uparrow}^{-}]_{\mathbf{W}}+(\mathbf{F}_{\updownarrow}^{\pm})_{\mathbf{C}}\rangle_R$$

==

$[\mathbf{VirSW}_S^{+} \backsimeq \mathbf{VirSW}_R^{+}]_{ext}^{\mathbf{C}}$ – virtual spin waves (+)

$[\mathbf{VPW}_S^{+} \backsimeq \mathbf{VPW}_R^{+}]_{ext}^{\mathbf{C}}$ – virtual pressure waves (+)

$[\mathbf{GW}_S^{+} \backsimeq \mathbf{GW}_R^{+}]^{\mathbf{C}\to\mathbf{W}}$ – recoil gravitational waves (+)

$[\mathbf{EW}_S^{+} \backsimeq \mathbf{EW}_R^{+}]^{\mathbf{C}\to\mathbf{W}}$ – recoil electromagnetic waves (+)

$[\mathbf{F}_{\downarrow}^{+}]$

$\Updownarrow$

$[\mathbf{F}_{\uparrow}^{-}]$

$[\mathbf{VirSW}_S^{-} \backsimeq \mathbf{VirSW}_R^{-}]_{ext}^{\mathbf{C}}$ – virtual spin waves (-)

$[\mathbf{VPW}_S^{-} \backsimeq \mathbf{VPW}_R^{-}]_{ext}^{\mathbf{C}}$ – virtual pressure waves (-)

$[\mathbf{GW}_S^{-} \backsimeq \mathbf{GW}_R^{-}]^{\mathbf{C}\to\mathbf{W}}$ – recoil gravitational waves (-)

$[\mathbf{EW}_S^{-} \backsimeq \mathbf{EW}_R^{-}]^{\mathbf{C}\to\mathbf{W}}$ – recoil electromagnetic waves (-)

==

These symmetrical standing waves with properties, determined by the unpaired sub-elementary fermion, are responsible for the internal, distant and nonlocal Virtual Replicas (VR) formation. Bivacuum - mediated interaction between Sender [S] and Receiver [R] is a result of superposition of their replicas (virtual hologram). These virtual channels between [S] and [R] works better, if the frequencies of geomagnetic Schumann waves (around 8 Hz) and of the other cosmophysical macroscopic fluctuations, are the same in location of [S] and [R], stimulating the coherency between them.

TABLE 2
The role of unpaired sub-elementary fermions
of the triplets of protons and electrons pulsations

$$\langle[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]_W + (\mathbf{F}_{\uparrow}^{-})_C\rangle_{p,e} \rightleftharpoons \langle[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]_C + (\mathbf{F}_{\uparrow}^{-})_W\rangle_{p,e}$$

in Bivacuum - mediated interaction between sender [S] and receiver [R]

===

The unpaired sub-elementary fermion $(\mathbf{F}_{\uparrow}^{-})$**, pulsating counterphase to pair** $[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]$:

$$(\mathbf{F}_{\updownarrow}^{\pm})_C \underset{\textbf{longitudinal and transversal recoil}}{\overset{\mathbf{CVC}^{\pm}\textbf{, angular momentum}}{<==============>}} (\mathbf{F}_{\updownarrow}^{\pm})_W$$

Generate following Bivacuum excitations:

1. The excessive rotational-translational Virtual Pressure:

$$\mathbf{\Delta VirP}^{\pm} = \pm(\mathbf{VirP}^{+}_{\mathbf{F}_{\uparrow}^{+}} - \mathbf{VirP}^{-}_{\mathbf{F}_{\downarrow}^{-}}) \sim$$

$$\sim \pm \frac{\vec{r}}{\mathbf{r}}[\mathbf{n}_{+}\boldsymbol{\varepsilon}_{\mathbf{VC}^{+}} - \mathbf{n}_{-}\boldsymbol{\varepsilon}_{\mathbf{VC}^{-}}]_{x,y,z} \sim$$

$$\pm\frac{\vec{r}}{r}\mathbf{n}_{BVF}[\mathbf{R}_{tr}(\alpha\,\mathbf{m}_0\boldsymbol{\omega}_0^2\mathbf{L}_0^2)^{in}_{rot} + \boldsymbol{\alpha}(\mathbf{m}_V^{+}\mathbf{v}^2)^{ext}_{tr}]_{x,y,z}$$

where, the external translational factor: $\mathbf{R_{tr}} = \sqrt{1-(\mathbf{v}/\mathbf{c})^2}$

2. Electromagnetic charge-dependent longitudinal recoil potential:

$$\mathbf{E}_W^E = \mp\mathbf{R_{tr}}\left(\frac{\alpha\,\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)^{in}_{rot} \mp \alpha(\mathbf{m}_V^{+} - \mathbf{m}_V^{-})^{ext}_{tr}\mathbf{c}^2$$

3. Gravitational charge-independent transversal recoil potential:

$$\mathbf{E}_W^G = \mp\mathbf{R_{tr}}\left(\frac{\beta\,\hbar^2}{\mathbf{m}_0\mathbf{L}_0^2}\right)^{in}_{rot} \mp \beta(\mathbf{m}_V^{+} - \mathbf{m}_V^{-})^{ext}\mathbf{c}^2$$

4. Nonlocal massless Virtual Spin Waves (**VirSW**) in form of $\mathbf{BVF}^{\uparrow} \rightleftharpoons \mathbf{BVF}^{\downarrow}$ equilibrium oscillations,

a) are the carriers of information in form of spin/phase;

b) realize Pauli repulsion or exchange attraction between $\mathbf{BVF}^{\uparrow} <==> \mathbf{BVF}^{\uparrow}$ of parallel and antiparallel $\mathbf{BVF}^{\uparrow} =><= \mathbf{BVF}^{\downarrow}$ spins

c) can transfer the excessive angular momentum

$$\Delta\mathbf{S} = \mathbf{V}_S(\mathbf{n}^{+}_{BVF^{\uparrow}} - \mathbf{n}^{-}_{BVF^{\downarrow}})\hbar/\mathbf{2} = \mathbf{V}_S(\mathbf{n}_{BVF^{\uparrow}} - \mathbf{n}_{BVF^{\downarrow}})\tfrac{1}{2}\mathbf{L}_0\mathbf{m}_0\mathbf{c}$$

d) form the virtual wave-guides between [S] and [R]

with: $\mathbf{H}_{in} > \mathbf{H}_{ext}$ and $\mathbf{n}_{in} > \mathbf{n}_{ext}$

$$\mathbf{VirWG} = [\mathbf{VirSW}_S^{\circlearrowright} \rightleftharpoons \mathbf{VirSW}_R^{\circlearrowleft}]$$

which can be used for exchange of virtual photons between [S] and [R]

===

One of the result of superposition of Virtual replicas of Sender and Receiver is a change of permittivity ε_0 and permeability μ_0 of Bivacuum, interrelated as: $\varepsilon_0 = 1/(\mu_0 c^2)$. In turn, $(\pm\Delta\varepsilon_0)$ influence Van-der-Waals interactions in condensed matter, changing the probability of defects origination in solids and cavitational fluctuations in liquids. Bidirectional change of pH of water inside the pyramid can be a consequence of its Virtual replica influence on probability of cavitational fluctuations in water and dissociation of its molecules: $H_2O \rightleftharpoons HO^{-} + H^{+}$.

18 Experimental data, confirming our Unified theory (UT)

It follows from our theory, that the charged particle, nonuniformly accelerating in cyclotron, synchrotron or in ondulator, could be a source of photons and gravitational waves.

From eqs.(44, 44a and 58a) we get general expression for electromagnetic and gravitational radiation, dependent on the doubled kinetic energy $\Delta(2T_k) = \Delta(m_V^+\mathbf{v}^2)$ of alternately accelerated charged particle:

$$\hbar\omega_E + \hbar\omega_G + \mathbf{\Delta 2T}_k = \mathbf{\Delta}\{(\mathbf{1} + \mathbf{R_{tr}})[\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2]\} = \mathbf{\Delta}[(\mathbf{1} + \mathbf{R_{tr}})\mathbf{HaE}] = \qquad 67$$

$$where: \quad \hbar\omega_E + \hbar\omega_G + \mathbf{\Delta 2T}_k = \mathbf{\Delta}[|\alpha\mathbf{m}_V^+\mathbf{v}^2 + \beta\mathbf{m}_V^+\mathbf{v}^2| + \mathbf{m}_V^+\mathbf{v}^2]^{ext} \qquad 67a$$

the translational factor: $\mathbf{R_{tr}} = \sqrt{1 - (\mathbf{v}/\mathbf{c})^2}$

We can see from this formula, that the increasing of kinetic energy of charged particle, as a result of its acceleration, should be accompanied by electromagnetic radiation, if the jump of its kinetic energy exceeds the energetic threshold, necessary for photon origination, as a result of inelastic excitation of Bivacuum matrix. The $[C \rightleftharpoons W]$ pulsations of all three sub-elementary fermions of charged elementary particles, modulated by external translational dynamics, participate in photons creation and radiation.

It is the Harmonization energy (HaE) of Bivacuum: $\mathbf{HaE} = [\mathbf{m}_V^+\mathbf{c}^2 - \mathbf{m}_0\mathbf{c}^2]$, that induces the transitions of the excited state of particle to its ground state at given conditions (67):

$$\mathbf{m}_V^+\mathbf{c}^2 \overset{HaE}{\rightarrow} \mathbf{m}_0\mathbf{c}^2 \quad at \quad \mathbf{v}_{tr}^{ext} \rightarrow 0 \qquad 68$$

The are huge number of experimental data, confirming this consequence of our theory for electromagnetic radiation. The gravitational radiation in similar conditions is also predictable by our Unified Theory (UT).

At the permanent (uniform) acceleration of the charged elementary particle, moving along the hyperbolic trajectory, the radiation is absent. This nontrivial experimental fact can be explained in the framework of our Unified theory (UT). In accordance to UT, the recoil energy, following radiation of CVC at $[\mathbf{C} \rightarrow \mathbf{W}]$ transitions, equal to deceleration of particle in [C] phase, activate the elastic longitudinal spherical waves in superfluid Bivacuum matrix. If the energy of this activation energy is smaller than threshold of *inelastic* recoil energy, necessary for photons origination, there are not EM radiation of moving particle. The uniform acceleration, in contrast to alternative one, do not provide the fulfilment of condition of overcoming of corresponding activation barrier and the EM radiation is absent. Consequently, the real photon radiation by charged particles and other dissipation inelastic process in Bivacuum matrix, are possible only in the conditions of nonuniform and big enough variations of acceleration.

Some similarity is existing between the mechanisms of phonons excitation in solids in Mossbauer effect (Kaivarainen, 2000) and photons excitation in Bivacuum by alternatively accelerated particle.

The one more consequence of UT is that the radiation of photons, induced by accelerations of charged elementary particle, should be strongly asymmetric and coincide with direction of charged particle propagation in space. This is also well supported result by analysis of synchrotron and ondulator radiation.

Most of energy, emitted by relativist particle is located in direction, close to its instant velocity ($\mathbf{v} = \mathbf{v}_{ext} \rightarrow \mathbf{c}$) in narrow angles range, determined by semiempirical expression (Ginsburg, 1987):

$$\Delta\theta \simeq [\mathbf{1} - (\mathbf{v}/\mathbf{c})^2]^{1/2} = \frac{\mathbf{m}_0\mathbf{c}^2}{\mathbf{E}} = \frac{\mathbf{m}_0}{\mathbf{m}} \rightarrow 0 \qquad 69$$

where: $\mathbf{E} = \mathbf{mc}^2$ is a total relativist energy of the charged particle.

Our theory leads to same result. Formula (15a) for relativist condition ($\mathbf{v} \to \mathbf{c}$) can be easily transformed to:

$$[\mathbf{1} - (\mathbf{v}/\mathbf{c})^2]^{1/2} = \left|\frac{\mathbf{m}_V^-}{\mathbf{m}_V^+}\right|^{1/2} = \frac{\mathbf{m}_0\mathbf{c}^2}{\mathbf{m}_V^+\mathbf{c}^2} = \frac{\mathbf{2L}^+}{\mathbf{2L}^-} \simeq \Delta\theta \overset{\mathbf{v}\to\mathbf{c}}{\to} 0 \qquad 70$$

where $2L^+$ and $2L^-$ are the diameters of the asymmetric actual and complementary torus of sub-elementary particles, correspondingly. Their ratio determines the angle range of radiation of accelerating particle. As far, in accordance to our approach, the actual energy of particle is $\mathbf{E} = \mathbf{m}_C^+\mathbf{c}^2 = \mathbf{mc}^2$, we can see that eq. 69 coincides with eq.70.

18.1 *New Interpretation of Compton effect*

Analyzing the experimental scattering of X-rays on the carbon atoms of paraffin and graphite target, formed by the carbon atoms only, Compton found that the X-rays wave length increasing ($\Delta\lambda = \lambda - \lambda_0$) after scattering on the electrons of carbon has the following dependence on the scattering angle (ϑ − angle between the incident and scattered beam):

$$\Delta\lambda = 2\frac{h}{m_0c}\sin^2\vartheta = 2\lambda_C\sin^2\vartheta \qquad 71$$

Compton got this formula from the laws of momentum and energy conservation of the system [X-photon + electron in atom] before and after scattering, in form:

$$\hbar\mathbf{k} = \hbar\mathbf{k}' + m\mathbf{v} \quad (the\, wave\, numbers:\ k = \omega/c\ and\ k = \omega'/c \qquad 72$$

$$\hbar\omega + m_0c^2 = \hbar\omega' + mc^2 \qquad m = m_0/[1 - (\mathbf{v}/\mathbf{c})^2]^{1/2} \qquad 72a$$

However, Compton made a strong assumption, that the electron before energy/momentum exchange with X-photon is in rest, i.e. his group velocity is zero: $\mathbf{v} = 0$.

We propose the new interpretation of the Compton experiments, assuming that only translational longitudinal group velocity of the electron is close to zero: $v_{\|tr} = 0$, but it is not true for rotational velocity. Such approach do not affect the final Compton result, if we assume, that just a rotational dynamics (spinning) of the electrons, following Golden mean conditions, determines the rest mass of particle (see Fig.1).

At the conditions of Golden mean, providing by fast spinning of sub-elementary particles of triplets $<[F_\updownarrow^- \bowtie F_\updownarrow^+] + F_\updownarrow^\pm>$ with frequency $\omega_0 = m_0c^2/\hbar$, when: $\left[\Delta m_C = m_C^+ - m_C^-\right]_e^\phi = m_0$, the internal rotational energy and momentum of the electron is equal to:

$$E_C^\phi = E_W^\phi = (m_C^+ - m_C^-)^\phi c^2 = (m_C^+\mathbf{v}^2)^\phi = \qquad 73$$
$$= m_0c^2 = m_0\omega_0^2L_0^2$$

$$(P^\pm)^\phi = (m_C^+ - m_C^-)^\phi c = m_0c \qquad 73a$$

The corresponding resulting de Broglie wave length is named a Compton length of the electron:

$$(\lambda^{res})^\phi = \lambda_C = \frac{h}{m_0c} = 24 \cdot 10^{-13}\,m \qquad 74$$

$$\text{the corresponding Compton radius is}:\ L_0 = \lambda_C/2\pi = \frac{\hbar}{m_0c} = 3.82 \cdot 10^{-13}\,m \qquad 74a$$

The Compton radius of the proton is equal to: $L_P = \frac{\lambda_P}{2\pi} = \frac{\hbar}{m_Pc} \simeq 2.1 \cdot 10^{-16}m$. The Compton radius of the electron is about 2000 bigger, than that of proton: $L_0/L_P^\phi = m_P/m_0 = 1836.15$. We may conclude, that scattering of photon on the electron or proton, change their momentum and kinetic energy *related to translations only*, not affecting the parameters of spinning.

18.2. *Artificial generation of unstable groups of virtual particles and antiparticles*

Let us consider the possible results of correlated symmetry shift in groups of virtual pairs $[\mathbf{BVF}_{+}^{\updownarrow} \bowtie \mathbf{BVF}_{-}^{\updownarrow}]_{S=0} = [\mathbf{F}^{\uparrow} \bowtie \mathbf{F}^{\downarrow}]^{Vir}$ of Bivacuum fermions ($\mathbf{BVF}^{\uparrow}$) and antifermions ($\mathbf{BVF}^{\downarrow}$) with opposite spins, acquiring the opposite uncompensated mass: $\Delta\mathbf{m}_{\pm} = (|m_V^+| - |m_V^-|)$ and charge: $\Delta e_{\pm} = (|e_+| - |e_-|)$ spontaneously or in the local gravitational (G), electric (E), magnetic (H) and massless spin (S) fields.

The first stage can be considered, as association/polymerization of *pairs* of asymmetric Bivacuum fermions, representing unstable pairs of virtual sub-elementary particles and antiparticles $[\mathbf{F}_{+}^{\updownarrow} \bowtie \mathbf{F}_{-}^{\updownarrow}]^{Vir}$ to clusters of different size:

$$[\mathbf{BVF}^{\uparrow} \bowtie \mathbf{BVF}^{\downarrow}]_{S=0}^{as} \equiv [(\mathbf{V}^{+} \uparrow\uparrow \mathbf{V}^{-}) \bowtie (\mathbf{V}^{+} \downarrow\downarrow \mathbf{V}^{-})]_{S=0}^{as} <======> \qquad 75$$

$$2[\mathbf{F}_{+}^{\updownarrow} \bowtie \mathbf{F}_{-}^{\updownarrow}]^{Vir} <==> 3[\mathbf{F}_{+}^{\updownarrow} \bowtie \mathbf{F}_{-}^{\updownarrow}]^{Vir} <==> \mathbf{n}[\mathbf{F}_{+}^{\updownarrow} \bowtie \mathbf{F}_{-}^{\updownarrow}]^{Vir} \qquad 75a$$

This stage can be a spontaneous act of Bivacuum self-organization without consuming the external fields energy, as far the energy of formation of asymmetric Bivacuum fermions $(\mathbf{BVF}^{\uparrow})^{as}$ are compensated by formation of asymmetric antifermions $(\mathbf{BVF}^{\downarrow})^{as}$ in each pair $[\mathbf{BVF}^{\uparrow} \bowtie \mathbf{BVF}^{\downarrow}]_{S=0}^{as}$. However, the presence of fields may increase the symmetry shift in pairs $[\mathbf{BVF}^{\uparrow} \bowtie \mathbf{BVF}^{\downarrow}]_{S=0}^{as}$ and their clusters.

The second stage - virtual photons origination, is a result of dissociation of the big coherent clusters (75a) to sextets. Then virtual photons can dissociate to triplets (virtual electrons and positrons) of metastable sub-elementary particles. These dissociation acts can be stimulated and correlated by presence of external fields, including the massless spin (S) field:

$$a) \quad \mathbf{n}[\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}]^{Vir} \overset{\mathbf{G},\mathbf{E},\mathbf{H},\mathbf{S}}{<======>} \frac{\mathbf{n}}{3}[3\mathbf{F}_{\uparrow}^{+} \bowtie 3\mathbf{F}_{\downarrow}^{-}]^{Vir} \equiv \textit{Virtual photons} \qquad 76$$

$$b) \quad [3\mathbf{F}_{\uparrow}^{+} \bowtie 3\mathbf{F}_{\downarrow}^{-}]^{Vir} \overset{grad(\mathbf{G},\mathbf{E},\mathbf{H})}{<======>} \{< [\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}] + \mathbf{F}_{\downarrow}^{-} >_{e^-}^{Vir} + < [\mathbf{F}_{\uparrow}^{+} \bowtie \mathbf{F}_{\downarrow}^{-}] + \mathbf{F}_{\uparrow}^{+} >_{e^+}^{Vir} \} \qquad 76a$$

The metastable (virtual) photons, electrons and positrons may turn to stable ones, if the value of $(BVF^{\updownarrow})^{as}$ symmetry shifts will increase to that, corresponding to Golden mean condition, when the resonance energy exchange of sub-elementary particles with Bivacuum virtual pressure waves ($VPW^{\pm}$), accompanied their $[C \rightleftharpoons W]$ pulsation, becomes effective and stabilizing. This makes possible a fusion of triplets of elementary particles from sub-elementary fermions/antifermions (section 6).

The dissociation of clusters of metastable virtual photons to metastable electrons (e^-) and positrons (e^+) is energetically much easier, than that of stable photons, and may occur even in small fields gradients.

Synchronization of $[C \rightleftharpoons W]$ pulsation of triplets of virtual electrons and positrons (e^-) and (e^+), as a condition of quantum entanglement between them, keeps on even after big cluster dissociation to equal coherent groups (ke^- and ke^+), where k can be about or more than 10.

The results, confirming our scenario of coherent groups of metastable charged particles origination from asymmetric Bivacuum fermions, has been obtained in works of Keith Fredericks (2002) and Sue Benford (2001). Fredericks analyzed the trucks on Kodak photo-emulsions, placed in vicinity of human hands during 5-30 minutes. The plastic isolator was used between the fingers and the photographic emulsion. *The tracks in emulsions point to existing of correlation in twisting of trajectories of big group of charged particles (about 20) in weak magnetic field.* The irregular but in-phase character of set of the trajectories may reflect the influence of geomagnetic flicker noise on the charged particles.

In these experiments the Bivacuum symmetry shift, necessary for dissociation of virtual clusters of pairs (75a) and metastable photons, electrons and positrons origination (76 and 76a), can be induced by the electric, magnetic fields and nonlocal spin field around biosystems, including human's body and its fingers.

The mechanism of virtual spin waves (VirSW) excitation can be explained in the framework of our Hierarchic theory of condensed matter (Kaivarainen, 2002; 2003). It is related to the fast reversible conversions of water in MTs. This process represents 'flickering clusters', i.e.

[dissociation ⇌ association] of coherent water cluster in state of mesoscopic molecular Bose condensate (mBC), accompanied by oscillation of the water molecules angular momentum with the same frequency about 10^7 s^{-1}. If the flickering of water clusters in MTs of the same cell or between 'tuned' group of cells occurs in-phase, then the cumulative effect of VirSW generation by human's finger near photoemulsion can be strong enough for stimulation of dissociation of virtual photons (76a) to virtual electrons and positrons, producing the observed tracks.

In work of Sue Benford (2001) the special device - *spin field generator* was demonstrated to produce a tracks on the dental film, placed on a distance of 2 cm from generator and exposed to its action for 7 min. The spin field generator represents rotating hollow cylinder or ring made of ferrite-magnetic material with the axis of rotation coinciding with the cylinder's main symmetry axis. Four permanent (wedge-like) magnets are inserted into the cylinder. It rotates with velocity several thousand revolutions per minute.

The effect of this generator is decreasing with distance and becomes undetectable by the dental films after the distance from the top of cylinder bigger than 8 cm. The dots and tracks on dental X-ray films were reproduced over 200 trials. They are close to the regular charged particle tracks on surface emulsions. However, the more exact identification of particles failed. The uncommon features of these tracks may be a result of unusual properties of short-living virtual electrons, positrons and their coherent clusters.

18.3 *Interpretation of Kozyrev - type experiments*

The experimental results, obtained by N.A. Kozyrev and his group during decades, are very important for following reasons:

- They prove the imperfection of existing today paradigm;
- They motivate strongly a searching of the unknown general principles in Nature, new kinds of distant and nonlocal weak interactions (nonelectromagnetic and nongravitational);
- They represent a good test for verification of new physical theories, challenging their ability to explain a mechanism of discovered phenomena, reproduced last years in many independent laboratories.

We analyzed a number of Kozyrev's most important and reliable experiments and results. It will be demonstrated, that they are in total accordance with consequences and predictions of our Unified theory. As a background, the review of A. Levich (1994) of Kozyrev's group works was used.

The results are classified in accordance to consequences of our theory, discussed in section 17:

I. Weak repulsion and attraction between [S] and [R] of nonelectromagnetic and nongravitational nature in conditions, providing the excessive virtual pressure of Virtual pressure waves ($VPW^{\pm}$);

II. Nonlocal transmission of the macroscopic angular momentum and energy between remote [S] and [R];

III. Increasing the probability of thermal fluctuations in the volume of [R] due to decreasing of Van der Waals interactions because of charges screening effects, induced by virtual replica of [S];

IV. Small changing of mass of [R] in conditions, increasing the probability of the inelastic recoil effects and exchange between energy of [R] and Bivacuum;

V. Registration of metastable virtual particles (photons, electrons, positrons), as a result of Bivacuum symmetry perturbations.

1. *The torsion balance* with strongly unequal arms has turned out to be perfect Receiver [R]. The suspension point was placed near the big weight whose mass was chosen to be about ten times as big as that of the smaller one, attached to the longer arm of the beam. This longer arm is a long flexible pointer with a loading of about 1 gram at its edge. The beam was suspended on a capron filament of 30 micrometer diameter and 5-10 cm long. The whole system was placed under a glass cap able to be evacuated. A metal net surrounding the cap protected the system from possible electromagnetic influences.

Any irreversible process being carried out in the neighborhood of the balance, used as a Sender [S], caused a rotation of the pointer either to [S] - the attraction, or in the opposite direction - the repulsion, depending on the character of the process in the volume of [S]. For instance, cooling of a previously heated body caused attraction, while a heating of body was followed by repulsion effect. The pointer turned out to be affected by a great variety of irreversible processes: salt dissolving, body compression or stretching, simple mixing of liquid or dry substances (Kozyrev 1971, pp.130-131).

All these effects are in accordance with the I st series of consequences, listed above, and analyzed in section 17 *of this paper.*

Weak repulsion and attraction between [S] and [R] of nonelectromagnetic and nongravitational nature, as a result of positive or negative excessive virtual pressure waves ($VPW^{\pm}$), radiated by nonuniformly accelerated atoms and molecules of [S] in nonequilibrium conditions. In case of positive particles acceleration, following the entropy producing processes, like heating, boiling, evaporation, etc., the excessive virtual pressure of [S] is positive and we get the repulsion effect. The processes in [S], accompanied by deceleration of its particles, like cooling of heated body induce the opposite Bivacuum mediated effect - attraction between [S] and [R]. First of all the VPW may influence on kinetic energy and pressure of air molecules, which, in turn, act on [R]. For details see section 17.

An attempt to measure directly the temperature variations near the evaporating acetone by Beckmann mercury thermometer with sensitivity of 0.01°C per scale division was made. The cardboard tube, enveloping the part of the thermometer with a mercury reservoir, was covered with cotton wool and placed in a glass flask. The process under study in [S] was carried out near the flask. The temperature was decreased when sugar was dissolved in water of settled temperature and increased when a previously compressed spring was placed near the thermometer.

Beckmann thermometer ought to respond to astronomical phenomena as well. However, one could hope that in a close room with stable temperature it will be possible to detect its response to such intense phenomena close to the Earth as a lunar eclipse. During an eclipse the lunar surface experiences very rapid (for about a hundred of minutes) cooling from 100°C to -120°C and heating to its former temperature. Such observations have been carried out with Beckmann thermometer. During the eclipse the thermometer was in sufficiently stable conditions of a semi-basement room. The thermometer readings were taken every 5 to 10 minutes. The corresponding graphs show that those readings started to change indeed only after the maximum eclipse phase was gone, i.e., when the parts of the lunar surface freed from the Earth's shade, started to be heated" (Kozyrev 1982, pp.63-65). Again the additional kinetic energy of the air molecules, induced by excessive virtual pressure of [S - Moon] in accordance with consequence (I), explains the temperature variations.

2. In another type of investigations of distant influence of nonequilibrium processes on sensitive [R]eceptor/detector by Kozyrev group, instead of asymmetric torsion balance, the *continual homogeneous disk*, suspended by its center was used. A thick shield was put on the glass lid of the can, with an opening over the disk suspension point. Consequently, a Sender [S] could affect only the disk suspension point. When the processes in [S] are carried out the disk rotates. The light disks of pressed, unrolled cardboard was used. For monitoring the rotations a small mark on its edge was made. Acetone evaporation over the suspension point caused disk rotation of a few degrees. The authors admit, that they were unable to explain the reaction of this instrument." (Kozyrev 1982, p.65).

The successful experiments with plants turn off the trivial explanation of distant nonelectromagnetic repulsion/attraction effect between [S] and [R], as a result of convectional air flows, induced by heating and cooling of [S]. The experiments were carried out on non-symmetric torsion systems and also on a suspended disk of glossy paper. The systems were confined to tin cylindrical cans with hermetically mounted glass lids for observation. The experiment methodology was the following. The plants were brought to the laboratory, laid down on a table, each one separately, for a certain time, and after that laid by a top or a cut near the torsion balance at a spacing of about 30° from the pointer direction. In the overwhelming majority of the experiments, the plants caused deflections of the torsion balance and the disk. The values of these effects varied both in magnitude and in sign. The reference process, namely, acetone evaporation from a piece of cotton wool, always led to a repulsive pointer deflection and to a clockwise disk rotation. The rotation effects magnitudes from the plants varied from season to season from 1-2° to nearly a round trip, with different effect signs.

In the process of eclipse the lunar surface is for a short time, about a hundred of minutes, cooled down from 100°C to -120°C and afterwards heated to the previous temperature. Such observations were carried out during lunar eclipse on 13-14 March 1979. The suspended disk was in a sufficiently stable environment of a semi-underground room. The disk positions were detected every 5-10 minutes" (Kozyrev 1982, p.65). The graphs show that the counts began changing after the maximum eclipse phase had passed, when the parts of lunar surface, freed from the Earth's shade, started to be heated. The second change in the disk counts was observed when the Moon was leaving the semi-shade and the normal solar irradiation and high temperature being restored at the lunar surface" (Kozyrev 1982, p.65).

The rotation of disc, induced by Bivacuum perturbations, is in line with consequence (II) of our theory , including possibility of nonlocal transmission of the macroscopic angular momentum and energy between remote [S] and [R].

It turned out that a measurement system [R] can be protected by screens from the action of ambient nonequilibrium processes in [S]. The screens can be made of various rigid substances: metal plates, glass, ceramics, with thickness of ~12 centimeters. Liquids have a much weaker screening effect: to absorb the course of time by water, a layer several decimeter thick is necessary" (Kozyrev 1977, p.215). For screening the action of acetone evaporation from a piece of cotton wool from about 10cm it is sufficient to take a steel sheet 8 mm thick or ten 1.5 mm thick glass plates (Nasonov 1985a, p.14).

The existence of signal reflection was verified by separate experiments. A box with a torsion balance was surrounded by a reliable barrier with a vertical slit. Some processes of liquid evaporation and the thermally neutral process of sugar dissolving in water were accomplished behind the barrier, far from the slit, and caused no effect on the balance. However, a mirror having been placed before the slit and reflecting the process in the proper direction, a repulsion of the balance pointer was observed. The processes attracting the pointer, i.e., accompanied by negative virtual pressure, are not reflected by a mirror. The experiments showed that the common law of reflection is valid: the angle of incidence equals that of reflection. Therefore a concave mirror should collect and focus the Sender action and, in particular, study of celestial objects distant influence on Receiver, using reflector telescopes is possible" (Kozyrev 1977, p.218). The suspended disk is a better instrument for astronomical observations than a non-symmetric torsion balance: when working with a disk, a star is to be projected upon the unambiguously determined point of its suspension. The evidence of the instant - nonlocal signal propagation from star to few detectors, including rotating disc, microbes and a Wheatstone bridge where obtained.

The signals from the actual, but yet invisible position of stars, including Sun, was much stronger, than from visible position, determined by limited light velocity. The consequence of theory (II), taking into account nonlocal properties of Virtual spin waves, stands for explanation of these results.

3. Under the action of liquid nitrogen evaporation *water viscosity* was measured. Kinematic viscosity was measured directly during the action. The measurements showed that in 10 to 15 minutes after the action, water viscosity abruptly decreased by a value of about 3%. This fact shows that the action had nothing to do with a thermal influence of the source of action, since water viscosity increases due to temperature decrease. The decreased viscosity of water restored to its usual value in approximately a day (Danchakov 1984, pp.111-112).

Such irreversible process sources as liquid nitrogen evaporation at room temperature, dissolution of sugar and sorbite in water, boiled water cooling and other processes of physical and chemical nature and also metabolic processes of a human body where investigated. We have fixed the fact that *distilled water density* responses to the above irreversible processes. These results are in accordance with consequence (III) of Unified theory: "Increasing the probability of thermal fluctuations in the volume of [R- water] due to decreasing of Van der Waals interactions between water molecules dipoles, because of charges screening effects, induced by virtual replica of [S]".

Not only the dissipative process, but also the asymmetric shape of [S]ender, like pyramid, may form Virtual replica (VR) with excessive virtual pressure: $\mathbf{\Delta VirP}^{\pm} = \pm(\mathbf{VirP}^{+}_{\mathbf{F}^{+}_{\uparrow}} - \mathbf{VirP}^{-}_{\mathbf{F}^{-}_{\downarrow}})$, changing permittivity (ε_0) of Bivacuum and stability of matter of [R] structure. For example, keeping a flask with water under the pyramid during few days makes pH of water lower, than in control flask, placed under cube in the same room and temperature (Narimanov, 2001). The ice, formed from the 'pyramid - treated water' melts about 10% faster, than the control ice. Both of these results point to decreasing of intermolecular interaction in water.

4. An inelastic solid body collisions, resulting in irreversible deformations were accompanied by their weight reduction. Bodies with masses up to 200 grams were weighed using an analytic balance with sensitivity of 1.4mg per division. A first class technical balance, with sensitivity of 10 mg per division, was used for weighing heavier bodies (up to 1kg) and for control. These experiments showed that the weight decreasing effect does not disappear immediately after a collision but decreases gradually, with relaxation times of about 24 hours. The complete balance readings restoration confirms the purity of the experiment and also indicates the reality of the observed weight loss. Unlike that, reversible deformations do not cause body weight variation. Thus, compressed rubber or compressed steel springs exhibit their usual weight. For the other hand, it turned out that heating of bodies leads to a very significant loss of their weight" (Kozyrev 1984, pp.94-95).

Only the vibration of rotating gyroscopes affect their mass, if their frequency and amplitude are big enough to activation the inelastic recoil effects in [$C \rightleftharpoons W$] pulsation of elementary particles of atoms and molecules. This effect occur in accordance to consequence (IV) of section 17: "the possibility of small changing of mass of [R-object] in conditions, increasing the probability of the inelastic recoil effects and exchange between energy of [R] and Bivacuum. In this case, the rotating Earth is a [S]ender.

5. Two photocells, as identical as possible, were mounted at the inner sides of the lids closing a tube, in whose middle an electric torch lamp was inserted through an opening. The plus of one photocell was joined to the minus of the other, with a galvanometer included between these connections. A perfect identity of photocell operations, such that the galvanometer showed no current, was achieved by adjusting an f-stop of the applied lamp light. In these conditions the galvanometer showed that the photocell operation is indeed changing when a certain process takes place in its neighborhood. The galvanometer deflections have been observed to be of a few scale divisions. Hence, a solar battery photocell current being about 1mA, the fractional photocell operation change was about 1 to 10 ppm. All the processes repelling the torsion balance pointer weakened the photocell operation, while those attracting balance, favoured its work" (Kozyrev 1977, p.222).

These data confirm the consequence (V): Possibility of registration of metastable virtual particles (photons, electrons, positrons), as a result of Bivacuum symmetry perturbations.

Let us consider in more detail the important results, obtained by group of Korotaev, pointing, like the Kozyrev data, to existence of unknown - nonelectromagnetic mechanism of all-penetrating physical interaction (Korotaev, et. al., 1999; 2000) and the existing of the advanced and delayed effects on cosmic scale.

These results also can be explained, as a consequence of superposition of Bivacuum virtual replicas (VR) of [S] and [R], exchanging the information and energy, taking into account, that the causality principle do not work in systems of virtual particles, in contrast to real ones.

One set of experiments was related to study of artificial dissipation process of [S] on properties of [R] in laboratory space. In this case a [S] was open vessel with 2 liters of boiling of water. The changes of corresponding Virtual Replica of [S] change of properties of special electronic receiver [R].

This receiver [R] represents a pair of detectors, isolated on the external electric and magnetic fields, precisely thermostated, designed to measure the difference of electric potentials between these detectors. Each of detectors: $\mathbf{U}_1$ and $\mathbf{U}_2$, consists of couple of isolated electrodes, placed in germetized glass vessel filled with electrolyte. The distance from the [S] to U_1 was only 0.5 m and from the same [S] to U_2 eight times bigger: 4 m. The electric scheme allows to evaluate the differences of potentials: $\Delta U_{1,2} = (U_1 - U_2)$ under the permanent control of temperature difference $\Delta T_{1,2} = (T_1 - T_2)$ between two detectors of [R] device.

The effect of temperature change in a course of water in [S] heating was about three order less, than the effect of boiling process itself, displaying in decreasing of $\Delta U_{1,2}$. The boiling is accompanied by the entropy increasing ($\Delta S_d > 0$) in source [S]-vessel with water. The time of water heating from the room temperature to boiling point was about 14 min, the time of boiling was about $\Delta t_b \simeq 40\,min$ till the evaporation of half of water volume ~1 liter. After this the heater was switched off. About 2 hours after this, the value of $\Delta U_{1,2} = (U_1 - U_2)$ was abruptly decreased and then, the many hours long relaxation process starts.

The effects of the ice melting and mixing of water with other liquids are smaller, than the boiling effect.

The important observation is a significant time lag ($\Delta t_I = t_{I,2} - t_{I,1}$) between activation time of [S] - when boiling starts ($t_{I,1}$) and activation time of [R], representing $U_{1,2}$ decreasing ($t_{I,2}$). The second lag is between switching off the boiling ($t_{II,1}$) and restoration (relaxation time, $t_{II,2}$) of the initial $U_{1,2}$ value ($\Delta t_{II} = t_{II,2} - t_{II,1}$). The second lag period (Δt_{II}) appears to be about 8 times longer, than the first one: $\Delta t_{II}/\Delta t_I \approx 8$. This means that the dependence of $\Delta U_{1,2}(t)$ is essentially asymmetric. This asymmetry is proportional to the maximum amplitude of boiling effect $|-\Delta U_{1,2}^{\max}|$:

$$\Delta t_{II}/\Delta t_I = -3.2\,\Delta U_{1,2}^{\max} + 0.39 \qquad 8.10$$

The total relaxation time of the boiling - induced effect in [R] device ($\Delta t_{I,II} = \Delta t_I + \Delta t_{II}$) is dependent on the time of boiling (Δt_b) and entropy change in the double electric layer of detectors (ΔS_d).

It was demonstrated, that these strange water-boiling induced retard (Δt_I) reaction of [R]-system and retard relaxation effects after the boiling was stopped (Δt_{II}) are not the consequence of local T-variations, or the external permanent magnetic or EM fields action. The effects obtained, can not be explained in the framework of conventional physics.

The long time delay between the starting of boiling and reaction of $\Delta U_{1,2}$ of detectors (~2h) on boiling (Δt_I) we can explain by stability of $VR_{\mathbf{water}}$, created by 2 liters of water in vessel between two detectors, before starting of its boiling and long time of creation of $VR_{\mathbf{vapor}}$, different from $VR_{\mathbf{water}}$.

The changes of Bivacuum permittivity ($\boldsymbol{\varepsilon}_0$) and permeability ($\boldsymbol{\mu}_0$) should be accompanied by the change of Coulomb interaction in the double electric layer of detectors and, consequently, by its entropy. Due to different distance of vessel with water - [Sender] from the 1st and 2nd detectors, the $\mathbf{VR_{RES}}$ perturbations nearby them also are not the same, the experiment show corresponding difference between detectors: $\Delta \mathbf{U}_{1,2} = (\mathbf{U}_1 - \mathbf{U}_2)$.

The resulting virtual replica ($\mathbf{VR_{RES}}$) in the volume of [R] is a complex superposition of lot of virtual replicas of material objects of different space scales. It can be presented as a function of superposition of number of:

$$\mathbf{VR_{RES}} = [\mathbf{VR_{S+R}} \Longleftrightarrow \mathbf{VR_{Lab}} \Longleftrightarrow \mathbf{VR_{Building+Environment}} \Longleftrightarrow \mathbf{VR^{Solar\,System}_{Earth+Moon+Sun}}]$$

where: $\mathbf{VR_{S+R}}$ is a combined virtual replica of detectors/receivers [R] (electrodes) and source of Bivacuum perturbation - vessel with boiling water [S]; $\mathbf{VR_{Lab}}$ is a complex virtual replica, generated by mass spatial distribution in the laboratory room (i.e. positions of other equipment in room, position of registration system as respect to walls of laboratory room, etc.), geometry of room;

The $\mathbf{VR}_{\mathbf{Building+Environment}}$ is a contribution of the external, as respect to laboratory space, the Building and its Environment complex virtual replica. Consequently, periodical changes of Solar $\mathbf{VR}^{\mathbf{Solar\,System}}_{\mathbf{Earth+Moon+Sun}}$ in may modulate the resulting $\mathbf{VR}_{\mathbf{RES}}$ and, consequently, the amplitude of $\mathbf{\Delta U}_{1,2}$ and the both times of delay Δt_I and Δt_{II} in the described above experiments. The circadian - 24 hours rhytms also can influence on $\mathbf{VR}_{\mathbf{RES}}$ and the results of experiments.

The violation of causality principle in virtual systems, when special relativity laws do not work, the consequence and reason may change a place. Such anomalous time effect can be a consequence of ability of Resulting virtual replica: $\mathbf{VR}_{res} = f(t \pm n\Delta t)$ to self-organization in both time directions - future and past during certain time interval $\pm n\Delta t$, corresponding to formation of stable set of $\mathbf{VR}_{res}$. It can be considered as a result of action of $\mathbf{VR}_{res}$, as a quantum supercomputer, including extrapolation the current to future states and 'memorizing' the selected time-quantized states.

The feedback reaction between properties of $\mathbf{VR}_{res} = f(t \pm n\Delta t)$ on the properties of registration system [R]= $F(t)$ - can explain the registered anticipated/advanced reaction on macroscopic geomagnetic and solar dissipative processes. The similar receivers [R], representing a pair of detectors, described above has been used. The registration of difference: $\mathbf{\Delta U}_{1,2} = \mathbf{U}_1 - \mathbf{U}_2$ was performed during 366 days and nights in 1996 - 1997 with time interval 30 minutes.

The good correlation (coherency) between changes of potentials in form of *flicker noise* of two receivers: [$\mathbf{R}_I$] and [$\mathbf{R}_{II}$], separated from each other to 300 m, was revealed. Our approach explains this important fact, as a consequence of nonlocal properties of virtual replica ($\mathbf{VR}^{\mathbf{Solar\,System}}_{\mathbf{Earth+Moon+Sun}}$) of the system: [Earth + Moon + Sun], changing coherently in large-scale cosmic and geophysical processes.

The receivers do not react on the actual changes of the Earth magnetic field in real or current time, induced by ionospheric variations, related with variation of Sun activity. However, two unusual: the advanced and the delay signals of receivers [R] with characteristic time interval about:

$$\Delta T = \pm n\Delta t = 48\,hours\,at\;\; n = 1$$

as respect to actual time of change of the Earth magnetic field and Sun activity, has been revealed. This time interval may correspond to one of the most stable time-dependent resulting virtual replicas $\mathbf{VR}_{\mathbf{RES}} = f(t \pm n\Delta t)$ in the infinity cycles ($n \to \infty$) of its self-computing/self-organizing process.

Our conjecture is that resulting $\mathbf{VR}_{\mathbf{RES}}$ of [R] environment, including all Solar system, has a properties of quantum supercomputer, calculating or self-organizing its own future and past states, starting from the current state. Any dissipative processes in system of sender/source [S], like melting, boiling or huge correlated fluctuation, like Sun spots, are accompanied by changes of its Virtual replica [$\mathbf{VR}_S$] and its interaction with [$\mathbf{VR}_R$] of Receiver. When the frequency of nonlocal flicker noise of Bivacuum in volumes of [S] and [R] - coincide, the resulting probability of signal transmission from [S] and detection by [R] is maximum.

Consequently, there are a lot of experimental evidence already, confirming the proposed Virtual Replica of macroscopic objects and remote Bivacuum - Mediated Interaction between sender and receiver.

19 Conclusion

Our Unified theory is confirmed by wide field of applications, the logical coherence of its consequences and coincidence of its predictions with available experimental data.

The concrete results, like the equality of curvature of electromagnetic potential of the electron to the Bohr radius of hydrogen atom, directed radiation, accompanied the charges nonuniform acceleration, explanation of the rest mass and charge origination, the absence of Dirac monopole in nature and fairly close evaluated magnetic moment of the electron to experimental one, also approve our theory. The proposed dynamic mechanism of corpuscle -

wave duality explains the electric and gravitational potential origination in form of longitudinal and transversal elastic waves in superfluid matrix of Bivacuum. The introduced Harmonization energy (HaE) of Bivacuum looks to be the external force, acting on all material objects (including biological ones), driving them to Golden mean conditions. Synchronization of $[C \rightleftharpoons W]$ pulsation between remote elementary particles under the action of harmonization force (HaF) is important factor in quantum entanglement between microscopic and macroscopic systems. The formulas for time and pace of time (dt/t) for coherent closed systems, leading from our concept, interrelate these parameters with particles acceleration and velocity, using special relativity theory.

20. Abbreviations and Definitions*

- $(\mathbf{V}^+)$ and $(\mathbf{V}^-)$ are correlated actual torus and complementary antitorus of Bivacuum, formed by subquantum particles of the opposite quantized energy, virtual mass, spin, charge and magnetic moments, separated by energetic gap;
- $(\mathbf{BVF}^\uparrow = \mathbf{V}^+ \upuparrows \mathbf{V}^-)^i$ and $(\mathbf{BVF}^\downarrow = \mathbf{V}^+ \downdownarrows \mathbf{V}^-)^i$ are cells-dipoles, named Bivacuum fermions and Bivacuum antifermions . Their opposite half integer spins $S = \pm\frac{1}{2}\hbar$, notated as $(\uparrow$ *and* $\downarrow)$, depend on direction of clockwise or anticlockwise rotation of pairs of [torus $(\mathbf{V}^+)$ + antitorus $(\mathbf{V}^-)$], forming them;
- $(\mathbf{BVB}^\pm = \mathbf{V}^+ \Updownarrow \mathbf{V}^-)^i$ are Bivacuum bosons, representing the intermediate transition state between $\mathrm{BVF}^\uparrow$ and $\mathrm{BVF}^\downarrow$. The index: $i = e, \mu, \tau$ define the energy and other properties of three lepton generations;
- $(\mathbf{VC}^+_{j,k} \sim \mathbf{V}^+_j - \mathbf{V}^+_k)^i$ and $(\mathbf{VC}^-_{j,k} \sim \mathbf{V}^-_j - \mathbf{V}^-_k)^i$ are virtual clouds and anticlouds, composed from sub-quantum particles. Virtual clouds and anticlouds emission/absorption accompany the correlated transitions between different excitation states (j,k) of torus $(V^+_{j,k})^i$ and antitorus $(V^-_{j,k})^i$ of Bivacuum dipoles $[\mathbf{BVF}^\updownarrow]^i$ and $[\mathbf{BVB}^\pm]^i$. *Virtual particles and antiparticles* in our model are the result of certain superpositions of virtual clouds: $\mathbf{VC}^+_{j,k}$ and $\mathbf{VC}^-_{j,k}$;
- $\mathbf{VP}^\pm$ is *virtual pressure,* resulted from the process of [*creation* $\rightleftharpoons$ *annihilation*] of virtual clouds $(\mathbf{VC}^\pm_{j,k})$;
- **$\mathbf{VPW}^+$ and $\mathbf{VPW}^-$** are the *positive and negative virtual pressure waves,* related with oscillations of $(\mathbf{VP}^\pm)$;
- $\Delta\mathbf{VP}^\pm = |\mathbf{VP}^+ - \mathbf{VP}^-| \sim |\mathbf{VPW}^+ - \mathbf{VPW}^-| \sim |\mathbf{VC}^+_{j,k} - \mathbf{VC}^-_{j,k}|_{S=0} \geq 0$ means the excessive virtual pressure, being the consequence of secondary Bivacuum asymmetry;
- $\mathbf{F}^+_\updownarrow$ *and* $\mathbf{F}^-_\updownarrow$ are sub-elementary *fermions and antifermions* of the opposite charge (+/-) and energy. They emerge due to stable symmetry shift between the *actual* (V^+) and *complementary* (V^-) torus of $\mathrm{BVF}^\updownarrow$ cells-dipoles: $[\mathrm{BVF}^\updownarrow_{\mathbf{as}} \rightarrow \mathbf{F}^\pm_\updownarrow]$ to the regions of positive or negative energy of Bivacuum dipoles, correspondingly. Their stability is determined by the resonant exchange interaction with Bivacuum pressure waves $(\mathbf{VPW}^\pm)$ in the process of their [**Corpuscle** $\rightleftharpoons$ **Wave**] pulsations;
- $\langle[\mathbf{F}^-_\uparrow \bowtie \mathbf{F}^+_\downarrow] + \mathbf{F}^+_\updownarrow\rangle^{e^+}$ is the coherent triplet of two sub-elementary fermions and one sub-elementary antifermion, representing the positron;
- $\langle[\mathbf{F}^+_\downarrow \bowtie \mathbf{F}^-_\uparrow] + \mathbf{F}^-_\updownarrow\rangle^{e^-}$ is the coherent triplet of two sub-elementary antifermions and one sub-elementary fermion, representing the electron. The absolute values of energy of sub-elementary particles/antiparticles in both triplets are equal and determined presumably by energy of *uncompensated* $[\mathbf{F}^\pm_\updownarrow\rangle$;
- (**CVC**) is *cumulative virtual cloud* of sub-quantum particles, representing [W] phase of sub-elementary particles, pulsating between the Corpuscular [C] and the Wave [W] phase: $[\mathbf{C} \rightleftharpoons \mathbf{W}]$. These reversible high-frequency quantum beats are accompanied by [emission $\rightleftharpoons$ absorption] of **CVC;**
- $\phi = (\mathbf{v}^2/c^2)^{ext,in} = 0.6180339887$ is a **Golden mean** ;
- **VirBC** is *virtual Bose condensation* of Cooper - like pairs $[\mathbf{BVF}^\uparrow \bowtie \mathbf{BVF}^\downarrow]$ and $[\mathbf{BVB}^\pm]$, providing the nonlocal properties of Bivacuum domains. These domains represent multilayer

structure. Each of 2D layer is formed by pairs [$\mathbf{BVF}^{\uparrow} \bowtie \mathbf{BVF}^{\downarrow}$] with defects, created by [$\mathbf{BVB}^{\pm}$];

- **HaE** and **HaF** are *Harmonization Energy and Harmonization Force* of secondary Bivacuum, correspondingly, driving the matter to Golden Mean conditions and responsible for its evolution on all hierarchic levels;

- **VirSW** are *Virtual spin waves*, excited by the angular moments of cumulative virtual clouds (CVC) of sub-elementary particles in triplets $\langle[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}] + \mathbf{F}_{\updownarrow}^{\pm}\rangle$. They are highly anisotropic, depending on orientation (polarization) of triplets in space;

- **VirWG** are the *nonlocal virtual wave-guides* of virtual and real photons, formed by **VirSW.** The internal magnetic field and refraction index of **VirWG** are much higher than the external ones: $\mathbf{H}_{in} >> \mathbf{H}_{ext}$; $n_{in} > n_{ext}$;

- (**mBC**) means *mesoscopic molecular Bose condensate*, representing, for example, the coherent fraction of water in *microtubules* (**MT**) of neurons. It plays the important role in Bivacuum mediated Mind-Matter and Mind-Mind interaction in accordance to our theory;

- **VR** is the *Virtual Replica (phantom)* of elementary, particles, atoms, molecules, matter and its different forms, including living organisms, created as a result of perturbation of Bivacuum by electromagnetic and gravitational contributions of the energy of each of sub-elementary particles of pairs [$\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}$] of triplets $\langle[\mathbf{F}_{\uparrow}^{-} \bowtie \mathbf{F}_{\downarrow}^{+}] + \mathbf{F}_{\updownarrow}^{\pm}\rangle$. This perturbation is a result of $\mathbf{F}_{\uparrow}^{-}$ **and** $\mathbf{F}_{\downarrow}^{+}$ of pairs in-phase [**C** ⇆ **W**] pulsation, accompanied by the exchange interaction with Bivacuum;

- (**EVR**) is the Earth **VR** ;

- (**SVR**) is a Star (Sun, in private case) system Virtual Replica;

- **BMI** is the new fundamental Bivacuum Mediated Interaction, including electromagnetic, gravitational, weak, strong and nonlocal interactions between different kinds of quantum coherent systems.

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* *The abbreviations are not in alphabetic, but in logical order to make this glossary more useful for perception of new notions, introduced in our work.*

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APPENDIX I

The Link Between the Maxwell's Formalism and Unified Theory

The electromagnetic energy (E_E) can be expressed as a recoil part of total energy of sub-elementary fermion:

$$E_E = \alpha\hbar\omega_{C\rightleftharpoons W} = \alpha\hbar[\omega_C^+ - \omega_C^-] = \alpha(m_C^+ - m_C^-)c^2 = \frac{\alpha}{2}\hbar[rot\vec{\mathbf{v}}^+(\mathbf{r}) - rot\vec{\mathbf{v}}^-(\mathbf{r})] \qquad \text{I-1}$$

where: $m_C^+c^2 = \hbar\omega_C^+$ *and* $m_C^-c^2 = \hbar\omega_C^-$ are the quantized energies of the actual and complementary torus of sub-elementary particle.

From this formula one can see, that the electromagnetic energy is a result of quantum beats with frequency ($\omega_{C\rightleftharpoons W}$) between the actual and complementary toruses of sub-elementray fermions.

In this consideration it is assumed, that all of sub-quantum particles/antiparticles, forming actual and complementary vortices of [C] phase of sub-elementary particles, have the same angular frequency: ω_C^+ and ω_C^-, correspondingly.

We can express the divergency of Pointing vector: $\mathbf{P} = (c/4\pi)[\mathbf{EH}]$, following from Maxwell theory, via difference of contributions, related to actual vortex and complementary torus, using known relation of vector analysis:

$$div[\mathbf{EH}] = \frac{4\pi}{c}div\,\mathbf{P} = \mathbf{H}\,rot\mathbf{E} - \mathbf{E}\,rot\mathbf{H} \qquad \text{I-2}$$

where $\mathbf{H}$ and $\mathbf{E}$ are the magnetic and electric components of cumulative virtual clouds of sub-quantum particles, radiated and absorbed in a course of correlated $[C \rightleftharpoons W]$ pulsation of superposition of two triplets of sub-elementary fermions and antifermions, forming the photon.

The analogy between two presented above formulas, illustrating the dynamic [vortex + torus] dipole background, is evident, if we assume that:

$$\hbar\omega_C^+ \sim \mathbf{H}\,rot\mathbf{E} \sim \frac{\alpha}{2}\hbar\,rot\,\vec{\mathbf{v}}^+(\mathbf{r}) \qquad \text{I-3}$$

$$\hbar\omega_C^- \sim \mathbf{E}\,rot\mathbf{H} \sim \frac{\alpha}{2}\hbar\,rot\,\vec{\mathbf{v}}^-(\mathbf{r})$$

Then, the divergence of Pointing vector will take a form:

$$\frac{4\pi}{c}div\,\mathbf{P} = \frac{\alpha}{2}\hbar\left[rot\,\vec{\mathbf{v}}^+(\mathbf{r}) - rot\,\vec{\mathbf{v}}^-(\mathbf{r})\right] \sim \alpha[m_C^+ - m_C^-]c^2 \qquad \text{I-4}$$

We can see from these formulas, that the properties of magnetic and electric fields are implemented in dynamics of each of our torus and antitorus of Bivacuum dipoles.

The second pair of the Maxwell equations also can be analyzed:

$$div\mathbf{E} = \mathbf{4\pi\rho} \qquad \text{I-5}$$

$$rot\,\mathbf{H} = \frac{1}{c}\frac{\partial\mathbf{E}}{\partial t} + \frac{4\pi}{c}\mathbf{j}$$

the charge density in the 1st eq., in accordance to our model at GM conditions, is related to corresponding damped fraction of the electron kinetic energy in its [C] phase of unpaired sub-elementary fermion:

$$\mathbf{4\pi\rho} \sim \boldsymbol{\alpha}\,\mathbf{m}_0\mathbf{c}^2 \qquad \text{I-6}$$

and the divergence of electric potential is related to propagation of spheric elastic waves in Bivacuum, excited by recoil energy of the anchor Bivacuum fermion in [W] phase of $\mathbf{F}^{\pm}$ >:

$$div\mathbf{E} \sim \boldsymbol{\alpha}[\mathbf{m}_V^+ - \mathbf{m}_V^-]^{\phi}\mathbf{c}^2 \qquad \text{I-7}$$

The conducting virtual current in 2nd eq. responsible for magnetism, can be ralated to asymmetry in torus and antitorus, standing for charge of asymmetric BVF_{as} and for difference in the angular velocity of subquantum particles, forming them:

$$\mathbf{j} \sim |\mathbf{e}_+ - e_-|^{\phi} |\mathbf{v}_{gr}^{in} - \mathbf{v}_{ph}^{in}|^{\phi} \qquad \text{I-8}$$

The derivative $\frac{\partial \mathbf{E}}{\partial t}$ is related to oscillations of longitudinal shifts (elastic waves) in the process of [C⇌ *W*] pulsation.

APPENDIX II

The Difference and Correlation Between our Unified Theory (UT) and General Theory of Relativity

Einstein (1965) postulates, that gravitation changes the trajectory of probe body from the straight-line to geodesic one due to curving of conventional two-dimensional surface. The Lobachevskian geometry on curved surface was used in Einstein's classic theory of gravitation. The criteria of surface curvature of sphere is a curvature radius (R), defined as:

$$R = \pm \sqrt{\frac{S}{\Sigma - \pi}} \qquad \text{II-1}$$

where S is a square of triangle on the flat surface; R is a sphere radius; Σ is a sum of angles in triangle.

The sum of angles in triangle (Σ) on the *flat surface* is equal to $\pi = 180^0$ and curvature $R = \infty$. For the other hand, on curved surface of radius ($0 < R < \infty$), the sum of angles is

$$\Sigma = \pi + S/R^2 > \pi \qquad \text{II-2}$$

When $(\Sigma - \pi) > 0$, the curvature ($R > 0$) is positive; when $(\Sigma - \pi) < 0$, the curvature is imaginary (iR).

In our Gravitation theory instead space-time curvature [$\pm R$], we introduce Bivacuum Symmetry Curvature ($\pm L_{\mathrm{Cur}}$). It is defined, as a radius of sphere of virtual Bose condensation (VirBC), equal to that of domain of nonlocality in secondary Bivacuum, generated by gravitating particle with mass (m_C^+):

$$\pm R \sim \pm L_{\mathrm{Cur}} = \frac{\hbar}{\pm \Delta m_V c} = \frac{\hbar}{\pm \beta \Delta m_C c} \qquad \text{II-3}$$

where Bivacuum symmetry shift, related to neutrino properties in accordance to UM (see section 12):

$$\pm \Delta m_V = \pm(|m_V^+| - |m_V^-|) = \pm \beta \Delta m_C = \pm \beta m_C^+ (v/c)^2 \qquad \text{II-4}$$

is a Bivacuum dipoles symmetry shift, positive for particles and negative for antiparticles, related directly to mass symmetry shift ($\Delta m_C = m_C^+ - m_C^-$).

In primordial Bivacuum, in the absence of matter, where: $\Delta m_V = \beta \Delta m_C = 0$, the space is flat, as far $L_{\mathrm{Cur}} = \infty$. The Bivacuum curvatures, induced by particles with mass, equal to that of the electron and proton where calculated in section 10.

The analogy between R and L_{Cur} $(VI - 3)$ is obvious. The more is energy of gravitational field and actual inertial mass, generating this field (m_C^+), the more is vacuum symmetry shift (Δm_V) and Bivacuum curvature. The bigger is Bivacuum curvature (R or L_{Cur}), i.e. the more flat is the Universe the less is Bivacuum dipoles symmetry shift $|\pm \Delta m_V|$ and corresponding actual mass.

In accordance to our Unified theory, the *primary criteria of inertial mass* is a Bivacuum dipoles symmetry shift and corresponding curvature of Bivacuum.

In our Unified model the matter and antimatter induce the opposite Bivacuum dipoles symmetry shift. It means that antigravitation should exist between matter and antimatter. This is another possible explanation of the repulsive 'dark energy' in contrast to attractive 'dark mass'.

The photons trajectory, moving in Bivacuum without its symmetry perturbation, reflects the Bivacuum curvature in 3D space. It is a consequence of our model of photon, as a symmetric superposition of three pairs of coherent pairs $[F^{+} \bowtie F^{-}]$.

The Red Shift of Photons in UT

As well, as General theory of relativity, UT can explain the red shift of photons in gravitational field. The RED, low-frequency shift:

$$\Delta\omega_p^{1,2} = \omega_p^{(1)} - \omega_p^{(2)} \qquad \text{II-6}$$

of photons in gravitation field is a result of deviation of their trajectory from the right line and is a consequence of increasing the vacuum symmetry curvature and corresponding length of its path.

In accordance to our model, red shift has a simple relation to difference of Bivacuum symmetry shifts at point of photon radiation: $\Delta m_V^{(1)} = |m_V^{+} - m_V^{-}|^{(1)}$ and at point of its registration $\Delta m_V^{(2)} = |m_V^{+} - m_V^{-}|^{(2)}$:

$$\Delta\Delta m_V^{1,2} = \Delta m_V^{(1)} - \Delta m_V^{(2)} \qquad \text{II-7}$$

in a form:

$$\hbar\Delta\omega_p^{1,2} = \Delta\Delta m_V^{1,2}\, c^2 \quad or: \qquad \text{II-8}$$

$$\Delta\omega_p^{1,2} = \frac{\Delta\Delta m_V^{1,2}\, c^2}{\hbar} = \beta\frac{\Delta\Delta m_C^{1,2}\, c^2}{\hbar} \qquad \text{II-9}$$

If $\Delta m_V^{(1)} > \Delta m_V^{(2)}$, i.e. gravitation potential in point of radiation is bigger, than in point of detection, we get the red shift: $\Delta\omega_p^{1,2} > 0$. If $\Delta\Delta m_V^{1,2} = \beta\Delta\Delta m_C^{1,2} = 0$, i.e. gravitational potential is the same in both points, meaning that Bivacuum is flat ($R = \infty$ and $\Delta\Delta m_V^{1,2} = 0$), then $\omega_p^{(1)} = \omega_p^{(2)}$ and red shift is absent.

We may conclude, that our Unified theory of Gravitation explains the same phenomena, as do the General theory of relativity, but in terms of Bivacuum symmetry shift instead of curved space-time. The tensor properties of Bivacuum dipoles symmetry shift is related directly to that of mass symmetry shift:

$$[\Delta m_V = \beta\Delta m_C = \beta m_C^{+}(\vec{\mathbf{v}}/\mathbf{c})^2 = \beta\frac{\vec{p}^{\,2}}{m_C^{+}c^2}]_{x,y,z} \qquad \text{II-10}$$

produced by asymmetry of actual momentum $(\vec{p} = m_C^{+}\mathbf{v})_{x,y,z}$ dependence on the external group velocity in 3D space $(\vec{\mathbf{v}})_{x,y,z}$.