The Neutrino: What is it?

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An analysis of known experiments on direct and indirect detection of the electron-type neutrino and antineutrino has been made. The analysis is based on a new hypothesis that the observable physical space is formed from a finite set of *byuons*, – one-dimensional discrete objects. It is shown, that the hypothesis for existence of neutrinos advanced by Pauli on the basis of an analysis of the conservation laws, is not unquestionable since the fulfillment of these laws may be secured by the physical space itself (physical vacuum) being the lowest energy state of a discrete oscillating system originating in the course of byuon interaction. This effect is analogous to that of Mössbauer. The direct experiments on detecting neutrinos are explained assuming the existence of a new information channel due to the uncertainty interval for coordinate of the four-contact byuon interaction forming the interior geometry of elementary particles and their properties. The results of an experiment on observation of variations of the ß-decay rate, which confirm the existence of said new information channel, are also given.

Keywords: (neutrino, byuons, ß-decay and cosmology)

As is known [1], the neutrino (electron-type one) was discovered by Pauli "on the tip of his pen", on the basis of analysis of conservation laws. There are works [2-12], which can considerably extend our knowledge of neutrino physics. In Refs. [2-7], it is shown by various research teams on the basis of investigation of tritium spectrum end, that mass of neutrino is less than zero. In Ref. [8], results of precision measurements of tritium spectrum end are presented which suggest that mass squared of the electron-type neutrino $m_{n_e}^2 < 0$. This artifact is explained in Ref. [9] with the aid of long-range interactions of anomalous neutrinos through introducing a potential equal to the sum of those of Yukawa's type. In Ref. [10], these unique experimental results are explained by introducing a weakly interacting light scalar boson through which the neutrinos interact in some cloud. It is shown in so doing that the parameters of neutrinos will be cloud density dependent. This work develops the assumption of Ref. [2] that to account for the experiments, a density of neutrinos is necessary which is 10^{13} times greater than that accepted in the cosmology. In the recent paper [11], a time variation (about 0.5 year) in tritium beta-spectrum was observed.

In the new physical conception [13,14] of forming the observed three-dimensional physical space $\mathbf{R_3}$ from a finite set of one-dimensional objects (*byuons*) in consequence of their dynamics in a one-dimensional space $\mathbf{R_1}$, the most simple object, under which the author means the electron-type neutrino, has just the imaginary self-rest-energy $m_{n_e} c^2$ in $\mathbf{R_1}$ and the imaginary quantum number, mass m_{n_e}, in $\mathbf{R_3}$. That is why the question in the heading of this article has arisen: "*The Neutrino, what is it?*"

It should be noted that the predictions of the theory of Refs. [13,14] associated with the notion of neutrino, differ markedly from

those in the Dirac's theory of neutrino (In the latter this particle is represented by a four-component wave function, and with due regard for the violation of P-parity, only left neutrino $\boldsymbol{n}_e$ and right neutrino $\boldsymbol{\tilde{n}}_e$ are left in the weak interaction if $m=0$), but has a vague similarity with the predictions of the Majorana's theory in which $\boldsymbol{n}_e \equiv \boldsymbol{\tilde{n}}_e$. The similarity consists in the fact that if the double ß-decay is observed according to the reaction *2n → 2p+2e* (the Majorana's theory with the violation of the law of lepton charge conservation) then the neutrino in its pure form is not present at all in the final product of the reaction.

In Refs. [12], the models of Dirac and Majorana are discussed in the context of experiments with the double ß-decay. It is shown that as opposed to the Dirac's theory, that of Majorana is not overthrown by the results of those experiments. Hence, indirectly, the theoretical statement of Refs. [13,14] about the impossibility of observation of the neutrino in a local volume of the physical space (according to [1], neutrino is a local particle) is not denied, too.

In order to understand what is the matter and to be acquainted with the terminology of the subject, let us present fundamental concepts and conclusions of the theory [13,14].

Fundamental Theoretical Concepts of Physical Space Origin.

In Refs. [15,16], the conception of formation of the observed physical space $\mathbf{R_3}$ from a finite set of one-dimensional discrete "magnetic" fluxes, new physical objects, which will henceforward be named

byuons[1] was firstly formulated. In quantum field theory, the observable space is usually given [17], and in modern superstring and supersymmetric theories, this space (Minkovsky's one) is obtained through compactification of "excessive" dimensions [18-20]. The *byuons* $\mathbf{F}(i)$ are one-dimensional discrete objects and have the form:

$$\mathbf{F}(i) = \mathbf{A}_g\, x(i),$$

where $x(i)$ is the "length" of the byuon, a real (positive, or negative) value depending on the index i=0,1,2,...,k...., a quantum number of $\mathbf{F}(i)$; under $x(i)$ a certain time charge of the byuon may be meant [21]. The vector $\mathbf{A}_g$ represents the cosmological vectorial potential, a new basic vectorial constant [15,16,22]. It takes only two values: $\mathbf{A}_g$={A_g, $-\sqrt{-1}\,A_g$} where A_g is the modulus of the cosmological vectorial potential ($|\mathbf{A}_g|$=1.95 10^{11}CGSE units).

According to the theory [13,14], the value A_g is the limiting one. In reality, there exists in nature, in the vicinity of the Earth, a certain summary potential $\mathbf{A_S}$, resulting from the vectorial potential fields from the Sun ($A_\odot \approx 10^8$ CGSE units), the Galaxy ($A_G \approx 10^{11}$ CGSE units), and the Metagalaxy ($A_M > 10^{11}$ CGSE units). These are superimposed on the constant $\mathbf{A}_g$ resulting probably in some insignificant turning of $\mathbf{A_S}$ relative to the vector $\mathbf{A}_g$ in the space $\mathbf{R_3}$ or in a decrease of it.

Hence in the theory of physical space (vacuum) which the present article leans upon, the field of the vectorial potential introduced long ago by Maxwell gains a fundamental character. As is known, this field was believed as an abstraction. All the existing theories are usually gauge invariant, *i.e.*, for example, in classical and quantum

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[1] In connection with the numerous comments: in order to make distinction between these new physical objects and the conventional magnetic fluxes existing in classical electrodynamics.

electrodynamics, the vectorial potential **A** is defined with an accuracy of an arbitrary function gradient, and the scalar one is with that of time derivative of the same function, and one takes only the fields of derivatives of these potentials, *i.e.*, magnetic flux density and electric field strength, as real. In Refs. [13,14,15,16] the local violation of the gauge invariance was supposed, and the elementary particle charge and quantum number formation processes were investigated in some set. Therefore the potentials gained an unambiguous physical meaning there. In the present paper and Refs. [13,14] this is a finite set of *byuons*. The works by D. Bohm and Ya. Aharonov [24-27] discussing the special meaning of potentials in quantum mechanics are the closest to the approach under consideration, they are confirmed by numerous experiments [28,29]. The *byuons* may be in four vacuum states (VS) II^+, I^+, II^-, I^- in which they discretely change the value of $x(i)$: the state II^+ discretely increases and I^+ decreases $x(i) > 0$ by one quantum of space ($\tilde{x}_0 \approx 2.8 \times 10^{-33}$cm), the states II^- and I^- discretely increase or decrease the modulus of $x(i) < 0$, respectively, by the same value $\tilde{x}_0$. The sequence of discrete changes of $x(i)$ value is defined as a proper discrete time of the byuon (quantum of time $t_0 \approx 0.9 \times 10^{-43}$ s, $\tilde{x}_0/t_0 = c$,—the speed of light). The byuon vacuum states originate randomly. In Refs. [13,14], the following ***hypothesis*** is put forward. It is suggested that *the observable space R_3 is built up as a result of minimizing the potential energy of byuon interactions in the one-dimensional space R_1 formed by them*. More precisely, *the space R_3 is fixed by us as a result of dynamics of byuons. The dynamic processes and, as a consequence, wave properties of elementary particles appear therewith in the space R_3 for objects with positive potential energy of byuon interaction*

(observable objects). Let us briefly list the results obtained earlier when investigating the present model of physical vacuum[2] [13, 14]:

2.1. The fundamental constants: h – Planck's constant, e_0 – elementary electric charge, and c – speed of light have been calculated; h, e_0 and c are invariants in the process of byuons dynamics [13,14,15,16].

2.2 The existence of a new long-range interaction in nature, arising when acting on physical vacuum by the vectorial potential of high-current systems, has been predicted [13,14,30-34].

2.3. All the existing interactions (strong, weak, electromagnetic and gravitational ones) along with the new interaction predicted have been qualitatively explained in the unified context of changing in three periods of byuon interactions with characteristic scales – 10^{-17}cm, 10^{-13}cm, and 10^{28}cm, determined from the minimum potential energy of byuon interaction [13,14,21,22].

2.4. Masses of leptons, basic baryons, and mesons have been found [13,14,35].

2.5. The constants of weak interaction (vectorial and axial ones) and of strong interaction have been calculated [13,14,35].

2.6. The origin of the galactic and intergalactic magnetic fields has been explained as a result of existence of an insignificant ($\approx 10^{-15}$) asymmetry in the formation process of $\mathbf{R_3}$ from the one-dimensional space of *byuons* [13-16].

2.7. The substance density observed in the Universe (10^{-29} g/cm^3) has been calculated [13-16].

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[2] It should be noted that only three numbers are given in the model to fulfill calculations: $\tilde{x}_0$, t_0, $|\mathbf{A}_g|$.

2.8. The origin of the relic radiation has been explained on the basis of unified mechanism of the space $\mathbf{R_3}$ formation from one-dimensional space $\mathbf{R_1}$ of *byuons* [13-16], *etc.*

Let us briefly explain item 2.2. It is shown in Refs. [13-16,35] that masses of all elementary particles are proportional to the modulus of $\mathbf{A}_g$ (more exactly $\mathbf{A_S}$). If now we direct the vectorial potential of a magnetic system in some space region towards the vector $\mathbf{A}_g$ then any material body will be forced out of the region where $|\mathbf{A_S}| < |\mathbf{A}_g|$. The new force is nonlocal, nonlinear, and represented by a complex series in $\Delta\mathbf{A_S}$, a difference in changes of $|\mathbf{A_S}|$ due to the potential of a current at location points of a sensor and a test body [30-33]. It was shown in Refs.[13,14], the first term of this series is

$$\mathbf{F} \sim \Delta\mathbf{A_S}(\partial\Delta\mathbf{A_S}/\partial x),$$

where x is the spatial coordinate.

As shown in Ref.[36] the new force acts over a cone with an opening of $\sim 90º\text{-}100º$ around the vector $\mathbf{A}_g$. According to the recent data [36,37] the vector $\mathbf{A}_g$ has the following coordinates in the second equatorial system: right ascension $a \approx 293º\pm10º$, declination $\delta \approx 36º\pm10º$.

One of the important predictions of the theory is revealing a new information channel in the Universe which is associated with the existence of a minimum object with positive potential energy, so called object $\mathbf{4B}$ arising in the minimum four-contact interaction of *byuons* in the vacuum states II^+, Γ^+, II^-, Γ^-. In four-contact byuon interaction, a minimum action equal to h occurs, and the spin of the object appears. Hence the greater part of the potential energy of byuon interaction is transformed into spin of the object $\mathbf{4B}$. The residual (after minimization) potential energy of the object $\mathbf{4B}$ is equal to $\approx 33\text{eV}$, it is identified with the rest mass of this object in the

space $\mathbf{R_1}$. In agreement with Refs. [13,14], the indicated minimum object **4B** has, according to Heisenberg uncertainty relation, the uncertainty in coordinate $\Delta x \approx 10^{28}$ cm in $\mathbf{R_3}$. The total energy of these objects determines near 90% energy of the Universe as well as its observable substance density. In such a manner the objects **4B** connect together, due to the uncertainty relation, all the elementary particles of the Universe and hence all the objects in the animate and inanimate nature as composed of elementary particles. The greater is the number of elementary particles of substance in some place of space, the greater is also the number of objects **4B** there because the latters form the interior geometrical space of elementary particles [13,14].

Analysis of experiments on detecting neutrino.

All the experiments proving the existence of neutrino may be divided into two groups in the first of which we are dealing with the circumstantial evidence, starting from the conservation laws, that neutrinos exist [38,39] among these are also the papers [2-12], whereas the second group of experiments has pretensions to the direct corroboration of neutrino existence [40,41].

Let us consider the first experiment on detecting neutrino, which was carried out by A.I.Leipunsky [38] and relates to the first of above mentioned group. The idea of his experiment was constructed on comparison of energetic spectra of electrons and recoil nuclei produced during the ß-decay. If a neutrino (antineutrino) were not emitted in this process, the law of conservation of momentum would be obeyed:

$$\mathbf{P_e} + \mathbf{P_{r,n}} = 0, \quad |\mathbf{P_e}| = |\mathbf{P_{r,n}}| \tag{1}$$

where $\mathbf{P_e}$ is momentum of ß-electron, $\mathbf{P_{r,n}}$ is momentum obtained by the recoil nucleus during ß-decay. If however a neutrino

(antineutrino) is emitted in ß-decay, the law of momentum conservation has the form

$$P_e + P_{r,n} + P_? = 0, \qquad (2)$$

and then

$$|P_e| \neq |P_{r,n}| \qquad (3)$$

A.I.Leipunsky, when investigating the process of ß$^+$-decay in his experiments with the carbon isotope ^4_6C, has validated the inequality (3) and thereby, as he believed, proved the existence of neutrino. The Leipunsky's experiment and those in the first group can be explained on the assumption that the conservation laws of momentum, angular momentum *etc.*, are taken over by a large-scale object, the physical space (physical vacuum) of the Universe. An analogy to such a phenomenon is the known Mössbauer effect [42] lying in the fact that the resonant absorption of *g*-radiation by nuclei in conditions of partial overlap of emitted and absorbed *g*-radiation lines rises sharply when cooling the radiation source and absorbent. Mössbauer had accounted for this strange (for the year 1958) effect by the fact that, in certain situations (sufficiently low transition energy, low temperature as compared with the Debye temperature of the crystal), the recoil momentum and energy produced during emission (absorption) of *g*-quantum do not go into either knocking out an atom from a site of the lattice or changing the energy state of the crystal but are transmitted, in elastic manner, to the entire crystal or at least to a large group of atoms embraced by travelling acoustic wave during the emission time. In such a case, the correlation between the momentum and energy of the emitting (absorbing) nucleus breaks down since the recoil energy practically equals zero due to large mass of the crystal, and hence the *g*-quantum energy difference between the emission and absorption lines practically disappears. The essence of the Mössbauer effect is that an oscillator being in the state with minimum energy can,

within the framework of quantum model of solid body[3] solely acquires energy but cannot give it up.

An analogous pattern is observed also in the experiment of A.I.Leipunsky as well as in other ones, for instance, in decay of neutron:

$$\text{n} \rightarrow \text{p} + e^- + \tilde{\boldsymbol{n}}_e, \tag{4}$$

if assumed that the physical space is a certain periodic oscillating medium taking over the laws of conservation, *i.e.* one may not introduce into Expr.(4) the electron-type antineutrino as it was done by Pauli in order to meet the conservation laws, but therewith the event (4) may not already be considered as a local phenomenon.

Let us show that on the theoretical basis [13-16].

The vacuum states Π^+, Γ^+, Π^-, Γ of the *byuons* appear randomly and are characterized for the byuon $\Phi(i+1) = \mathbf{A}_g x(i+1)$ by special functions $\Psi_{\Pi^+}^{i+2}, \Psi_{\Gamma^+}^{i}, \Psi_{\Gamma^-}^{k-i-2}$ and $\Psi_{\Pi^-}^{k-i}$, respectively. Under the product $\Psi_{\Pi^+}^{i+2} \Psi_{\Gamma^+}^{i}$ is meant the probability of existence of vacuum states Π^+ and Γ^+ of *byuons* with the index $(i+1)$. Recall that the vacuum state Π^+ increases the index i of a byuon, *i.e.*, the value $x(i+1)$, by one, and the vacuum state Γ^+ decreases it by one. Normalizing the functions $\Psi_{\Pi^+}, \Psi_{\Gamma^+}, \Psi_{\Gamma}, \Psi_{\Pi^-}$, we obtain for the case $i<k$:

$$\sum_{\boldsymbol{x}=0}^{(NkP-k)/2} \sum_{j=0}^{j=i} \Psi_{\Pi^+}^{j+2} \cdot \Psi_{\Gamma^+}^{j} \cdot \Psi_{\Pi^-}^{NkP-j-2\boldsymbol{x}} \cdot \Psi_{\Gamma^-}^{NkP-j-2-2\boldsymbol{x}} = \frac{NP}{2}, \tag{5.1}$$

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[3] The solid body is a set of harmonic oscillators [38].

$$\sum_{x=1}^{NP-1} \sum_{j=0}^{j=i} \Psi_{II^-}^{NkP-j} \cdot \Psi_{II^-}^{NkP-j-2-xk} = P, \tag{5.2}$$

$$\sum_{x=0}^{(NkP-k)/2} \sum_{j=0}^{j=i} \Psi_{II^+}^{j+2} \cdot \Psi_{\Gamma^-}^{NkP-j-2-2x} = \frac{NP}{2}, \tag{5.3}$$

$$\sum_{x=0}^{(NkP-k)/2} \sum_{j=0}^{j=i} \Psi_{I^+}^{j} \cdot \Psi_{II^-}^{NkP-j-2x} = \frac{NP}{2} \tag{5.4}$$

Here N,k,P are periods of *byuon* interaction in i, they are computed precisely in Refs. [13-16,21] based on the minimum potential energy of byuon interaction in $\mathbf{R_1}$ (N,k, and P are integer numbers equal to 1.54×10^4, 3.2×10^{15}, 10^{42}, respectively). To these periods there correspond the distances $k\tilde{x}_0 \approx 3 \times 10^{-17}$cm; $Nk\tilde{x}_0 \approx 10^{-13}$cm; $NkP\tilde{x}_0 \approx 10^{28}$cm.

It turned out to be remarkable and surprising that, for the four-contact interaction of *byuons* (**4B**-objects) when at a single discrete point of the discrete one-dimensional space $\mathbf{R_1}$ *byuons* can be observed at a time (*i.e.*, in quantum of time t_0) in four vacuum states $II^+, \Gamma^+, II^-, \Gamma^-$, the equation for the Ψ-function has, for those states, the form of that of harmonic oscillator [13-16]:

$$\Delta[\Psi_{II^+}^{i+1} + \Psi_{I^+}^{i+1}] + \Psi_{II^+}^{i+1} + \Psi_{I^+}^{i+1} = 0, \tag{6.1}$$

$$\Delta[\Psi_{II^-}^{NkP-i-1} + \Psi_{\Gamma^-}^{NkP-i-1}] + \Psi_{II^-}^{NkP-i-1} + \Psi_{\Gamma^-}^{NkP-i-1} = 0, \tag{6.2}$$

Here Δ denotes the second finite differences in index i. It is seen from Eqs. (5) that the object **4B** is determined with probability 1 on the characteristic dimension in $\mathbf{R_3}$ equal to $\approx 10^{-17}$cm (the completion of forming $\mathbf{R_3}$). It was shown in Ref.[13,14,18] that the charge and quantum numbers of elementary particles are formed on distances of

$10^{-17} \div 10^{-13} cm$, and that in accordance with the Heisenberg uncertainty relation, an uncertainty in coordinate of $10^{28} cm$ corresponds to the free **4B** object in $\mathbf{R_3}$.

The residual (from minimization process) potential energy in $\mathbf{R_1}$ is considered in Refs.[13,14] as a rest energy mc^2 in $\mathbf{R_1}$. The energy of the object **4B** equivalent to mc^2 is equal to $E_{k_{min}}^0 \approx 33 \ eV$. This object is a boson with spin 1, there corresponds a pair of electron-type neutrino-antineutrino $(\boldsymbol{n}_e \Leftrightarrow \tilde{\boldsymbol{n}}_e)$ to it. The neutrino is a spinor produced by the interaction of *byuons* in VS II^+I^+, but its mc^2 is imaginary. The "smearness" of objects **4B** over the Universe gives the observed density of substance $\approx 10^{-29} \ g/cm^{-3}$ and connects all the objects of the Universe into a single information field.

Let us return to reactions of (4)-type. Thus it is stated that the momentum, energy, spin, and lepton charge attributed to the antineutrino are given up, when the reaction (4) proceeds, to the physical space being formed as a result of minimizing the potential energy of *byuons* in $\mathbf{R_1}$ and observed by us as an assemblage of the objects **4B** which is developing constantly due to the vacuum state II^+ and creating an oscillating system of the lowest energy level. Well, but what of the experiments with direct detection of neutrino which particle is being observed repeatedly in leading nuclear laboratories in the world? For example, the known experiment of Cowen and Reines [40,41]:

$$\tilde{\boldsymbol{n}}_e + p \rightarrow n + e^+. \tag{7}$$

An answer is simple. The nuclear reactors near which the reaction (7) is observed due to the reaction (4), create around themselves an unobservable field of objects[4] produced during interaction of *byuons*

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[4] The self-energy is imaginary.

in the vacuum states ΓII^- (antineutrino), which objects in turn, when connected with the objects created by *byuons* in the vacuum states $\Gamma^+ II^+$, give bosons being in the vacuum states $\Gamma^+ II^+$ $\Gamma^- II^-$. The assemblage of these bosons forms the physical space, or the space of the elementary particles. At that the laws of conservation are met to a high accuracy, however not in a local form but in a volume with a characteristic dimension of $\approx 10^5 cm$. Let us show this.

According to the basic hypothesis, the objects **4B** form, as was said above, the interior space of an elementary particle along with all its quantum numbers and charges. Therefore this object always creates, due to its perpetual dynamics in the space $\mathbf{R_3}$, the minimum momentum for an elementary particle as an integer entity whose interior geometrical space is formed by it. The momentum of the object **4B** corresponding to the minimum one for elementary particles, may be represented in a general form [13,14,43,44]

$$P = \Phi \cdot E^0_{k_{min}} \big/ c$$

where Φ is probability of detecting the object **4B** in some region of the space $\mathbf{R_3}$. If the objects **4B** are free (*i.e.* not an elementary particle but a space free of elementary particles is created by them), then

$$\Phi = \frac{1}{16} \cdot \frac{\tilde{x}_0^3}{4\mathbf{p}\, x_0^2 \tilde{x}_0}$$

where $\tilde{x}_0 \approx kx_0 \gg 10^{-17} cm$ [13-16].

In this case, if the spread in values of momentum for an elementary object Δp is set equal to P, the uncertainty in coordinate in $\mathbf{R_3}$ for the object **4B** will comprise $10^{28} cm$. The coefficient 1/16 in the formula for F is determined from the combinatorics of the *byuons* in the vacuum states $\Gamma^+, II^+, \Gamma^-, II^-$. If the object **4B** is not free (*i.e.* it forms the interior geometry of an electron, as an example), then
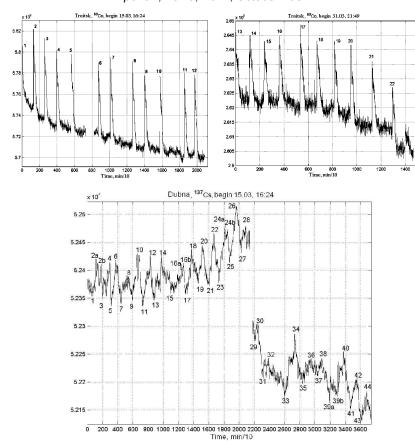
Fig.1. The variation of the flow of γ-quanta accompanying the ß-decay of ^{60}Co (INR, Troitsk), and ^{137}Cs (JINR, Dubna), with the time (since 15.03.2000).

$$\Phi = \frac{1}{16} \cdot \frac{x_0^3}{4\boldsymbol{p}(Nx_0)^2 x_0} \tag{8}$$

and for an assemblage of N objects **4B** forming an electron (for which $m_e c^2 = N E^0_{k_{min}}$) we may write

$$\Delta p = \frac{1}{16} \cdot \frac{x_0^3}{4\boldsymbol{p}(N x_0)^2 x_0} \cdot \frac{N E^0_{k_{min}}}{c} = \frac{1}{64\boldsymbol{p}} \cdot \frac{E^0_{k_{min}}}{Nc} \qquad (9)$$

When using Eq. (9), we have, for N objects **4B** an uncertainty in coordinate Δx on the order of $10 cm$ in $\mathbf{R_3}$, *i.e.* an electron, due to wave properties of N objects **4B** carries information on its properties not over distances of $10^{-8} cm$ (de Broglie wave at the temperature ~ 300 K) as in the case if it were considered as a pointwise particle, but at distances of the order of $10 cm$. If one considers not N objects **4B** in an electron but only one object **4B** (however in an electron, *i.e.* F is determined by formula (8)) then $\Delta x \approx 10^5$ cm. Thus a lesser quantity of information on the state of interior space characteristic of an electron has a greater spread in coordinate. Hence in the range of uncertainty in coordinate $\sim 10^5 cm$ around an electron and consequently a neutron, the processes associated with transmitting energy, momentum etc to the free space as well as to other objects in accordance with the reaction (4) and (7) can occur. As is seen, the overlapping of the processes (4) and (7) is tremendous if the reaction (7) is detected even at a distance of hundreds meters from the reactor, which, let us underline it once again, is in perfect analogy to the resonant absorption of $\boldsymbol{g}$-radiation by nuclei and to the Mössbauer's effect as well, however not in coordinates $\Delta E,\ \Delta t$, but $\Delta p,\ \Delta x$. Using our approach, one can do a simple estimation of the cross-section of the reaction (7), if representing it in the form $\boldsymbol{s} = \dfrac{1}{n\boldsymbol{l}}$ where n is concentration of nucleons in a nucleus, and λ is the maximum uncertainty interval for the new information field of the nucleon which field makes possible the intersection of the reactions (4) and

(7). When put $n = 10^{38} \mathrm{cm}^{-3}$ and $\lambda \approx 10^5 \mathrm{cm}$, as said above, then we have s $\approx 10^{-43} \mathrm{cm}^2$. As is known, just such a value of s is observed in the experiment with neutrinos from a reactor as well as found on the basis of standard phenomenological theories [42].

Experiment on influence of vectorial potential on ß-decay rate.

The first data for influence of changes in the physical space structure, and more precisely, in A_Σ depending on the vectorial potentials of the Sun and Earth, on reactions like that in Expr. (4), are given in Ref. [45-47].

The below-described recent experiments were patterned after following scheme [48,49]. One used the neutron as a test body. Since it has a magnetic moment, and the value of $\frac{\partial \Delta A_\Sigma}{\partial x}$ is on the order of $10^{16} Gs$, the new force could be expected to act on the rate of the *b*-decay of radioactive elements because of changes $\Delta \mathbf{A}_S$ in time, for example, in the process of daily and yearly rotation together with the Earth due to the influence of its vectorial potential ($|A_E| \approx 10^8 Gs \cdot \mathrm{cm}$) and that of the Sun ($|A_\odot| = 10^8 \mathrm{Gs} \cdot \mathrm{cm}$).

In Fig.1 the results of an experiment [48] on simultaneous investigating changes in intensity of the ß-decay of radioactive elements in two towns, are shown. The experiment was carried out at the Institute for Nuclear Research of Russian Academy of Sciences (Troitsk) with ^{60}Co and at the same time at the Joined Institute for Nuclear Research (Dubna, Russia) with ^{137}Cs, using the germanium-lithium detectors.

The experimental technique (schematic diagram, electronic equipment, measurement of backgrounds) at Dubna was the same as
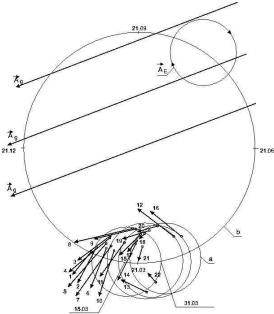
Fig.2a. The spatial positions of sites where the clearly expressed extrema in the magnitude of the flow of *g*-quanta in the experiment with the ß-decay of ^{60}Co, were observed (see Fig.1):

• ® – the site of the maximum flow of *g*-quanta with the indication of the direction of action of the new force drawn along the tangent line to the parallel of latitude;

a – the trajectory of motion of the radioactive source rotating together with the Earth;

b – the trajectory of motion of the Earth and the radioactive source around the Sun;

21.03 *etc.* – the point of the vernal equinox and other characteristic points of the trajectory "**b**'';

A$_E$ – the direction of the vectorial potential of the magnetic field of the Earth's dipole;

A$_g$ – the direction of the cosmological vectorial potential.

in the experiment described in detail in Ref.[50] and differed from the latter only in that a Ge(Li)-detector (volume ≈ 100 cm^3) was used. As before (when using a scintillation detector), the intensities of *g*-transition from an excited level of a daughter nucleus with an energy

of 0.661MeV in the course of the ß-decay of ^{137}Cs, were measured. The value of the integral of *g*-quanta counts entered into the memory of a computer every 10*s*.

As distinguished from the technique of long-term measurements of β-decay rate with an scintillation detectors [45,50] the *g*-registration following the β-decay of the investigated radioactive nuclei with a Ge(Li)-detectors made it possible to substantially improve the stability and reliability of long-term measurements. At Troitsk, a Ge(Li)-detector (also with a volume of 100cm^3) was used for measuring the *g*-spectra with energies of 1.117MeV and 1.332MeV accompanying the β-decay of ^{60}Co. A radioactive source was placed beyond the vacuum volume at a distance of 7mm from the sensitive surface of the detector. To protect the detector and preamplifier from the possible influence of alternating high-frequency and magnetic fields, they were closed by covers from permalloy and electrolytic copper, and a 10cm layer of lead served as a shielding from the natural radioactive background. The signal time constant of the input signal was equal to 0.5μs at a gain factor of 10-20, which led the influence of amplitude overload of electronic paths to a minimum.

To record the amplitude spectra, a fast ADC with off-line storage built into a personal computer (PC) was used. A control program gave the time of measuring each spectrum (600*s*), start time, and storage instruction, noted the time of transcription of a next spectrum to the PC memory, zeroed the off-line storage, and started a new measurement. The program worked in a cycle so that the information sequentially accumulated in the memory of PC through a long time. The final processing of information was made off-line by integration over the spectrum in various intervals of energy from the first channel to the maximum energy of photopeak (or only the peak itself) with the resulting formation of a sequence of numbers reflecting the time
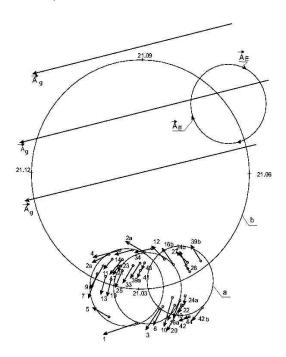
Fig.2b. The same as in Fig.2a but for minimum and maximum flows of g-quanta during the β-decay of ^{137}Cs (see Fig.1).

dependence of the ß-decay rate. The statistic-average digital load of the detector was no more than $(2 \div 3) \times 10^4$ counts per second, *i.e.*, corresponded to the optimum working conditions of the instrumentation. The statistical accuracy obtained at one point was 0.03% for the radioactive decay of ^{60}Co.

Thus the measurements were made simultaneously by two identical Ge(Li)-detectors with two independent and different systems of information storage in natural conditions spaced 140 km apart. One detector measured the decay of ^{137}Cs, the other did that of ^{60}Co.

We can see from the Fig.1 that, firstly, there are near-daily quasiperiodical ß-decay intensity up to 0.7-0.8% at Troitsk and up to 0.2% at Dubna which are in themselves contradictory to existing views on constancy of coefficients of the ß-decay.

In Fig. 2a-b the directions of action of the new force drawn tangentially to Earth's parallels of latitude at extremum points of ß-decay intensity (that is, the directions of the vectorial potential of the Earth at these points) form three clearly distinguishable subsets of directions being in agreement for both setups. One of these directions coincides with the direction of $\mathbf{A}_g$, and others lie on the above-indicated cone of the new force. This result is discussed and explained in Ref.[48].

The results of the experiment carried out confirm that the physical space is a complex formation, and its "breathing" tells, through the potentials, on such a fundamental phenomenon as ß-decay which is influenced on, according to the existing standard physics, practically by no factors (pressure, magnetic and electric fields, *etc.*).

Because of the limited volume of the article, far from all reactions and phenomena associated with the neutrino are considered. But they all are reduced to two above indicated methods of analysis: the direct and indirect ones. For example, when investigating the reaction

$$\mu^- \rightarrow e^- + \tilde{\boldsymbol{n}}_e + \boldsymbol{n}_\mu \tag{10}$$

one measures the energy spectrum of electrons to analyze properties of the neutrino (an indirect method). That is, we may assume the laws of conservation to be undertaken by the physical vacuum in the context of the byuon model (as this was done by us when discussing the reaction (4)).

Another example is the solar neutrino (experiments by Davis [51]). Considered is the reaction

$$\boldsymbol{n}_e + {}^{17}_{37}Cl \rightarrow {}^{18}_{37}Ar + e^- \tag{11}$$

On the grounds of the byuon theory it can be expected that the potential of the Sun $A_\odot$ is in permanent variations and this information is transmitted, because of the nature of the byuons, to the place where the Davis' detectors are positioned. These oscillations lead to changes in A_Σ and, as the probability of ß-decay is [13,14]

$$W \sim |A_\Sigma|,$$

then the appearance of the reaction (11) is quite probably.

Thus the *byuon model* allows to consider known phenomena from quite a new viewpoint.

Acknowledgments

Appendix

In Ref. [13,14,35] the expressions for the vectorial constant C_V and the axial one C_A of weak interaction in terms of A_g, elementary electric charge e, and periods of byuon interaction, are found. These periods are determined mathematically from the minimum potential energy of byuon interaction in the one-dimensional space formed by them ($x_0 = k\tilde{x}_0 \approx 10^{-17}$cm is the period characterizing the completion of R_3 formation; $Nx_0 = ct^* \approx 10^{-13}$cm):

$$c_V = e_0 A_g \frac{2x_0}{ct^*} \cdot \frac{ct^*}{2x_0} \cdot 2x_0^3 = e_0 A_g \cdot 2x_0^3 \approx 10^{-49} erg \cdot cm^3 \,,$$

$$c_A = e_0 A^0 \cdot \frac{ct^*}{2x_0} \cdot \frac{\sqrt{x_0 ct^*}}{2\sqrt{3}} x_0^2 = \frac{1}{2} e_0^2 ct^* \cdot x_0 \approx 10^{-49} \, erg \cdot cm^3 \; .$$

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