Dialectical view on the particle structure

Part 2

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The second part of the article presents the following data, continuing the consideration begun in Part 1. These data should be enough to understand the general structure and mass spectrum of particles considered in terms of the Wave Model (WM) [1], which is based on dialectical philosophy and dialectical logic [2].

1. Periodic Law of measures

Based on the considerations set forth in Part 1 [3, 4], the *general structure* of *measures* (reflecting the *periodic essence* of the Universe) can be expressed as follows:

$$\hat{\Delta} = n\delta + id\delta . \qquad (1)$$

Here, δ is the physical parameter (magnitude), $\hat{\Delta}$ is the general meaning of its measure; n is the number of periods-quanta δ, $d\delta$ is a fractional part of the value of the measure; i is the ideal unit (the unit of polar negation) [2].

The fractional value $d\delta$ relates to the *superstructure* that marked by the *unit* of *negation i*, which represents the *unit* of *superstructure*. Formula (1) can be considered as the *Periodic Law of Measures*.

If $\hat{\Delta}$ is a *scalar* measure, its *quantitative* value is determined by the norm

$$\Delta = n\delta + d\delta . \qquad (2)$$

If $\hat{\Delta}$ is a *polar* quantity, then its *total measure* is determined by the modulus

$$\Delta_m = \left|\hat{\Delta}\right| = \sqrt{(n\delta)^2 + d\delta^2} . \qquad (3)$$

2. Fundamental periods-quanta

The *basis* and *superstructure* reflect the *periodic essence* of the Universe.

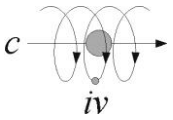
The *speed* of processes in the Universe is *not limited* by anything, and, as already shown in [3], is equal to

$$\hat{C} = c \cdot n + iv \qquad (4)$$

If it is limited only to the level of basis-superstructure, we have

$$\hat{C} = c + iv . \qquad (5)$$

In the simplest case of a *cylindrical circular* wave of *basis-superstructure* with *central* and *orbital* discrete constituents, the following *graph-formula* corresponds to the superlight speed $\hat{C}$,



The complex of basis-superstructure is characterized by the *wave* of *basis-superstructure* of the *complex* type

$$\hat{\Lambda} = \lambda + i2\pi a \qquad (6)$$

and by the corresponding *wave radius*

$$\hat{R}_\lambda = \frac{\hat{\Lambda}}{2\pi} = \hat{\lambda} + ia\,. \tag{7}$$

The *modulus* of the complex wave, as the polar quantity, is equal to the *length* of the *unit screw trajectory* (Fig. 1)

$$\Lambda_m = \left|\hat{\Lambda}\right| = \sqrt{\lambda^2 + (2\pi a)^2} = 2\pi \cdot \left|\hat{R}_\lambda\right|, \tag{8}$$

where

$$tg\theta = \frac{2\pi a}{\lambda} = \frac{v}{c}, \tag{9}$$

θ is the polar angle of the trajectory.

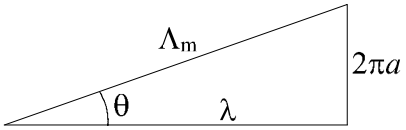


Fig. 1. Trigonometric relations between the unit screw trajectory and the wavelength of the basis and superstructure.

Along this trajectory, the *motion* of a particle of the *superstructure* occurs with a *total speed* C_m and period T:

$$C_m = \sqrt{c^2 + v^2} \tag{10}$$

$$T = \frac{\hat{\Lambda}}{\hat{C}} = \frac{\lambda + i2\pi a}{c + iv} = \frac{(c + iv)T}{c + iv} \tag{11}$$

The *wave motion* of a particle m at the level of the *basis* occurs with the *period* τ,

$$\tau = \frac{2\pi a}{c} = \frac{vT}{c} = \frac{v}{c}T\,, \tag{12}$$

So it makes sense to talk about the *total period*

$$\hat{T} = T + i\tau \tag{13}$$

and *wavelength*

$$\hat{\Lambda} = c\hat{T}\,. \tag{14}$$

It is natural to assume that the *fundamental frequency* ω_e of the atomic and subatomic levels [5] is the *frequency quantum-period*; therefore, the *complete frequency* formula, according to (1), has the form

$$\hat{\Omega} = n\omega_e + i\omega\,. \tag{15}$$

The limiting *fundamental frequency* ω_e determines the minimum *period-quantum* of *time* $T_e = \frac{2\pi}{\omega_e} = 3.361498580 \cdot 10^{-18}\ s$, accordingly, the *complete formula* of the *period*, in a general case, takes the following form,

$$\hat{T} = nT_e + i\tau\,. \tag{16}$$

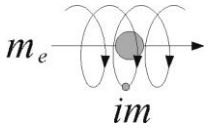
Similar relations are also valid for *associated masses.* For example, if the *associated mass* [5] of an *electron* m_e is taken as a *period-quantum* of mass, we have

$$\hat{M} = nm_e + im\,. \tag{17}$$

Multiplying (17) by the fundamental frequency ω_e, we arrive at a formula for *associated powers* of *exchange* (*associated charges*)

$$\hat{Q} = ne + iq\,. \tag{18}$$

The *electron mass* (17) can be represented by the following *graph-formula*



or $\hat{M} = m_e + im\,,$ (19)

where *im* is the mass of the *satellite* of the *electron*, m_e is the mass of the electron.

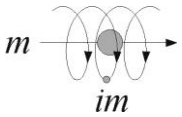
Short note. At *high speeds* that not occur in ordinary conditions, but are *achieved* in laboratory conditions at *accelerators*, it is necessary to operate with a *fictitious mass* of particles m_v, replacing the real wave motion with mechanical "relativistic" motion [1]:

$$m_v = \frac{m}{\sqrt{1 - v^2 / c^2}}\,. \tag{*}$$

And when at the *superstructure* level, a moving wave-particle with a speed *v* significantly *exceeds* the speed of light *c* (the *period-quantum* of *speed*), *v*>>*c*, we will have

$$\tilde{m}_v = \frac{m}{\sqrt{v^2 / c^2 - 1}}\, i \approx \frac{c}{v} im\,, \tag{**}$$

which means the *formation* of a structure similar to (19) the next *higher level*,



It should also be noted that the formula (*) *ceases* to be *valid* at the transition of speed through the value of the period-quantum of speed *c*.

3. Periodicity of measures of masses

Let us present the *norm* of the complete mass (17) as a *scalar measure* in the following form

$$M = \tilde{n} m_e = (n + \Delta n) m_e\,, \tag{20}$$

where $\tilde{n} = n + \Delta n = qnt(M)$ is a *relative* measure of *mass*; in this *n* is a discrete (discontinuous) *integer* component, and Δn is an indiscrete (continuous) *fractional* component of the measure.

As $\tilde{n}$ *increases*, the formula (20) "*runs through*" the masses of ***G**-class particles*. As soon as the discrete component *n* will *reach* the *integer value n*=68, and the *non-discrete* Δn - the "*magic*" value

$$\Delta n = 25 \cdot 2\pi \lg e - 68 = 0.68218817692092067374923...\,, \tag{21}$$

the *boundary particle* of ***G***-class – *g-quantum* – with the mass

$$m_g = (68 + \Delta n) m_e = 25 \cdot 2\pi \lg e \cdot m_e \tag{22}$$

is formed, that is *equivalent* to the *condition*

$$e^{2\pi} = 10^{\frac{m_g}{25 m_e}}\,. \tag{22a}$$

Above this level, masses are determined by measures of m_g:

$$\hat{M} = k m_g + im\,, \tag{23}$$

with the norms

$$M = (k + \Delta k) m_g = (k + \Delta k) \cdot 25 \cdot 2\pi \lg e \cdot m_e\,. \tag{24}$$

At $\Delta k = 0$ and $k = 2, 3, 4, ...$, the *next levels* are formed, namely, the *levels* of γ-, μ-, and π-*particles* with the following reference measures:

$$m_\gamma = 2 \cdot 25 \cdot 2\pi \lg e \cdot m_e \text{, equivalent to the condition } e^{2\pi} = 10^{\frac{m_\gamma}{50 m_e}}, \quad (25)$$

$$m_\mu = 3 \cdot 25 \cdot 2\pi \lg e \cdot m_e, \quad \Rightarrow \quad e^{2\pi} = 10^{\frac{m_\mu}{75 m_e}}, \quad (26)$$

$$m_\pi = 4 \cdot 25 \cdot 2\pi \lg e \cdot m_e, \quad \Rightarrow \quad e^{2\pi} = 10^{\frac{m_\pi}{100 m_e}}. \quad (27)$$

Generally, at any *k*, we have the following spectrum of reference measures

$$m_k = k \cdot m_g = k \cdot 25 \cdot 2\pi \lg e \cdot m_e, \quad (28)$$

that is equivalent to the condition

$$e^{2\pi} = 10^{\frac{m_k}{k 25 m_e}}. \quad (28a)$$

The $k \in (5; 24)$ *interval* belongs to the *meson* $\boldsymbol{K}_k$-class of particles with the following *reference masses* (in parentheses are the masses in *MeV* and particle designations).

k=5,	$\boldsymbol{K}_5$-class,	$m_5 = 5 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 341.0940885 m_e$,	(174.30, *g*)
k=6,	$\boldsymbol{K}_6$-class,	$m_6 = 6 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 409.3129061 m_e$,	(209.16, γ)
k=7,	$\boldsymbol{K}_7$-class,	$m_7 = 7 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 477.5317238 m_e$,	(244.02, γ*g*)
k=8,	$\boldsymbol{K}_8$-class,	$m_8 = 8 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 545.7505415 m_e$,	(278.88, π)
k=9,	$\boldsymbol{K}_9$-class,	$m_9 = 9 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 613.9693592 m_e$,	(313.74, π*g*)
k=10,	$\boldsymbol{K}_{10}$-class,	$m_{10} = 10 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 682.1881769 m_e$,	(348.60, πγ)
k=11,	$\boldsymbol{K}_{11}$-class,	$m_{11} = 11 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 750.4069946 m_e$,	(383.46, πμ)
k=12,	$\boldsymbol{K}_{12}$-class,	$m_{12} = 12 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 818.6258123 m_e$,	(418.32, ππ)
k=13,	$\boldsymbol{K}_{13}$-class,	$m_{13} = 13 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 886.8446300 m_e$,	(453.18, π*g*)
k=14,	$\boldsymbol{K}_{14}$-class,	$m_{14} = 14 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 955.0634477 m_e$,	(488.04, ππγ)
k=15,	$\boldsymbol{K}_{15}$-class,	$m_{15} = 15 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1023.282265 m_e$,	(522.90, ππμ)
k=16,	$\boldsymbol{K}_{16}$-class,	$m_{16} = 16 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1091.501083 m_e$,	(557.76, πππ)
k=17,	$\boldsymbol{K}_{17}$-class,	$m_{17} = 17 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1159.719901 m_e$,	(592.62, πππ*g*)
k=18,	$\boldsymbol{K}_{18}$-class,	$m_{18} = 18 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1227.938718 m_e$,	(627.48, ππππγ)
k=19,	$\boldsymbol{K}_{19}$-class,	$m_{19} = 19 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1296.157536 m_e$,	(662.34, πππμ)
k=20,	$\boldsymbol{K}_{20}$-class,	$m_{20} = 20 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1364.376354 m_e$,	(697.20, ππππ)
k=21,	$\boldsymbol{K}_{21}$-class,	$m_{21} = 21 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1432.595172 m_e$,	(732.06, πππ*g*)
k=22,	$\boldsymbol{K}_{22}$-class,	$m_{22} = 22 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1500.813989 m_e$,	(766.92, πππγ)
k=23,	$\boldsymbol{K}_{23}$-class,	$m_{23} = 23 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1569.032807 m_e$,	(801.78, πππμ)
k=24,	$\boldsymbol{K}_{24}$-class,	$m_{24} = 24 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1637.251625 m_e$,	(836.64, πππππ)

Levels of $k \in (25; 28)$ *interval* relate to *nucleon* levels. The fundamental measure of $2\pi \lg e \cdot 10$ is in this interval, as well as the *golden section* of the interval equal to

$$25 + \frac{5}{8}(28 - 25) = 26.875.$$

The *nucleon* mass

$$m_n = 26.87525 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1833.380726 m_e \qquad (29)$$

corresponds to the *golden section*. The interval itself is represented by the *spectrum* of *nucleons* with the norms of masses

$$M = (25 + \Delta k) m_g = (25 + \Delta k) \cdot 25 \cdot 2\pi \lg e \cdot m_e , \qquad (30)$$

where $\Delta k \in (0; 3)$.

Just as *g-quanta*, *nucleons* are *different* in mass and structure. The ***A**-class* of *particles* represented by the *periodic table* begins from the nucleon level.

Reference mass levels for classes located *above* the $k \in (25; 28)$ *nucleon interval* are as follows*:

			MeV	
k=29,	$\boldsymbol{K}_{29}$-class,	$m_{29} = 29 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 1978.345713 m_e$,	(1010.93;	π_N, φ)
k=30,	$\boldsymbol{K}_{30}$-class,	$m_{30} = 30 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2046.564531 m_e$,	(1045.79;	η_0)
k=31,	$\boldsymbol{K}_{31}$-class,	$m_{31} = 31 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2114.783348 m_e$,	(1080.65;	η_0)
k=32,	$\boldsymbol{K}_{32}$-class,	$m_{32} = 32 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2183.002166 m_e$,	(1115.51;	Λ)
k=33,	$\boldsymbol{K}_{33}$-class,	$m_{33} = 33 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2251.220984 m_e$,	(1150.37;	H)
k=34,	$\boldsymbol{K}_{34}$-class,	$m_{34} = 34 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2319.439802 m_e$,	(1185.23;	Σ, H)
k=35,	$\boldsymbol{K}_{35}$-class,	$m_{35} = 35 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2387.658619 m_e$,	(1220.09;	B)
k=36,	$\boldsymbol{K}_{36}$-class,	$m_{36} = 36 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2455.877437 m_e$,	(1254.95;	$A,\ f$)
k=37,	$\boldsymbol{K}_{37}$-class,	$m_{37} = 37 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2524.096255 m_e$,	(1289.81;	$D, \pi,\ f, \varepsilon$)
k=38,	$\boldsymbol{K}_{38}$-class,	$m_{38} = 38 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2592.315072 m_e$,	(1324.67;	Ξ, ε, A_2)
k=39,	$\boldsymbol{K}_{39}$-class,	$m_{39} = 39 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2660.533890 m_e$,	(1359.53;	π, k)
k=40,	$\boldsymbol{K}_{40}$-class,	$m_{40} = 40 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2728.752708 m_e$,	(1394.39;	Λ, Σ)
k=41,	$\boldsymbol{K}_{41}$-class,	$m_{41} = 41 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2796.971525 m_e$,	(1429.25;	E, K_N, K^*)
k=42,	$\boldsymbol{K}_{42}$-class,	$m_{42} = 42 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2865.100343 m_e$,	(1464.11;	l, N)
k=43,	$\boldsymbol{K}_{30}$-class,	$m_{43} = 43 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 2933.409161 m_e$,	(1498.97;	N)
k=44,	$\boldsymbol{K}_{44}$-class,	$m_{44} = 44 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 3001.627978 m_e$,	(1533.83;	$\Xi, \Lambda,\ f$)
k=45,	$\boldsymbol{K}_{45}$-class,	$m_{45} = 45 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 3069.846796 m_e$,	(1568.69;	N)
k=46,	$\boldsymbol{K}_{46}$-class,	$m_{46} = 46 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 3138.065614 m_e$,	(1603.55;	Λ)
k=47,	$\boldsymbol{K}_{47}$-class,	$m_{47} = 47 \cdot 25 \cdot 2\pi \lg e \cdot m_e = 3206.284431 m_e$,	(1638.41;	N) ; *etc.*

(*Particles closest to the corresponding reference mass levels are indicated in parentheses; symbols of some particles do not match in some cases – such is the system of designations)

4. Place of an electron in the mass spectrum

It can be assumed that at the ***G**-level*, the *electron* is the *smallest nucleon*. Then the *g-quantum*, judging by its reference mass m_g=68.22m_e, represents a *composite atom-molecule* of the *g-nucleon* level with the *ordinal number* $z = 30 - 31$ (if we rely on solutions of the wave equation for the *g*-quantum space). *Indeed*, at the nucleon level, an *atom* with the *mass number* of 68 is located in the periodic table, where there are ^{30}Zn and ^{31}Ga.

In this case, we can say that *all elementary particles consist finally of electrons*. Then, the *g-quantum* is an *electron molecule* with a set of intrinsic *wave shells* and a *certain structure* of the *arrangement* of *nodes* on them (by *analogy* with the *shell-nodal-structure* of *atoms* [2]). The *spherical radius* of the g-*quantum* in this case represents, approximately, the *golden section* of the fundamental measure

$$r_g = \left(\frac{m_g}{4\pi\varepsilon_0} \right)^{1/3} \approx \frac{5}{8} 2\pi \lg e \cdot 10^{-9}\ cm \approx 4r_e\,, \qquad (31)$$

where r_e is the *radius* of the *electron sphere*, $r_e = \left(\frac{m_e}{4\pi\varepsilon_0} \right)^{1/3} = 4.169587953 \cdot 10^{-10}\, cm$ [5] ($\varepsilon_0 = 1\ g \cdot cm^{-3}$ is the *absolute unit* of *density*).

The *golden ratio* (31) for the radii of the spheres *allows* us to give one more *prediction*: a *spectrum* of particles with measures ranging *from* an *electron* to *g-quantum mass* and higher (components of a huge variety of ***G***-class particles) also *exists in nature*. The last is most likely.

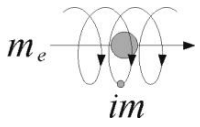
In addition, it should also be noted that there are two types of electrons, of *right* and *left polarization* (which correspond to *positrons* and *electrons*), but we do not know exactly what polarization the electron and positron actually each individually have.

5. Electron as a microgalaxy of the Universe

An *electron* belongs to the ***G-class*** of particles, which are structural components of the world of elementary particles, including nucleons. And the electron is also the boundary structure of ***E-class*** particles.

The *complexity* of the structure of the Universe *increases* both when *moving up* from one level to another in the hierarchy of *megaobjects* and in the *movement down* in the hierarchy of *microobjects*. This means that the "most elementary" boundary particle of the ***E***-class – the *electron* – is at the same time the *most complex particle*. The *electron* in its complexity can be compared with the *Megagalaxy*; therefore it should be called the *Microgalaxy* of the Universe.

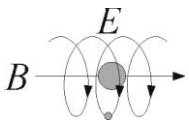
According to (19), the structural *formula-graph* of an *electron* has the form



where $\boldsymbol{m}_e$ is the *electron-nucleus* of the *Microgalaxy* of the Universe, and ***im*** are the *equatorial galactic orbits* of its numerous *microstars-satellites*.

When the mass *wave motion* of *electrons-galaxies* occurs in the *cylindrical* space of a *wire conductor*, an *aura* of electron *satellites* of ***E***-class particles arises in the surrounding space of the conductor. The *electron satellites* represent the *superstructure* of the mass wave motion of galaxies-electrons.

Numerous ***im***-particles of the *superstructure* with their own continuous field of rest-motion form the *cylindrical* wave *magnetic field* ***B***. As soon as the *speed* of the *particles* of the magnetic field *exceeds* the speed of the *quantum-period c*, a *superstructure* of the *magnetic field* arises - the *electric field* ***E***:



In turn, when the *motion* at the level of the superstructure *overcomes* the *quantum-period* of speed *c*, the *E-field* as the basis *forms* its own *superstructure* (*magnetic* field). However, we do not know what level of magnetic field is generated – the former or a new one. If we assume that the arising field is equal to the former magnetic field *B*, then, at the relevant level, the *transformation* of the *superstructure* into the *basis* and the *basis* into the *superstructure* (basis-superstructure transmutation) takes place.

In such a case, a *right rotation* particle, for example, an *electron*, passing through zero during a consequential series of transformations of the matter-space-time field, *becomes* a particle of a *left cylindrical* field, that is, a *positron*. In this sense, the *positron* is the *future* of the *electron* and at the same time is its *past*, since in the past the electron was a positron. Such is the *dialectics* of the actual *field* of *time* whose concentration is the electron.

6. A possible g-nucleon structure of the neutron

As *follows* from the stated above and *solutions* of the *wave equation* in spherical polar coordinates, the *structure* of a *neutron* in g-*nucleon* space (Fig. 2) is *identical* to the shell-nodal (*molecule-like*) structure of the ^{28}Si atom,

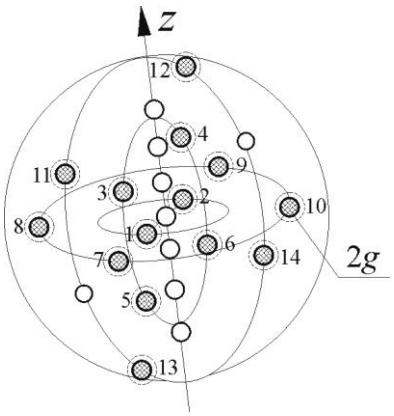


Fig. 2. The g-nucleon structure of a neutron following from solutions of the wave equation.

Two *polar-azimuthal nodes* with numbers 1 and 2 of the *inner neutron shell*, corresponding to the solution for quantum numbers l=1 and m=±1, contain *four* g-nucleons (two per node). Next neutron shells correspond to the solutions for l=2 and m=±1 (node numbers 3, 4, 5, 6), l=2 and m=±2 (node numbers 7, 8, 9, 10), l=3 and m=±1 (node numbers 11, 12, 13, 14).

Nodes of all *wave shells*, except the nodes with numbers 8 and 10, are in the *same plane*. The *outer wave shell* contains also *two* unfilled *collateral* nodes (smaller white circles in Fig. 2, they are responsible for the so-called "*hole conductivity*" of silicon). Along the z-axis, there are *seven* polar *potential-kinetic nodes* (they are *nodes* of *rest* and *motion* simultaneously).

Each of the 14 numbered *main potential polar-azimuthal* nodes is filled with two *coupled g-nucleons* (which mass is $m_g = 68m_e$). The *ordinal number* of the *neutron* in the *g-nucleon* space Z_g=14 (exactly equal to the number of completed *main* potential polar-azimuthal nodes).

Thus, being the *wave formation* (as all *elementary particles*), the *neutron* in its nodal (molecule-like) structure is *identical* to the *nodal structure* of *standing waves* in a *spherical* field-space [6]. It consists of 28 g-*nucleons* located *by pairs* in 14 polar-azimuthal nodes, and is an *analog* of the *silicon* atom ^{28}Si, consisting of 28 *hydrogen atom*s (to which we refer nucleons, *protons* and *neutrons*, and *protium*).

Generally, the *geometry* of the *wave shells*, on which are nodes filled with *coupled* constituent particles (hydrogen atoms or g-nucleons), *determines* in both cases the discrete space *structure* of certain *molecules*, forming the *vast variety* of *crystal* forms strictly determined by the *disposition* of the *nodes* on the shells [7].

Neutrons are obviously *different*. They all make up the neutron ***N***-class of particles.

In the case of *radioactive decay* of atoms, intra-atomic *rearrangement* occurs. *Helium* has a *simplest* shell-nodal *structure*. Its single wave shell contains *two nodes* bound by *strong interaction*. It is the *main fragment* of wave shells of more complex (*many-nodal*) atoms, which is *emitted* during radioactive decay. With this, the *wave shells* of particles in two *nodes* of helium *lose* their *electrons*.

For all that, the definite *modification* both on the rest part of nucleons and on the part of *g*-particles (constituents of nucleons) runs its course. As a result, *fine fractions* in the form of γ-*rays* and miniature *nucleons-electrons* of right and left polarization are *emitted*. The latter are detected as a *stream* of positive and negative *electrons*.

Upon *bombardment* of targets by fast *protons*, decay of nucleons takes place, and the g-*nucleon* "*helium*", in the form of π-*mesons* (containing in their two nodes 4 g-*quanta*), is emitted. In turn, π-*mesons* decay into two γ-*quanta*, each of which generates a pair of *g-quanta* of right and left polarization. In addition, these *g-quanta* can eject electrons.

The *decay picture* considered above *corresponds* to *reality*. Therefore, *it can be argued* that in the hierarchy of elementary particles, *electrons* are at the *end* of the *hierarchical chain* of microobjects of the ***E***-*class*.

7. External and internal particle spaces

We recognize an existence of such an o*verall physical field-space*, unlike all other cosmic fields, which is the *primary source* from which all particles and, hence, all other forms of *matter* are *formed*, and which is a *medium* for the *propagation* of perturbations in the form of *electromagnetic* and *gravitational* waves.

It can be called *aether*, or *physical vacuum*, or in some other way. It is *not essential*; it does not alter the main *concept* of the WM on *material-ideal essence* of the *Universe*, in which *everything* (besides of an ideal part) is *matter*, and absolute vacuum (*emptiness*) *does not exist*.

According to the Dynamic Model (DM) [5], *elementary particles* are formed in result of *compression* (*thickening*) of local *swirls* of the mentioned above *primary* (comprehensive, *physical*) *wave field-space* of the Universe.

Therefore, they *behave* like *pulsating spherical microobjects* (Fig. 3). Longitudinal oscillations (*pulsations*) of their *wave shells*, occurring at the *fundamental frequency* ω_e inherent

in the atomic and subatomic levels (discovered in the DM), provide *interaction* of the particles in *radial* directions with each other and with the surrounding field-space.

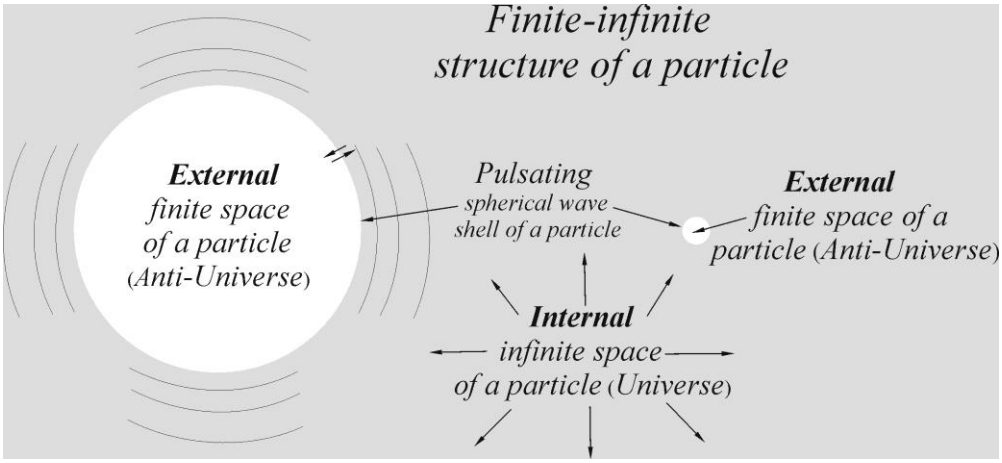


Fig. 3. Finite-infinite structure of elementary particles, in accordance with the DM.

The *wave shell* is an *intermediate* (characteristic) *sphere*. It divides the *main part* of the particle from its *field part*; the latter *gradually merges* with the surrounding field-space to *infinity*. The *main* part (*finite*), within the characteristic wave sphere, is the *basis* of the particle. We regard it as the *Anti-Universe*. The *field* part (*infinite*) represents its *superstructure* (the *Universe*).

Thus, specific *physical point* of the wave field-space (formed *from this space* itself), observed experimentally as a microobject (an *elementary particle*), in fact is the formation of *finite-infinite* in size. *Finite* size (the *main part*) of a particle is *restricted* by the spherical *wave shell* (intermediate) *pulsating* at a strictly defined ultimately high *fundamental frequency*

$$\omega_e = 1.869162505 \times 10^{18}\, s^{-1} \tag{32}$$

inherent in the *atomic* and *subatomic* levels. *Pulsations perturb* the surrounding wave field-space.

The *perturbation*, spreading, *leads* to the *wave exchange* (interaction) of particles, occurring within the *distances* of the order of the *fundamental wave radius*, corresponding to the above frequency,

$$ƛ_e = \frac{c}{\omega_e} = 1.60 \times 10^{-8}\, cm \tag{33}$$

Infinite size of particles *has no boundary*, but it includes a *far remote zone* restricted by the *gravitational wave* spherical *shell*. The size of the shell is defined by the *gravitational wave radius* of particles $ƛ_g$, corresponding to the *fundamental frequency* of *gravitational field* ω_g:

$$ƛ_g = \frac{c}{\omega_g} = 327.36\, Mkm \tag{34}$$

$ƛ_g$ *divides oscillatory* and *wave* domains of *particles* at the *mega* level.

Pulsations of the wave shell (intermediate) of a particle at the ultimately low *fundamental frequency*

$$\omega_g = 9.158 \times 10^{-4}\, s^{-1} \tag{35}$$

discovered in the DM together with ω_e *generate*, respectively, *long waves* in outer space. We call them *gravitational waves*, because they define the *gravitational exchange* (interaction) of particles at the *mega* level.

Thus, in accordance with the DM, *elementary particles* behave like *pulsating spherical microformations*, being in the *dynamic equilibrium* with environment. As *dynamic* objects, *energy clots*, they *exchange* (interact) with environment and other particles on the *fundamental frequencies* ω_e and ω_g. This is realized in the form of *strong*, *electromagnetic* and *gravitational exchanges* (interactions).

The *density gradient* of space (let's call it *ether*), naturally formed near the *vortex* dynamic (*pulsating*) material *formations*, which are *elementary particles*, provides continuous *replenishment* of their *energy*, necessary for *existence*. Similarly, for the pulsations of the heart muscles of living beings, a constant supply of their energy is necessary.

So the *proton* (the *most stable* elementary particle) - a *continuously pulsating* wave formation, is a *vivid example* of the "*perpetual motion machine*" created by nature itself from the wave field-space (ether) and "*feeding*" the *ether energy* in the process of its long existence (*proton lifetime* by some data are estimated at 2.9×10^{29} years).

In view of the above, the *external space* of an atom, that is, its *internal* (*finite*) *volume* limited by the wave shell, is the *space* of the *Anti-Universe* (the antispace) [5]. It is represented by the *antispace* of *nucleons*, which consist of the *antispace* of *g-particles* formed by the *electron antispace* (Fig. 4). Thus, the *external boundary* of *atoms* is represented by *electron spheres.*

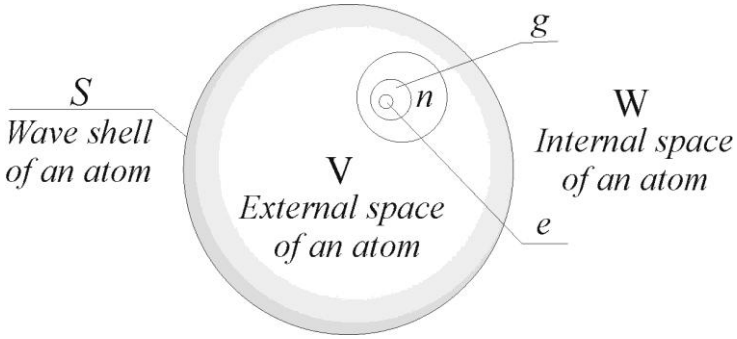


Fig. 4. The hierarchy of the atomic space of an arbitrary atom.

In Fig. 4, one nucleon *n* in the atom, one *g*-particle in the nucleon and one electron *e* in the *g*-particle are only shown. W is the *internal* space (*infinite*) of the atom, *restricted* from the *external* (*finite*) space of the volume V by the *wave shell S*.

V is the *external* space of the *atom* and the *internal* space of the *nucleon*; *n* is the *external* space of the *nucleon* and the *second* stage of the *external atomic space*; *g* is the *external* space of the *g-particle* and the *third* stage of the *external atomic space*; *e* is the *external* space of the *electron* and the *fourth* stage of the *external atomic space*.

The *fourth* stage of the *external atomic space*, equal to the *sum* of *all external electron spaces*, really composes the *external space* of the *atom*. The *spaces* of *g* and *n* particles, and the *external* and *internal* spaces of an atom, respectively, V and W, *represent* the *first*, *second*, *third*, and *fourth* levels of the *internal spaces* of *electrons* in the atom.

In modern *physics*, W-space (*internal* space of an *atom*) is named the *interatomic* space, and all *external* spaces are named the *internal* spaces.

According to the WM, *true atoms* are only *one-nucleon* (hydrogen) *atoms*: *proton*, *neutron* and *protium*. The *remaining atoms* of the periodic table are *nucleon molecules* [8]. Their *shell-nodal* structure is *identical* to the *nodal structure* of *standing waves* in a spherical field-space.

The *boundary* "*external*" wave shell *S* of an atom, *nodes* on which are *filled* with hydrogen atoms (*maximum* by *two per node*), is, strictly speaking, the very *internal* shell of the atomic space. It *determines* to a considerable extent the *qualitative features* of the atom.

If this shell is just *starting* to be built from nucleons, then the probability of *electron emission* into the *internal* atomic space W, in the presence of an additional *electric field*, is significant. The *internal* atomic space will be the "*conductor*" of *electrons*.

In the case of a *saturated shell*, when *completion* of the external wave shell *S with nucleons* is *ending*, an atom will have a *low probability* of electron *emission* outside its external space V; hence, we will deal with the "*nonconductor*" of electrons. *Semiconductors* are between these extreme states.

Atoms of *semiconductors*, such as Si and Ge, have *collateral polar-azimuthal nodes* on their *external* wave shells *S*, *unfilled* with *nucleons*. For example, an *isotope* of ^{28}Si has *two* such *nodes* (*unnumbered* smaller *white circles* in Fig. 2), and ^{32}Ge – *four* (details in [7, 8]). Such atomic spaces are *characterized* by the *electron* and "*hole*" (*proton* and *g-nucleon*) conductivity.

Thus, if we move *from* the ordinary *molecular* level to *lower levels* of matter-space-time, the *following sequence* is *viewed*:

1) The *molecular level*; its basis constitutes *nucleon molecules* ("*atoms"*).

2) The "*atomic" level* (the level of *nucleon molecules*); main structural units are *nucleons*, *neutrons* and *protons*, and *protium*. We call all of them *hydrogen atoms*. They form *nucleon molecules* – "*atoms"*.

3) The *nucleon level*. Its main structural units are *g-nucleons* representing subnucleons of nucleons; they form *g-nucleon molecules* (g-*"atoms")*. The *g-nucleon* in a spectrum of elementary particles is called the *muon neutrino* ν_μ. As physicists previously assumed, its mass is equal to $68.5m_e$.

4) The *subnucleon level*; *electrons* and *positrons* belong to it; etc.

We have *considered* some of the features *inherent* in particles, as *wave formations*, belonging to the *range* from the *usual molecular level* to the lower *subnucleon* level of matter-space-time. Let us *look now* at the *general scheme* of the *dialectical interrelation* of these *levels*.

8. Dialectics of the basis-superstructure

The *hierarchy* of atomic spaces (Fig. 4) shows that the *spaces* of ***G***-, ***N***-, and ***A***-*class* particles *enter* in the *internal* space of ***E***-*class* particles (in particular, electrons). The ***E***-*class*, as the *basis*, has its own *superstructure* – the ***G***-*class*, which we will briefly present as

$$\boldsymbol{G} = ad(\boldsymbol{E}). \qquad (36)$$

For a *pair* of *electron-g-particle*, it is

$$g = ad(e). \tag{37}$$

In turn, the ***G**-class*, as the *basis*, has the ***N**-class* as the *superstructure*:

$$\boldsymbol{N} = ad(\boldsymbol{G}) \quad \text{and} \quad n = ad(g). \tag{38}$$

At last, ***N***- and ***A**-classes* are relative to *each other* as the *basis* is to the *superstructure*:

$$\boldsymbol{A} = ad(\boldsymbol{N}) \quad \text{and} \quad a = ad(n). \tag{39}$$

Here, *a* is an atom, *n* is a nucleon.

As the *electron* is the *basis* for particles of the above-mentioned classes, it is *greater* than *g-particles*, *nucleons*, and *atoms*.

Let us agree to designate the *internal* space of particles of any class by the symbol of a corresponding class with the subscript "*isp*"; then for the *internal* spaces of ***A***-, ***N***-, ***G***-, and ***E**-classes*, we have

$$\boldsymbol{A}_{isp} \subset \boldsymbol{N}_{isp} \subset \boldsymbol{G}_{isp} \subset \boldsymbol{E}_{isp}\,. \tag{40}$$

The interrelation of *external* spaces, designated by the symbol "*esp*", is *opposite* to that expressed by (40), namely,

$$\boldsymbol{E}_{esp} \subset \boldsymbol{G}_{esp} \subset \boldsymbol{N}_{esp} \subset \boldsymbol{A}_{esp}\,. \tag{41}$$

Thus, according to (40), an *electron contains*: *g-particle*, a *nucleon*, and an *atom*. But according to (41), an *atom* is *greater* than a *nucleon*, a *nucleon* is *greater* than a *g-particle*, and a g-*particle* is *greater* than an *electron*. This is a *fundamental dialectical contradiction*, which *must always be kept in mind*.

Dialectics of *basis-superstructure* embraces the Universe on the whole. In particular, *matter-space* and *space-time* are connected by the relations of *basis-superstructure*:

$$\boldsymbol{S} = ad(\boldsymbol{M}) \tag{42}$$

and

$$\boldsymbol{T} = ad(\boldsymbol{S}) \tag{43}$$

or

$$\boldsymbol{T} = ad(\boldsymbol{S}) = ad(ad(\boldsymbol{M})). \tag{44}$$

The *ratio* of the *parameters* of the *superstructure* **S** and the *basis* **B** for *one class* of physical quantities is equal to

$$\frac{\boldsymbol{S}}{\boldsymbol{B}} = \frac{v}{c} = tg\theta\,. \tag{45}$$

It can be presented, in the *limiting case* of the *fundamental frequency* ω_e, in the following ways

$$\frac{\boldsymbol{S}}{\boldsymbol{B}} = \frac{\omega_e}{c} a = k_e a \tag{46}$$

or

$$\frac{\boldsymbol{S}}{\boldsymbol{B}} \frac{1}{a} = \frac{\omega_e}{c} = \frac{m_e \omega_e}{m_e c} = \frac{e}{m_e c} = k_e\,, \tag{47}$$

where *a* is the parameter corresponding to the limiting frequency ω_e, and ***B**a* is the *wave moment* of parameter ***B***.

The *strict regularity* of *measures*, considered above and expressed, in particular, by the ratio (47), has been *exhibited* in the *Einstein-de Haas* experiments. The *total* micro- and macro-, *magnetic M* and *kinetic L*, *moments* of a metallic *sample-cylinder* were *constant*,

$$M_{micro} + M_{macro} = const, \qquad L_{micro} + L_{macro} = const\ . \tag{48}$$

In the process of *remagnetization* of the cylinder, a *microlevel* of motion-rest is *generated*, *equal* in value to the *macrolevel* of motion-rest:

$$\Delta M_{macro} = -\Delta M_{micro}, \qquad \Delta L_{macro} = -\Delta L_{micro}\ . \tag{49}$$

But, as far as

$$\Delta M_{micro} = \sum \frac{v_k}{c} e \cdot r_k = \frac{ve}{c} \frac{\sum v_k r_k}{v} \tag{50}$$

and

$$\Delta L_{micro} = \sum m_e v_k r_k = m_e v \frac{\sum v_k r_k}{v}, \tag{51}$$

then the *ratio* of *macroparameters* ΔM_{macro} and ΔL_{macro} *determines* the *fundamental wave number* k_e:

$$\frac{\Delta M_{macro}}{\Delta L_{macro}} = \frac{e}{m_e c} = k_e\ . \tag{52}$$

Einstein-de Haas experiments *confirmed* this, and, hence, the *validity* of the *law of measures*.

However, the *theory adopted* in physics *leads erroneously* to *half* the value (52), namely to $\frac{e}{2m_e c} = \frac{k_e}{2}$. To *preserve* the *honor* of the generally accepted *theory* and bring it into line with experimental data, the concept of "*electron spin*", equal in magnitude to $\hbar/2$, was *introduced subjectively* [9], doubling the erroneously obtained ratio $\left(1/2\right)k_e$.

The *erroneous* concept of the *electron spin* of the *quantity* $\hbar/2$ *laid* the *foundation* for the introduction of *subsequent erroneous concepts* and *postulated equations*. As a result, *principally* on the *basis* of all the aforementioned *subjectively introduced concepts* and *postulates*, the theory of *quantum electrodynamics* was created [9].

9. Conclusion

Studying the structure of elementary particles in the framework of the Wave Model of dialectical physics (which we develop) led us to the following results.

1) *Neutron* occupying a special place in the hierarchy of elementary particles, being the *main* structural *unit* of matter, represents a g-*nucleon molecule*, whose *shell-nodal* structure is as shown in Fig. 2.

Relative *mass* of a *neutron*, expressed in *units* of the *mass* of constituent *g-leptons*, is 28.07576479. Therefore, a *neutron* (a g-*nucleon molecule*) as the $^{28}_{14}G$ *atom* of the *subatomic g-nucleon level*, is an *analog* of the $^{28}_{14}Si$ silicon *atom* (a *nucleon molecule*, most common in nature) of the *subatomic nucleon level* with a mass number of 28.0855.

2) The *periodic law* of *measures* (1) reflects the *periodic essence* of the *Universe*. All *objects* and fields in Nature *obey* this *law*. The latter *contains* information *about* both the *basis* and the *superstructure* of all specific physical parameters, such as speed, wavelength, wave radius, wave period, frequency of exchange, mass, charge (associated powers of exchange), etc.

3) The *speed* of processes in the Universe is *not limited* by anything, and the *speed* of *light* is the fundamental *period-quantum* in the field of material-ideal exchange.

4) *Reference measures* of *masses* (*mass spectrum*) of elementary particles, following from the periodic law for mass, *correlate* with the *fundamental* metrological *period-quantum* $\Delta = 2\pi \lg e$. In particular, the *mass* of a *neutron* corresponds to the *golden sectio*n of the *mass interval* of ***N****-class* particles.

5) The *electron* belongs to ***G****-class* particles, which are structural *components* of the world of *elementary particles*, including *neutrons*; and the *electron* is a *boundary particle* of ***E****-class* particles.

6) The *ratio* of the parameters of *superstructure* and basis for the *one class* of physical *quantities* is equal to the *fundamental wave number* $k_e = \frac{e}{m_e c}$.

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