Biquaternionic representation of harmonic elementary particles. Periodic system of atoms

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Abstract : *Particular monochromatic solutions of biquaternionic wave for the free fields of electro-gravimagnetic charges and currents have been constructed that describe elementary particles as standing monochromatic electro-gravimagnetic waves. Two classes solutions of this biwave equation generated by scalar potentials (pulsars) and vectorial potentials* (spinors) *are studied. Their asymptotic properties have been researched on the basis of which they are classified on heavy and light elementary particles* (bosons *and* leptons). *It is shown that bosons are spherical harmonic pulsars, the mass density of which is determined by their frequency of oscillations. This allows constructing periodic systems of elementary particles on the basis of classical musical scale. In particular, a biquaternionic representation of the hydrogen atom is given and advising it a periodic system, built on the principle musical system of a simple harmonic gamut.*

Keywords: *biquaternion, frequency, standing wave, pulsar, spinor, boson, lepton, atom, hydrogen, periodic system, musical scale.*

I. INTRODUCTION

In [1-6], the author developed a biquaternionic model of electro-gravimagnetic field (EGM-field) and electro-gravimagnetic interactions. It is based on biquaternionic representations of Maxwell and Dirac equations (MEq, DEq) and their generalization in bi-quaternions algebra (GMEq, GDEq)). The biquaternionic representation of GMEq expresses the biquaternion of EGM-charges and EGM-current densities through the bigradient of EGM-field intensity. The biquaternionic representation of GDEq defines transformation a density of EGM-charges (mass-charges) and EGM-currents under influence of external EGM-fields. In particular, in absence of external fields, on its basis, the biquaternionic wave equation of a free field of mass-charges and currents, which is a field analogy of the first Newton law - *inertia law* was obtained.

Here the particular monochromatic solutions of this equation are constructed, which describe elementary particles as standing EGM-waves. They can be divided into two classes generated by scalar potentials (*pulsars*) and vectorial potentials *(spinors*). Their asymptotic properties are researched, on the base of which they are classified on heavy (*bosons*) and light (*leptons*) elementary particles.

It is shown that bosons are spherical harmonic pulsars, the mass-charge density of which is determined by their oscillation frequency. This allows us to build periodic system of elementary particles based on the simple harmonic musical scale. In particular, a biquaternionic representation of hydrogen atom and the correspond-ding periodic system are built on the principle of a musical simple gamut.

II. EQUATION OF A FREE FIELD OF CHARGE-CURRENT

The equation of a free field of charge-currents has the form of a homogeneous biwave equation:

$$\nabla^{-}\boldsymbol{\Theta}(\tau,x)=\left(\partial_{\tau}-i\nabla\right)\circ\left(i\rho(\tau,x)+J(\tau,x)\right)=\mathbf{0}$$

Here $\boldsymbol{\Theta}(\tau,x)$ is biquaternion of charge-current (CC), which scalar part $\rho(\tau,x)$ describes the densities of electric and gravimagnetic charges (*EGM-charge*). Vectorial part $J(\tau,x)$ is the density of electric and gravimagnetic currents (*EGM-currents*):

$$\rho=-\rho^{E}/\sqrt{\varepsilon}+i\rho^{H}/\sqrt{\mu}$$

$$J=J^{E}+iJ^{H}=-\sqrt{\mu}\,j^{E}+i\sqrt{\varepsilon}\,j^{H}$$

Here $\rho^{E}(x,t), J^{E}(x,t)$) are densities of electric charge and current, $\rho^{H}(x,t), J^{H}(x,t)$ are densities of gravimagnetic charge and current; ε,μ are constants of electric conductivity and magnetic permutability of vacuum, $c=1/\sqrt{\varepsilon\mu}$ is light speed, i is imaginary unit.

Action of biquaternionic differential operators ∇^{+} and ∇^{-} (*mutual bigradients*) are defined according to the rule of quaternions multiplication:

$$\nabla^{\pm}\mathbf{F}(\tau,x)=(\partial_{\tau}\pm i\,\nabla)\circ(f(\tau,x)+F(\tau,x))\,\square$$

$$\square\,\{\partial_{\tau}f\mp i\,\mathrm{div}F\}+\{\partial_{\tau}F\pm i\,\mathrm{grad}\,f\pm i\ \ \mathrm{rot}F\}$$

Energy-pulse Bq of any **F**-field has the form:

$$\mathbf{\Xi}=W+iP\ =0,5\mathbf{F}\circ\mathbf{F}^{*}$$

;

where $\mathbf{F}^{*}$ is *conjugated* Bq:

$$\mathbf{F}^{*}=\bar{f}-\bar{F}\,.$$

Here, the line above the symbol means complex conjugation. The scalar part W is energy density of **F**-field, and P is analogue of Pointing vector of electro- magnetic field. We name it by the same name (for details, see [5,6] about application of differential algebra of biquaternions in electrodynamics). Scalar part of this equation is well known

the law of EGM-charge conservation:

$$\partial_{\tau}\rho+\mathrm{div}\,J=0$$

The vectorial part describes the connection between charges and currents in absence of external EGM-field. It is

the law of EGM-current motion:

$$\partial_{\tau}J-i\,\mathrm{rot}\,J+\mathrm{grad}\,\rho=0$$

This two laws is the closed hyperbolic system of differential equation for construction of its solutions.

III. MONOCHROMATIC EGM-FIELD. HARMONIC ELEMENTARY PARTICLES AND STRUCTURES

For monochromatic fields of frequency ω, CC-Bq can be represented as

$$\mathbf{\Theta}(\tau,x)=\mathbf{\Theta}(x,\omega)\exp(-i\omega\tau),\quad \omega>0. \qquad (2.1)$$

In this case from Eq (1.1) we get the equation for complex biquaternionic amplitude (*biamplitude*) $\mathbf{\Theta}(x,\omega)$:

$$(\omega+\nabla)\circ(i\rho(x)+J(x))=\mathbf{0}\,.$$

Since composition of ω-*gradients* is equal to

$$(\omega+\nabla)\circ(\omega-\nabla)=(\omega-\nabla)\circ(\omega+\nabla)=\omega^{2}+\Delta\ ,$$

from here follows that biamplitude satisfies to Helmholtz equation:

$$\Delta\mathbf{\Theta}(x,\omega)+\omega^{2}\mathbf{\Theta}(x,\omega)=0,$$

Δ is Laplace operator.

Monochromatic solutions of Eq.(1.1) have the form:

$$\mathbf{\Theta}(x,t)=\exp(-i\omega)(\omega-\nabla)\circ\left(\psi^{0}(x,\omega)+\sum_{j=1}^{3}\psi^{j}(x,\omega)e_{j}\right), \qquad (2.2)$$

where potentials ψ^{j} are any solutions of Helmholtz Eq.

$$\Delta\psi^{j}+\omega^{2}\psi^{j}=0$$

which can be presented as surface integral of the kind

$$\psi^{j}=\int_{\|\xi\|=\omega}\phi^{j}(x,\omega)\,e^{-i(\xi,x)}dS(\xi)$$

for any function $\phi^{j}(x,\omega)$ summed on the sphere of radius ω.

We consider particular solutions of the Helmholtz equation [7]:

$$\psi_{nm}(x,\omega)=j_{n}(\omega r)P_{n}^{m}(\cos\vartheta)\exp(im\lambda)$$

where $j_{n}(\omega r)$ are spherical Bessel functions of order n (n = 0, 1, 2..), $P_{n}^{m}(\cos\vartheta)\exp(im\lambda)$ are spherical harmonics, $P_{n}^{m}(\cos\vartheta)$ are Legendre's and associated Legendre's polynomials [8]; r,ϑ,λ are spherical coordinates.

It's natural to take these decisions to build elemen-tary particles, which can be named *harmonic*. Among them we single out generated by the scalar potential,

which we call *pulsars*:

$$\Theta_{nm}^{0}(x,\omega)=(\omega-\nabla)\psi_{nm}=$$
$$=\omega\psi_{nm}(x,\omega)-\mathrm{grad}\,\psi_{nm}(x,\omega) \qquad (2.3)$$

Spinors are generated by vectorial potential:

$$\Theta_{nm}^{j}(x,\omega)=(\omega-\nabla)\circ\psi_{nm}(x,\omega)e_{j}=$$
$$=\mathrm{div}\left(\psi_{nm}e_{j}\right)+\left\{\omega\psi_{nm}e_{j}-\mathrm{rot}\left(\psi_{nm}e_{j}\right)\right\} \qquad (2.4)$$

They are polarized in direction of coordinate axes, respectively to j = 1, 2, 3.

Using structural biquaternions of an arbitrary form $\mathbf{K}(x)$ and biquaternionic operation of convolution (ε_{jlm} is Levi-Civita pseudo-tensor):

$$\mathbf{\Theta}(x,\omega)*\mathbf{K}(x)=(i\rho+J)*(k+K)=$$
$$i\rho*k-\sum_{j=1}^{3}J_j*K_j\}+\left\{i\rho*K+J*k+\sum_{j,l,m=1}^{3}\left(J_j*K_l\right)\varepsilon_{jlm}e_m\right\}$$

we can construct different monochromatic CC-fields:

$$\mathbf{\Theta}(x,\omega)=\sum_{j=0}^{3}\mathbf{\Theta}_{nm}^{j}(x,\omega)*\mathbf{K}_j(x) \qquad (2.5)$$

The functional convolution for regular function has integral form:

$$\rho*k=\int_{R^3}\rho(y,\omega)k(x-y)dy_1dy_2dy_3$$

Components of convolutions for vector are written in the same way. At the strength of the differentiation property of convolution, it is also solution of Eq (2.1).

Formulas (2.5) allow us to build various crystal lattices from harmonic elementary particles, if as a structural biquaternion we take *lattices*, which are various shifts of the delta-function and others generalized functions.

Here is a simple example of a heterogeneous rectangular grid with variable step (h_l; h_m; h_n) and weights a^{lmn}: for any M>1

$$\mathbf{K}(x)=\sum_{l,m,n=1}^{M}a^{lmn}\delta(x_1-lh_1)\delta(x_2-mh_2)\delta(x_3-h_3)$$

It corresponds to the such orthotropic crystalline ω-pulsar:

$$\mathbf{\Theta}(x,\omega)=\sum_{l,m,n=1}^{M}a^{lmn}\mathbf{\Theta}^0(x_1-lh_1,x_2-mh_2,x_3-nh_3,\omega)$$

The formula (2.5) allow us to build the most diverse monochromatic structures, such as bodies, tissues and threads (about their representation see in more detail in [4]). And their frequency superpositions are generally vast.

IV. ELEMENTARY SPHERICAL PULSARS. BOSONS

Among solutions of Helmholtz Eq. only one is spherically symmetric [8]:

$$\psi_{00}(x,\omega)=j_0(\omega r)=\frac{\sin\omega r}{\omega r}, \qquad (3.1)$$

Here $j_0(\omega r)$ is spherical Bessel function, $r=\|x\|$, $e_x=x/r$. The biamplitude of corresponding pulsar has the form:

$$\mathbf{\Theta}^0(x,\omega)=(\omega-\nabla)\psi_{00}= \\ =\omega\left(j_0(\omega r)-j'_0(\omega r)e_x\right) \qquad (3.2)$$

Hence, taking into account the fact that

$$\frac{dj_0(z)}{dz}=-j_1(z),$$

we obtain complex amplitudes and amplitudes of CC-field oscillations:

$$i\rho^0+J^0=\omega\left\{j_0(\omega r)+j_1(\omega r)e_x\right\},$$
$$\rho^0=-i\omega j_0(\omega r), \quad J^0=\omega j_1(\omega r)e_x,$$
$$\left|\rho^0\right|=\omega\left|j_0(\omega r)\right|, \quad \left\|J^0\right\|=\omega\left|j_1(\omega r)e_x\right|$$

Calculating the energy-momentum

$$\mathbf{\Xi}^0=W^0+iP^0=0,5\mathbf{\Theta}^0e^{i\omega t}\circ\left(\mathbf{\Theta}^0\right)^*e^{-i\omega t} \qquad (3.3)$$

we get energy density

$$W^0=0,5\omega^2\left(j_0^2(\omega r)+j_1^2(\omega r)\right)$$

and zero Pointing vector

$$P^0(x)\equiv 0$$

From these relations and properties of spherical functions follow that CC-density decreases with increasing r as r^{-1}, and the vibrations energy decays even faster, like r^{-2}.

Let's consider the asymptotic behavior of these quantities by $r\to 0$. Insofar as

$$j_0(0)=1, \quad j_1(0)=0 \qquad (3.4)$$

by $r\to 0$

$$\left|\rho^0\right|=\omega+o(\omega r)\to\omega,$$
$$\left\|J^0\right\|=\frac{2}{3}\omega^2r+o(\omega r)\to 0,$$
$$W \,\square\, 0,5\omega^2,$$
$$P\equiv 0.$$

And so we have next

Properties of spherical harmonic pulsars

At spherical harmonic pulsars in the center (x = 0) GM-charge density is equal to its oscillation frequency ω, EGM-current density is zero, EGM-energy density is equal to $0,5\,\omega^2$, and Pointing vector is zero everywhere.

Based on these properties of the density of the mass charge, spherical harmonic pulsars are heavy elementary particles - *bosons.*

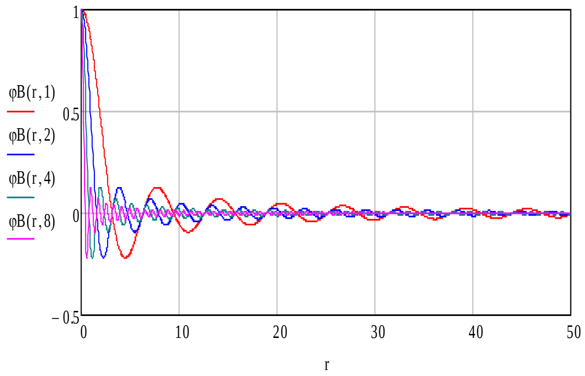


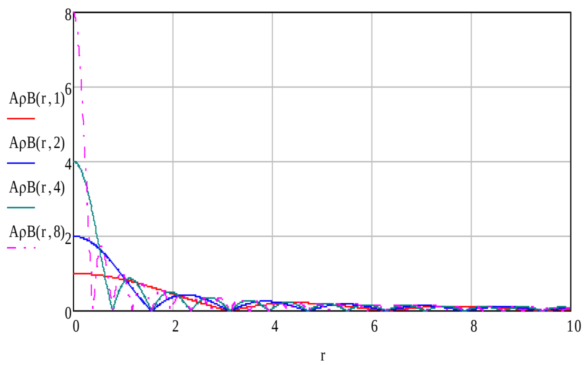
Figure 1. Scalar potential $\psi_{00}(x,\omega)$ of bosons: ω =1,2,4,8

At figures 1-6 you can see their properties depend on r for different frequencies. Figures 1-5 show graphs of changes in the scalar potential and the amplitudes of the densities of the EGM charge and the EGM current of bosons and their components in the radial coordinate on which they depend, with successive doubling of frequencies on each graph. With in-creasing frequency, the density maxima at zero increase, the nodal points thicken, and the decrease along the radius from the center of a boson increases.

Figure 6 shows graphs changes of boson energy density. There are not nodal points. The energy in the center of a boson sharply increases with increasing frequency and falls faster near its center.

Nonspherical harmonic pulsars (6) for $n > 0$ have zero density at $x = 0$, because [8]

$$j_n(z) = \frac{z^n}{(2n+1)!!}(1+o(z)) \quad by \quad z \to 0. \quad (3.5)$$



They are light elementary particles - *leptons.*

Figure 2. Amplitude EGM-charge density of bosons : ω= 1; 2; 4; 8

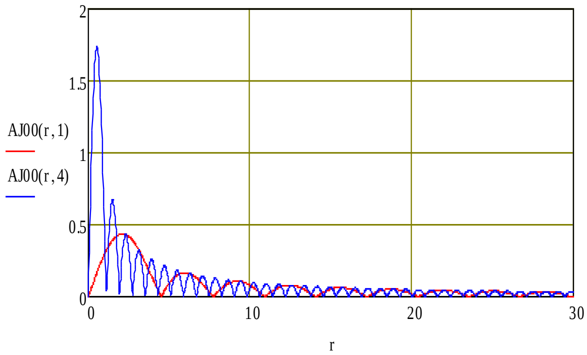


Figure 3. Amplitude of gravimagnetic density of bosons : ω= 1; 2; 4; 8

V. ELEMENTARY SPHERICAL SPINORS. LEPTONS

At first let's consider a spinor polarized in the direction of X_1 axis:

$$\mathbf{\Theta}_0^1(\tau,x) = \mathbf{\Theta}_0^1(x,\omega)e^{-i\omega\tau},$$

generated by vectorial potential

$$\psi_{00}^1(x,\omega) = j_0(\omega r)e_1$$

which biamplitude is equal to

$$\mathbf{\Theta}_0^1(x,\omega) = i\rho_0^1 + J_0^1 = (\omega - \nabla)\, j_0(\omega r)e_1 =$$

$$= \mathrm{div}(j_0(\omega r)e_1) + \omega j'_0(\omega r)e_1 - \mathrm{rot}(j_0(\omega r)e_1)$$

From here follow

$$\rho_0^1 = i\omega j_1(\omega r) r_{,1}\,,$$
$$J_0^1 = \omega\left(j_0(\omega r)e_1 + j_1(\omega r)(r_{,3}\, e_2 - r_{,2}\, e_3)\right); \quad (4.1)$$

$$\left|\rho_0^1\right| = \omega\left|j_1(\omega r) r_{,1}\right|, \quad r_{,j} = x_j / \|x\|,$$

$$\left\|J_0^1\right\| = \omega\sqrt{j_0^2(\omega r) + j_1^2(\omega r)(r_{,3}^2 + r_{,2}^2)}.$$

Energy-impulse density is equal to

$$\Xi_0^1 = W_0^1 = 0{,}5\omega^2\left(j_0^2(\omega r) + j_1^2(\omega r)\right),$$
$$P^{01} \equiv 0. \quad (4.2)$$

By $r \to 0$

$$\left|\rho_1^0\right| \approx 0, \qquad \left\|J_0^1\right\| \approx \omega,$$
$$W_0^1 \approx 0{,}5\omega^2, \quad P_0^1 \equiv 0. \tag{4.3}$$

Following (4,1), we obtain the biquaternion representation of the spherical spinor, polarized along an arbitrary vector *e*

$$\mathbf{\Theta}_0^e(x,\omega) = i\rho_0^e + J_0^e = (\omega - \nabla)\, j_0(\omega r)e =$$
$$= \mathrm{div}(j_0(\omega r)e) + \omega j_0\,'(\omega r)e - \mathrm{rot}(j_0(\omega r)e)$$

Calculating we get

$$\rho_0^e = -\omega j_i(\omega r)(e_x, e)$$
$$J_0^e = \omega\left(j_0(\omega r)e + j_1(\omega r)\left[e, e_x\right]\right) \tag{4.4}$$

with the same asymptotic properties. Here $\left(e, e_x\right)$, $\left[e, e_x\right]$ are scalar and vector productions. And so we have next

Properties of spherical spinors.

In the center (x = 0) of spherical spinors EGM-charge density is zero, the norm of EGM-current density is equal to ω , energy density equal to $0{,}5\,\omega^2$, Pointing vector is zero.

Thus, spherical harmonic spinors, in terms of EGM charge density, belong to the light elementary particles -*leptons*.

Mass-charge density of all other spinors, generated by vectorial potential $\psi_{nm}(x,\omega)e$ tends to zero by $r \to 0$ in virtue of (3.5). They are leptons.

VI. BIQUATERNIONIC REPRESENTATION OF ELEMENTARY HYDROGEN ATOM

So, we have shown that among monochromatic solutions of the charge-current free field equations (1.1), only harmonic spherical pulsars have nonzero density at their center. This suggests that spherical harmonic pulsars can be used to build the biquaternionic model of elementary atoms.

The simplest atom is hydrogen (H). It is known that the spectrum of the hydrogen atom contains a set of frequencies. Let's denote ω_0 the minimum frequency in its spectrum.

We name *elementary hydrogen atom* the spherical harmonic pulsar with ω_0 frequency. Its biquaternionic representation has the form:

$$\mathbf{H}_0(\tau, x) = \omega_0 \left\{ j_0(\omega_0 r) + j_1(\omega_0 r)e_x \right\} e^{-i\omega_0 \tau}$$

The asymptotic properties of its density at the center of the atom are related to the oscillation frequency: by $r \to 0$

$$\left|\rho_{\mathbf{H}_0}(x,\tau)\right| \approx \omega_0, \quad \left\|J_0(x,\tau)\right\| \approx 2\omega_0^2 r/3,$$
$$W_0(x,\tau) \approx 0{,}5\omega_0^2, \quad P_0(x,\tau) \equiv 0.$$

Note, from last formulas follows that this atom does not radiate energy. The nodes of this *standing wave* in mass density $\rho_{\mathbf{H}_0}$ are the spheres whose radius are determined as the roots r_k of the simple trigonometric equation:

$$\sin \omega_0 r_k = 0 \quad \Rightarrow \quad r_k = \frac{\pi k}{\omega_0}, \quad k = 1,2,3...$$

To determine the nodes of this standing wave by energy density W_{H_0} it needs to find the zeros of a more complex equation:

$$\left(\omega_0 r\right)^2 + \omega_0 r \sin\left(2\omega_0 r\right) - \sin^2\left(\omega_0 r\right) = 0 \tag{5.3}$$

However, this equation has not real roots (see Fig.5).

In the original space-time (t,x)

$$\exp(-i\omega_0 \tau) = \exp(-i\omega_0 ct) = \exp(-i\omega_0 ct), \quad \varpi = \omega_0 c$$

c=2997924581m/s. Using the representation of complex charges and currents through electric and gravimagnetic charges and currents (1.1), we obtain the following expressions for its elementary hydrogen atom , electric and gravimagnetic charges, electric and gravimagnetic currents:

$$\rho_{\mathbf{H}_0}^E = \frac{\sqrt{\varepsilon}}{r}\cos(\varpi t)\sin\frac{\varpi r}{c}$$
$$\rho_{\mathbf{H}_0}^H = \frac{\sqrt{\mu}}{r}\sin(\varpi t)\sin\frac{\varpi r}{c} \tag{5.1}$$

$$j_{\mathbf{H}_0}^E = \frac{1}{\sqrt{\mu}\, r}\cos(\varpi t)\left(\cos\frac{\varpi r}{c} - \frac{c}{\varpi r}\sin\frac{\varpi r}{c}\right)e_x$$
$$j_{\mathbf{H}_0}^H = \frac{1}{\sqrt{\varepsilon}\, r}\sin(\varpi \varpi t)\left(\cos\frac{\varpi r}{c} - \frac{c}{\varpi r}\sin\frac{\varpi r}{c}\right)e_x \tag{5.2}$$

Density of the mass-charge decreases as r^{-1} by increasing r, oscillation energy decays even more rapidly, as r^{-2}. On the Fig. 2-5 these characteristics of elementary atom are presented for ω =1,2,4,8…

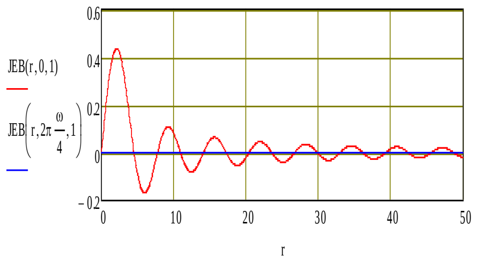


Figure 4. Electric currents $J^E(\tau, r)$ of bosons: $\omega = 1$; $\tau = 0; \pi / 2\omega$.

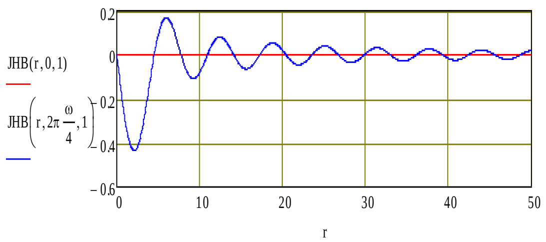


Figure 5. Gravimagnetic currents $J^H(\tau, r)$ of bosons: $\omega = 1$; $\tau = 0; \pi / 2\omega$.

Accordingly, in the initial space-time biquaternion of the elementary hydrogen has the form:

$$\mathbf{H}_0(t, x) = \frac{\varpi}{c}\{j_0(\varpi r / c) + j_1(\varpi r / c)e_x\}e^{-i\varpi t}$$

Consequently (5.2),

$$\left|\rho_{\mathbf{H}_0}(t, x)\right| \sim \omega_0, \quad \left\|J_0(t, x)\right\| \sim 2\omega_0^2 r / 3,$$

$$W_0(t, x) \sim 0,5\omega_0^2, \quad P_0(t, x) \equiv 0.$$

VII. PERIODIC SYSTEM OF ATOMS AS SIMPLE GAMMA

So, in biquaternionic representation, the hydrogen atom is a spherical harmonic standing wave in CC-field with fixed frequency. Since the main characteristic of the hydrogen atom is an oscillation frequency, which determines its mass, on its basis it's possible to construct the *periodic system* for elementary atoms according to the principle of the *musical scale*. As the frequency increases, the mass of atoms also increases.

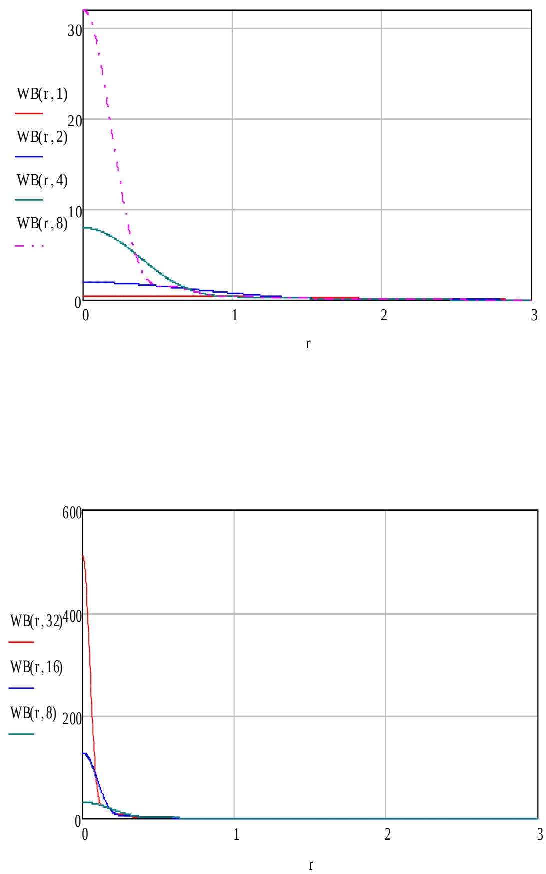


Figure 6. Energy density $W(r, \omega)$ of bosons: $\omega = 1,2,4,8\ldots$

The musical scale is the system of octaves with base frequency w doubling for each subsequent octave:

$$w, 2w, 4w, 8w, 16w, \ldots.$$

The ratio of oscillation frequencies of atoms inside the n-octave:

$$2^{n-1}w, \ldots, 2^n w$$

like to the ratio of tone frequencies within the musical scale. Number of tones in the musical scale depends on the type of a musical system. Here in Table 1 the pure harmonic musical scale is presented, which can be taken as a basis. In it the ratio frequency of tones is a rational number. For such tones (*notes*), there is the total period of oscillations, which makes possible to harmoniously sound the accords from different notes. For each of them, in nature, there is the substance which possesses the described above properties.

Table1. *Simple gamma*

Pure scale. Harmonic sound row							
Pri-me *Do*	Big Second *Re*	Big Terza *Mi*	Quart *Fa*	Qwint *Sol*	Big Sesta *La*	Big Septi-ma *Si*	Octave *Do*
w_n	$\frac{9}{8}w_n$	$\frac{5}{4}w_n$	$\frac{4}{3}w_n$	$\frac{3}{2}w_n$	$\frac{5}{3}w_n$	$\frac{15}{8}w_n$	$2w_n$

The number of tones within an octave can be changed with growth octave numbers, but all the similar tones of a previous octave in it should be present, which explains the repeatability of chemical properties of substances in columns of periodic Mendeleyev system, just as the musical sounds are harmonious for perception for octaves and chords composed of them.

Proceeding from this, the atoms can be called *musical elementary particles* with the appropriate names. The hydrogen atom is the note *do* of the *first natural octave*.

Biquaternion of k-th elementary atom in n-th octave has the form

$$\mathbf{Atom}^{n,k}(t,x) =$$

$$= \frac{e^{-iw_{n,k}t}}{r}\left\{\sin\frac{w_{nk}r}{c} - \left(\cos\frac{w_{nk}r}{c} - \frac{c}{w_{nk}r}\sin\frac{w_{nk}r}{c}\right)e_x\right\}$$

Here vibration frequencies of atoms

$$w_{nk} = 2^n \gamma_k \varpi$$

where n is octave number, γ_k is the number from *k*-th column in the Table 1 musical scale.

All above formulas for bosons are true for them with indicating the corresponding vibration frequency.

The presented figures 1-6 describe the behavior of the first atoms in the first 6 lines (octaves) of the Table 1.

CONCLUSION

How many such natural octaves exist? Obviously no less than the number of lines in the Mendeleev periodic table. Note that now accepted in classical music twelve-tempered musical scale with 12 notes inside octaves cannot be taken, since the ratio of the frequencies of consecutive tones in it is irrational number ($\sqrt[12]{2}$) and there is not the total oscillations period in any row of periodic system.

Similar periodic systems can be constructed for elementary harmonic leptons (spinors and asymmetric pulsars), the addition of which to atoms with the same vibration frequency creates isotopes of these atoms. Moreover, the addition of spinors, apparently, associated with the magnetization of a substance. You can build a lot different isotopes with the same asymptotic density of the EGM charge. Which of them exist in nature? It's also a special question of experimental research.

We also note that this description of atoms is based on the construction solutions of a free field equations of charge-currents. At the action of external EGM-fields the charges-currents are transformed. Their transformation is described by generalized Dirac equation (see [10]). External EGM action shifts atoms vibration spectrum. In particular, external static EGM-field must be taken into account in the experimental justification of considered model.

Currently the most common and canonized representations of light and heavy elementary particles and atoms, constructed on the basis of solutions of equations of quantum field theory. The bibliography in this direction is more then half a century and very extensive. Here we use the names for heavy and light particles, adopted from this theory. However, the presented biquaternionic model is completely different, deterministic, based on the definition of real physical characteristics of elementary particles and atoms, not probabilistic.

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