The Wave Nature of Gravitational Fields: General Characteristics

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Dialectical analysis of foundations of physics, conducted in the works of the author, showed that gravitational fields are longitudinal-transversal wave fields. Their general characteristics in comparison with characteristics of wave electromagnetic fields, which are longitudinal-transversal as well, are briefly considered in this report. Both above fields are subjected to the universal law of exchange (exposed here) discovered as a result of the analysis. Analytical formulas of fundamental (carrier) frequencies of the fields, ω_g and ω_e, unknown earlier, and values of the frequencies resulted from these formulas are also presented.

Let us recall at the beginning the firmly established fact that all in the Universe, at all its levels, including micro- and mega-, is in incessant oscillatory-wave motion. All in the Universe is undergone the law of rhythm. Continuous mutual transformations of fields with opposite properties (for example, potential field $\Leftrightarrow$ kinetic field) cause the wave nature of the World. It means that fields of all objects in Nature are wave; hence, static fields do not exist in principle. We should recall too the next fact, namely that all in the Universe is in natural harmony. Accordingly, between all fields, including electromagnetic and gravitational, as between any objects and phenomena, it exists a natural harmonic bond.

Following stated above, we should recognize that: (1) both electric and gravitational **static** fields do not exist; (2) all wave processes, including electromagnetic and gravitational, must be subjected to, and described by, the general **wave equation**

$$\Delta \hat{\Psi} - \frac{1}{c^2}\frac{\partial^2 \hat{\Psi}}{\partial t^2} = 0 \qquad (1)$$

And actually, Eq. (1) is applicable to both above fields if one considers them on the basis of new concepts described in detail in the work [1]. The latter explains the general features of the fields elucidating meanwhile that the word "*electromagnetic*" is not appropriate word for corresponding physical fields. The name *electromagnetic* was fully formed historically and literally means *amber-magic*. Such a name does not reflect the

true nature of fields hidden under this alias. Fortunately, this matter was clarified in [1] where the proper name of the fields, *longitudinal-transversal*, was first denominated.

According to the Dynamic Model (DM) [2], developed in the framework of the new approach [1], elementary particles are pulsing physical points of space of the spherical structure, which are in a state of continuous exchange (interaction) with environment over definite fundamental frequencies of pulsations, ultimately high ω_e and ultimately low ω_g, of the wave spherical shell. Such particles, being, according to the definition, unceasingly pulsing microobjects, possess internal energy. The value of the latter ($E_0 = m_0 c^2$) is defined by the associated mass of a particle m_0 and the fundamental wave speed c of extension of the pulsations in surrounding space.

As follows from the result obtained, beginning from setting forth the DM, the key problems of modern physics found their natural solutions. In particular, for the first time a logically non-contradictory simple solution explaining the so-called "anomaly" of the magnetic moment of the electron [3] and the Lamb shift nature [4] (without use of virtual particles) was found at last. It is very important fact, which (along with other revelations not mentioned here) shows that potentially the DM is able to successfully compete with quantum electrodynamics (QED) and, hence, can supersede the standard model (SM) accepted currently in physics [5].

From the DM it follows that both **electromagnetic and gravitational fields** are **longitudinal-transversal potential-kinetic fields** of ultimate high and ultimate low fundamental frequencies, correspondingly.

A field of particles of the **ultimate high fundamental frequency**, lying in the exafrequency band, is responsible for their interactions at the atomic and subatomic levels. This frequency is defined by the formula

$$\omega_e = e / m_e = 1.869162559 \times 10^{18} \, s^{-1}, \tag{2}$$

where e is the **exchange charge** and m_e is the **associated mass** of the electron. It is the frequency of the field, which is called in modern physics "electrostatic". Present time devices cannot detect exafrequency fields and therefore perceive them as static. Amplitude modulation of the field at different, but essentially less than ω_e, frequencies gives the whole spectrum of fields which are regarded as electromagnetic.

The fundamental frequency ω_e is responsible for intraatomic ("electrostatic" and "nuclear") and interatomic ("molecular") interactions. It defines, in particular, the strong correlation (specific distance) in relative location of nodes (atoms) in crystals.

The **fundamental wave radius**, related to the fundamental frequency ω_e, and defined as

$$\lambdabar_e = c / \omega_e, \tag{3}$$

is equal to $1.603886492 \times 10^{-8} \, cm$. Its double value $2\lambdabar_e \approx 3.2 \times 10^{-8} \, cm$ is equal in average, in magnitude, to the lattice parameters of crystals. It means that the fundamental wave radius shows itself as a measure for setting the pitch, providing a step in disposition of atoms in crystal lattice. As shown in [6], there is a full correspondence of dispositions of atoms in crystals with the dispositions of nodes of standing spherical waves.

The fundamental frequency ω_e enters in equations, which describe in particular the aforementioned "anomalous" magnetic moment of the electron and the Lamb shift [3-5]. Discovery of this fundamental frequency allowed accomplishing the corresponding calculations for the first time without QED concepts.

A field of particles of the **ultimate low fundamental frequency** ω_g, called gravitational, is responsible for their gravitational interactions. From the DM it follows that the **fundamental frequency of gravitational field** is defined by the formula

$$\omega_g = \sqrt{4\pi\varepsilon_0 G} = 9.158082264 \times 10^{-4} \, s^{-1}, \qquad (4)$$

where $\varepsilon_0 = 1 \, g \cdot cm^{-3}$ is the absolute unit density, $G = 6.6720 \times 10^{-11} \, m^3 \cdot kg^{-1} \cdot s^{-2}$ is the gravitational constant known experimentally. This frequency is responsible for gravitational interaction of elementary particles and, hence, all objects, in particular for the disposition of orbits of planets and their satellites in solar system, *etc*. The **gravitational wave radius** of elementary particles, which is simultaneously the radial elementary gravitational wave, is

$$\lambdabar_g = \frac{c}{\omega_g} = 3.274 \times 10^{13} \, cm = 327.4 \times 10^6 \, km \qquad (5)$$

On our Earth we are inside of the gigantic gravitational wave and, therefore, we perceive gravitational field as stationary, but not as wave. The shell of the gravitational radius (5) in stellar systems, which are spherical objects of Megaspace (atoms of the Megaworld), divides the oscillatory domain of the spherical field-space of a star and its wave domain.

The gravitational radius (5) of elementary particles defines, in accordance with solutions of the wave equation (1) the radii of shells of the gravitational domain:

$$r = \lambdabar_g z_{m,n} = 327.4 \times 10^6 \times z_{m,n} \quad km; \qquad (6)$$

where $z_{m,n}$ are roots of Bessel functions [7]. These solutions are realized in the first approximation in the spectrum of Keplerian shells-orbits **if one <u>assumes</u> that these shells are <u>spherical</u> and, hence, the <u>orbiting is circular</u>** (Table 1).

Table 1. The gravitational spectrum of *H*-atomic wave shells

s	$j_{0,s}$	r, Mkm	Planets*
1	2.4048	787.3	Jupiter (778.3)
2	5.5201	1807.3	Saturn (1429.4)
3	8.6537	2833.2	Uranus (2870.99)
4	11.7915	3860.5	
5	14.9309	4888.4	Neptune (4504.3)
6	18.0711	5916.5	Pluto (5913.5)

*) Planets located in the relative proximity to the specified shells.
 The big half-axes of orbits are in brackets.

Saturn and Neptune are closer to the shells of extremes at $z_{m,n} = a'_{0,2} = 4.49341$ and $z_{m,n} = a'_{0,5} = 14.0662$ [7]: $r = 1471.1\,Mkm$ and $r = 4605.3\,Mkm$, respectively.

We can rest on the formula of radii of shells, followed from (1):

$$r_s = r_1 \frac{z_{m,s}}{z_{m,1}} \qquad (7)$$

In this expression the characteristic fundamental frequency of the gravitational field, which was subjected to changes in the course of the Entire Historica Process of the Universe, is absent. Let us take, for example, as the shell of basis, r_1, the shell of Mercury. The following spectrum (Table 2) is produced then by the first-order Bessel functions.

Table 2. The gravitational spectrum of shells

s	$j_{1,s}$	r_s, Mkm	Planets
1	3.831706	57.91	Mercury
2	7.015587	106.03 (108.2)	Venus
3	10.17347	153.76 (149.6)	Earth
4	13.32369	201.36 (178.0)	Toro
5	16.47063	248.93 (227.9)	Mars
6-…	19.61586-…	296.46-…	Asteroids
13	41.61709	628.97	1 asteroid
14	44.75932	676.46	
15	47.90146	723.95	
16	51.04354	771.44 (778.3)	Jupiter

The big half-axes of orbits are in brackets.

The transient domain, between oscillatory and wave, is represented by a ring of asteroids around the Sun. In this zone, big planets cannot be, since in the process of development of solar system this region was a place of the most intensive motion.

In addition, the spectrum of Saturn's shells, followed from (1), is presented in Table 3, where r_1 is Saturn's radius; $<r_s>$ are average radii of shells of Saturn's satellites.

Table 3. The spectrum of Saturn's shells; r_s, *kkm*

s	r_s ($j_{1,s}$)	r_s ($y_{1,s}$)	$<r_s>$ (experiment)
1	60.33		
2	110.46	85.49	
3	160.18	135.34	137.64, 139.34
4	209.78	184.99	185.52
5	259.32	234.56	238.02
6	308.85	284.09	294.66 (3 satellites)
7	358.35	336.60	
8	407.85	383.10	377.40 (2 satellites)
...	...	...	...
11	556.30	531.55	527.04 (Rhea)

Solutions of the wave equation (1) are common for micro- and mega-levels. The formula of radii of shells in the micro (atomic) domain has the same form, like (6), if we substitute $\lambdabar_g$ with $\lambdabar_e$:

$$r = \lambdabar_e z_{m,n} \tag{8}$$

Thus, for example, H-atoms (to which we refer proton, neutron and hydrogen atoms) are described at the micro- and mega-levels by the same wave equation (1). Accordingly, interactions of particles on both levels must be described by the single unified equation as well. Actually, an equation of universal exchange presented below (after some necessary definitions), originated from the DM, resolves this problem.

In the DM there is the notion of **exchange charge** defined as

$$q = m\omega, \tag{9}$$

where m is the associated mass, and ω is the fundamental frequency of the corresponding field of exchange. As concerns the exchange ("electric") charge of the electron, it actually is an **elementary quantum of the rate of mass exchange** [8,9],

$$e = m_e\omega_e = 1.702691627 \times 10^{-9} \ g \cdot s^{-1}. \tag{10}$$

Neutron is the base of atomic systems (as the main unit of mass). **Gravitational charge** of the neutron is

$$q_g = m_n \omega_g = 1,533912182 \times 10^{-27} \, g \cdot s^{-1} \tag{11}$$

Neutron is simultaneously the fundamental quantum of mass and the fundamental graviton with the gravitational charge of exchange q_g.

The universal law of exchange (interaction), originated from the DM, is presented in the following form

$$F = \omega^2 \frac{(Z_1 m)(Z_2 m)}{4\pi\varepsilon_0 r^2} \tag{12}$$

where Z_1 and Z_2 are relative masses of interacting objects, $\varepsilon_0 = 1 \, g \cdot cm^{-3}$ is the absolute unit density.

Coulomb's law and Newton's law of universal gravitation are particular cases of this universal law. For example, the following equations

$$F_e = \omega_e^2 \frac{(Z_1 m_e)(Z_2 m_e)}{4\pi\varepsilon_0 r^2} \tag{13}$$

$$F_g = \omega_g^2 \frac{(Z_1 m_n)(Z_2 m_n)}{4\pi\varepsilon_0 r^2} \tag{14}$$

describe, correspondingly, exchange-interaction at the level of the wave "electric" field (13) on the basis of electron with the associated mass m_e and the exchange ("*electric*") charge $e = m_e \omega_e$ (Coulomb's law); and the exchange-interaction at the level of gravitational wave field (14) on the basis of graviton-nucleon with the associated mass m_n and the exchange power (gravitational charge) $q_g = m_n \omega_g$ (Newton's law).

From the universal law it follows that **gravitational constant** is related with the fundamental gravitational frequency by the following way

$$G = \frac{\omega_g^2}{4\pi\varepsilon_0} \tag{15}$$

The value of the gravitational frequency (4) originates from the latter equality.

The gravitational frequency ω_g defines the **radial time wave-period** T_g,

$$T_g = \frac{2\pi}{\omega_g} = 0.686080898 \times 10^4 \, s \, . \tag{16}$$

The **azimuthal time wave of the fundamental tone** T_c corresponds to the above period:

$$T_c = 4\pi T_g = 8.621546841 \times 10^4 \, s \,. \tag{17}$$

Its value is actually equal to the Earth's day (24 h = $8.640 \times 10^4 \, s$). The **time wave** T_c repeats the structure of **spatial wave** of the fundamental tone at the Bohr orbit, $\lambda = 4\pi r_0$, and the analogous structure of the azimuthal (transversal) electron wave of the fundamental tone, $\lambda_e = 4\pi r_e$ (where r_e is the radius of the electron).

Hence, taking into account (16) and (17), the gravitational constant G (15) can be also presented in the following way

$$G = \frac{16\pi^3}{T_c^2 \varepsilon_0} \,. \tag{18}$$

The above relationships show that the **Earth** is in the **harmonic resonance bond** with the fundamental gravitational frequency ω_g. Just like the **electron** on the Bohr orbit is in the **harmonic resonance bond** with the fundamental frequency of the subatomic and atomic levels ω_e.

Thus, the Earth is fundamentally distinguished from other planets (just like the hydrogen atom is distinguished from all other elements of the periodic table), taking a special place in the field-space of the Solar system and maybe in Cosmos on the whole!

Conclusion

According to the DM, elementary particles are finite-infinite in size. A finite size of a particle is defined by the spherical wave shell pulsing with exafrequency ω_e. The latter defines interaction of particles at the microlevel (atomic and subatomic). An infinite size of particles has no boundary, but it includes the far remote zone, spherical wave shell, pulsing with the fundamental frequency ω_g, which divides oscillatory and wave domains of particles at the mega- (gravitational) level, and defines gravitational radius of the particles and their gravitational interaction.

Thus, elementary particles are infinitely small and infinitely big at the same time. From this it follows that wave fields of all particles in the Universe are overlapped. Hence, the wave equation (1) must describe all kinds of wave processes and so-called fundamental interactions, including electromagnetic and gravitational that is realized in the DM.

Gravitational fields, just like electromagnetic, are longitudinal-transversal wave fields. Both above fields are subjected to the universal law of exchange discovered as a result of the dialectical analysis of foundations of physics. Analytical formulas of

fundamental (carrier) frequencies of the fields, ω_g and ω_e, unknown earlier, gave possibility for the first time to calculate their values, (2) and (4).

The existence of the gravitational frequency ω_g and the gravitational radius r_g (along with the fundamental frequency ω_e and the wave radius $\lambdabar_e$ of the subatomic level) of elementary particles shows the indissoluble harmonic bond of micro- and megaobjects of the Universe in the unit complex of the Infinitely Small and Infinitely Big.

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