

DIALECTICAL VIEW OF THE WORLD

The Wave Model
(Selected Lectures)

George P. Shpenkov

Vol. 2
Dynamic Model of Elementary Particles

Part 1.Fundamentals

2013

Vol. 2

Dynamic Model of Elementary Particles

Part 1. Fundamentals

Contents

Lecture 1: The Dynamic Wave Nature of Elementary Particles5

1. Introduction
 2. An overview of the concept
 3. Basic definitions
 4. Conclusion
- References

Lecture 2: The Origin of Mass16

1. Introduction
 2. Initial conditions and equations
 3. Main stages of the derivation
 4. The associated nature of mass
 5. Characteristic parameters
 6. The dynamic energy of particles
 7. Conclusion
- References

Lecture 3: The Nature of Charges 28

1. Introduction
2. The modern state of the problem
3. A solution of the problem; the exchange nature of charges

4. The exchange charge of the electron
 5. The fundamental frequency of exchange
 6. Conclusion
- References

Lecture 4: The Central Exchange.....40

1. Introduction
 2. The universal law of central exchange; derivation
 3. Internal dynamic energy of elementary particles
 4. The exchange charge of the electron
 5. The fundamental frequency of exchange and wave radius
 6. Conclusion
- References

Lecture 5: Gravitational Field of Elementary Particles51

1. Introduction
 2. Fundamental frequency of the gravitational field
 3. Fundamental gravitational wave radius
 4. The universal law of central exchange
 5. Gravitational frequency and Earth's and Moon's parameters
 6. Conclusion
- References

Lecture 6: Gravitational Wave Shells of Elementary Particles.....59

1. Introduction
 2. Theoretical background
 3. Planetary orbits of the solar system
 4. Orbits of planetary satellites
 5. Conclusion
- References

Lecture 7: The Vortical Structure of Gravitational Waves68

1. Introduction
 2. Basis and superstructure
 3. Superstructure of gravitational waves
 4. Hierarchy of cylindrical gravity waves
 5. Conclusion
- References

Lecture 8: The Fundamental Regularity Inherent in Wave Processes 78

1. Introduction
 2. A current definition of the α -constant
 3. Problems related to the α -constant
 4. Interrelationship of basis and superstructure
 5. Threshold parameters at the acoustic level: an example
 6. Conclusion
- References

Lecture 9: The Physical Meaning of the α -Constant.....91

1. Introduction
 2. The energies of wave exchange and their interrelation
 3. The proper forms of the α -ratio
 4. An analysis of the obtained relation
 5. Discussion and conclusion
- References

Lecture 10: Fundamental Quanta of the DM102

1. Introduction
 2. Speed of exchange, c
 3. Frequency of exchange, ω_e
 4. Power of exchange, e
 5. Conclusion
- References

Lecture 11: Fundamental Interactions: A Unified Description114

1. Introduction
 2. Basic formulas and the data
 3. Estimations
 4. Conclusion
- References

Lecture 1

The Dynamic Wave Nature of Elementary Particles

1. Introduction

Let us remind briefly some basic tenets of the Standard Model (SM) that we have discussed in our first lectures of Volume 1. It is very important to keep in mind them for further consideration of the Wave Model (WM), developed as an alternative to the SM. First of all, we would like to stress once more that the flaw in principle of the Standard Model, the fatal flaw on the whole, is the reliance on the *erroneous theoretical physics paradigm*. As you already know from previous Lectures, this paradigm is based on formal logic, which is characterized by limited capabilities, and on numerous abstract and abstract-mathematical postulates. Unfortunately, the use of abstract (fictitious, unreal, mythic) postulates became a routine method for creating all theories in modern physics. A negative result of such an approach is too impressive: it led to the sustained stagnation in physics that noticed currently by the majority of physicists.

More and more physicists come to an unequivocal conclusion that in the framework of the SM cognition of Nature is impossible in principle. At the same time, judging from the publications, it is lamentably that the leading experts in official physics do not want to hear about it; they merely ignore this. Being in captivity of the traditional concepts, they do not want to delve into sensible arguments of the opponents of the SM. And may be the reason is another? Namely, perhaps they are unable at all, in principle, to comprehend such a resulting sad situation, to admit the reality of its occurrence.

What does follow from the erroneous conceptual approach accepted in modern physics and realized within the SM? The better way for answering this question is if we present once more a list of some of the fundamental problems unsolved and unsolvable in principle by the SM. Here they are.

For the reason of using the aforesaid erroneous (from our point of view) approach, modern physics does not comprehend till now such fundamental things as: what is

the nature of charges,
the origin of mass,
the nature of gravitation?

A great mystery for physicists is still the physical meaning of:

the speed of light c in the famous formula $E_0 = m_0 c^2$,
the fine structure constant α ,
the polar-azimuthal functions in Schrödinger's equation.

Modern physics theorists are unable to derive theoretically:

the relative atomic masses of isotopes,
the magnetic moment of a neutron,
the magnetic moment of a proton;

and to build

a unified field theory; *etc.*

In addition to the listed above, please, pay a special attention at the derivation of the anomalous magnetic moment of the electron carried out in quantum electrodynamics (QED), wherewith so proud modern theorists [1]. The aforesaid derivation has reached in QED such an extent of absurdity that it goes far beyond the bounds of common sense. In following Lectures of Vol. 3, we will demonstrate this.

Modern physics erroneously interprets the polar-azimuthal functions in Schrodinger's equation ascribing to these functions, quite arbitrarily and unfoundedly, the physical meaning of atomic "electron orbitals" with which these functions, actually, have nothing to do. As a result, the development of atomic physics has gone astray.

About what else is there to speak. Modern physics does not know also, from which substance and how are made the particles referred to as elementary (electrons, protons, neutrons, and mystic quarks, strings, and *etc.*)? *Etc.*

A disclosure of fallibility of theoretical foundations of modern physics, based on the erroneous paradigm, forced us to seek noncontradictory concepts as the new foundation for creation of an all-embracing adequate model (theory), in order to replace the inadequate Standard Model existed currently.

The **Wave Model** developing during last time, solely by the author of these Lectures (up to 2002 together with L. G. Kreidik), has turned out to be just such an adequate theory, if to judge by the results. This is confirmed by the uniqueness and the large number of the obtained data that are on the level of discoveries.

The WM is based on a *new physics paradigm* that we have accepted and follow in all our works. It includes:

- (1) Dialectical philosophy and dialectical logic.
- (2) The postulate on the wave nature of all phenomena and objects in the Universe.

It is clear beyond any doubt that the presented above constituents of the *new physics paradigm* are adequate to reality. Actually, dialectical philosophy and dialectical logic supersedes the Aristotelian philosophy with its formal logic of limited possibilities, accepted in modern physics. And as for the wave nature of the Universe, it is also the undisputed fact. The new theoretical physics paradigm, as the new conceptual basis for physics, in a natural way led us to the creation of a *new foundation of physics*, which we called the *Wave Model*, reflecting by this title the main idea laying in its foundation.

Following the aforementioned postulate, the wave structure of matter-space is described by the well-developed methods of classical wave physics, in particular, by the general wave equation $\Delta\hat{\Psi} - \frac{1}{c^2} \frac{\partial^2 \hat{\Psi}}{\partial t^2} = 0$ ((8), L. 10, Vol. 1). This equation contains information about both the spherical and cylindrical components of the field of matter-space at all levels of the Universe.

The WM embraces the following two new theories:

- (1) The Dynamic Model (DM) of elementary particles and
- (2) The Shell-Nodal Atomic Model (SNAM).

All Lectures in this volume, Vol. 2 (Part 1), and the next one, Vol. 3 (Part 2), are completely devoted to the Dynamic Model. The second theory of the WM, the SNAM, will be discussed later in Vol. 4 of the Lectures.

So, we proceed now directly to the consideration of the very bases of the Dynamic Model [2], which is an integral part of the Wave Model.

2. An overview of the concept

A correct statement of a problem is half of the success to get the right solutions leading to new discoveries. In the case of the Dynamic Model, such a resulting effect actually takes place. It should be noted with this that the DM is not a casual invention or a fruit of our imagination; all readers should thoroughly understand and realize that. The DM naturally originates from a new approach proposed and developed for the last time in physics, which is based on the dialectical view of the World and on the aforesaid adequate postulate.

According to the DM, an elementary particle is regarded as a pulsating spherical microformation of space, reminding a spatial vortex (see Fig. 1).

A spherical wave shell (characteristic sphere) is an intermediate region of a particle that is between its *main part* and a *field part*, dividing them. The field part merges gradually with the ambient field-space in infinity. The main *finite* part (core) is the *basis* of the particle; the *infinite* field part represents its *superstructure*. Such a model interprets an elementary particle as a particular physical point (a *vortical microformation*) formed in wave space from the space itself.

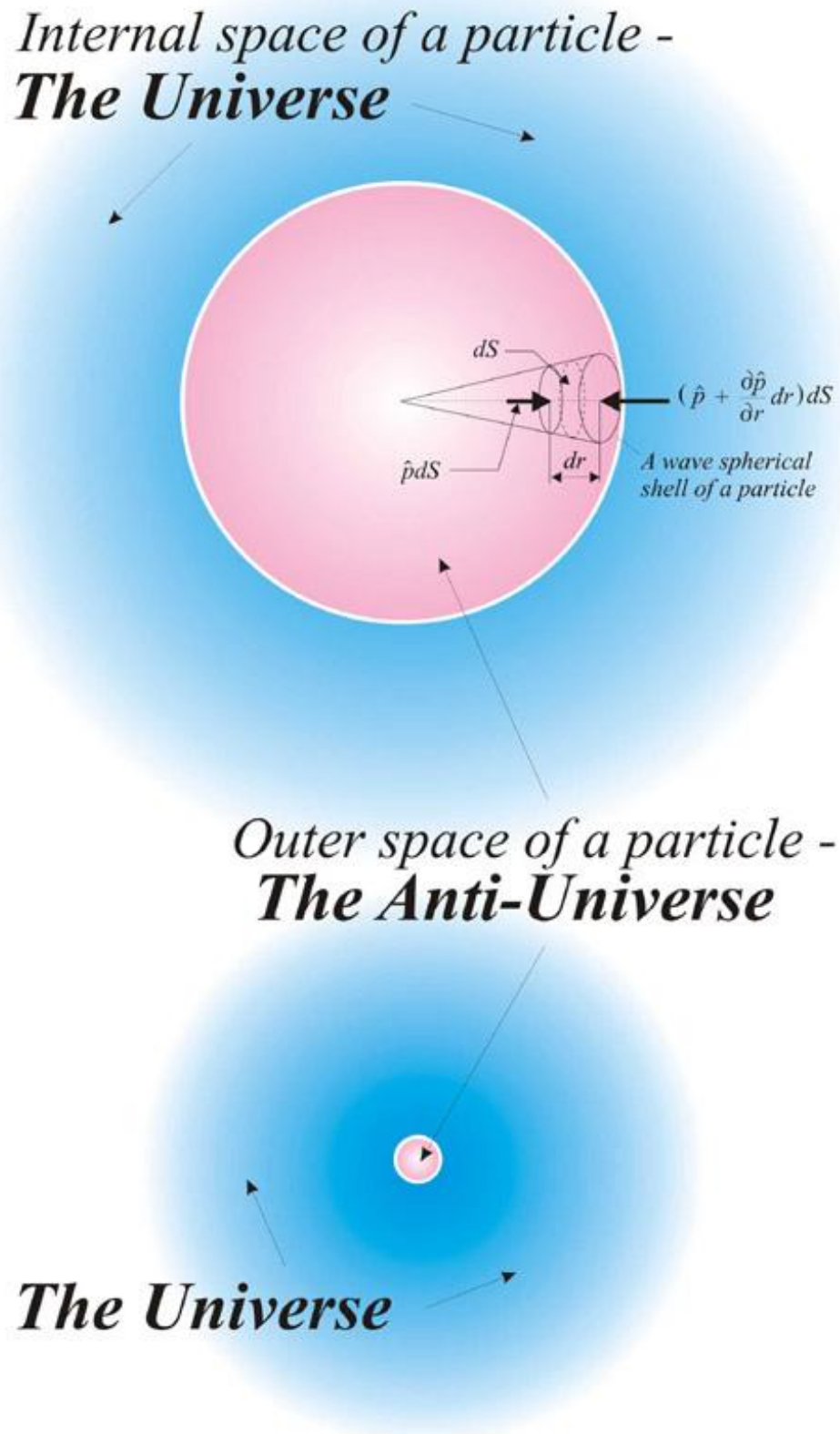


Fig. 1. A particular physical pulsating point formed in physical space from the space itself as an interference microformation of wave space; resembles a three-dimensional vortex or a thickening of the space.

Thus we see that according to the DM elementary particles are *finite-infinite* in size. A **finite size** of a particle is restricted by the spherical wave shell pulsating, as we will show below, at the strictly definite exafrequency ω_e . These wave pulsations, unceasing and not damping, spreading in space, determine the stability of particles in space and their interaction with other particles at the atomic and subatomic levels.

Being an **infinite in size**, such particles naturally has no an upper bound, but they have a far remote characteristic zone restricted by the spherical wave shell that divides *oscillatory* and *wave domains* of particles at the mega level, defining thus the *gravitational radius* of the particles.

The dynamic equilibrium of such a particle with environment and other particles is realized due to the wave exchange (interaction) caused by wave pulsations of its wave shell at the well-defined fundamental frequency ω_e :

$$\omega_e = 1.869162559 \times 10^{18} \text{ s}^{-1}. \quad (1)$$

This frequency, unknown earlier in physics, as it turned out, is characteristic for atomic and subatomic levels of the Universe. The origination of this frequency and other discovered within the DM new physical parameters, which we mention briefly here in general terms, are described in detail further in subsequent Lectures.

Longitudinal oscillations of the wave shell of a particle in radial directions on the fundamental frequency (1) provide its interaction with other particles, objects and the ambient field.

Wave pulsations of the shell at the ultimately low (with respect to (1)) frequency ω_g ,

$$\omega_g = 9.158082264 \times 10^{-4} \text{ s}^{-1}, \quad (2)$$

are spreading in space as gravitational waves. They determine the *gravitational interaction* of particles.

The fundamental frequency responsible for the exchange (interaction) at the atomic and subatomic levels of the Universe ω_e (1) defines an average discreteness of space at these levels. Really, the fundamental wave radius of the field of exchange is

$$\lambda_e = \frac{c}{\omega_e} = 1.603886492 \times 10^{-8} \text{ cm}. \quad (3)$$

Its double value, the fundamental wave diameter,

$$2\lambda_e \approx 3.2 \times 10^{-8} \text{ cm}, \quad (4)$$

correlates with an average magnitude of lattice parameters in crystals.

A wave field with the strictly defined fundamental frequency ω_g (2) is responsible for the exchange (interaction) at the gravitational level. For this reason we call this field the *gravitational wave field*.

The *gravitational wave radius* of elementary particles (that is the *radial elementary gravitational wave*) is

$$\lambda_g = \frac{c}{\omega_g} = 3.274 \times 10^{13} \text{ cm} = 327.4 \times 10^6 \text{ km}. \quad (5)$$

An existence of gravitational frequency ω_g and gravitational radius λ_g of elementary particles along with the fundamental frequency ω_e and wave radius λ_e , characteristic for atomic and subatomic levels, shows an indissoluble *harmonic bond of micro and mega* objects of the Universe in a single complex of the Infinitely Small and Infinitely Big.

The pulsating spatial microformation formed in wave physical space from the space itself can be regarded as an *energy compaction*, *energy vortex* or *energy thickening* of the space. Such a formation is thereby inseparable *associated* with the space. Such a singular spatial microformation *gains the mass* due to its natural *dynamic behaviour*, pulsations, and resulting excitations of the given space at the pulsations.

Therefore, the mass has the *associated nature*. Let me explain what is behind this word. What does it mean to be “*associated*” with respect to mass? The following comparison will help to easy understand the essence of this notion characterized particles in the DM.

The *associated mass* is, to some extent, analogous to the hydrodynamic (added) mass attributed to a moving body in liquid. For example, a hollow pulsating elastic sphere or a cylinder in water sets in motion all surrounding water mass, which is called thereby hydrodynamic. Equations to calculate the added mass are based on traditional ship design techniques.

The formula of the *associated mass* of a particle, originated from the DM, has the form,

$$m = \frac{4\pi r^3 \varepsilon_0 \varepsilon_r}{1 + k^2 r^2}. \quad (6)$$

Here r is the radius of the characteristic (pulsating) sphere (see Fig. 1) of a particle.

The Universe is *material-ideal* in a very general sense (see Vol. 1 of the Lectures). Nothing more constitutes the Universe apart from these two qualitatively opposite essences. Therefore, in view of the DM, an elementary particle is not only generated by the physical field-space, which is material according to the definition, but being an *interference microformation* of this physical (material) space, it itself is a space, although slightly modified – compacted (thickened).

Just like the mass, the *charge* has also the *exchange nature*; it is defined as the measure of the rate of mass exchange,

$$q = \frac{dm}{dt} = m\omega, \quad (7)$$

where ω is the fundamental frequency. We call the rate of mass exchange q the *exchange charge*, or the *power of mass exchange*.

In view of the latter, the **electron** charge is an *elementary exchange charge*, or an *elementary quantum of the rate of mass exchange*.

Thus, an elementary particle, according to the DM, is an interference microformation of wave space, a local three-dimensional pulsating vortex of wave space (an antinode of standing waves); therefore it behaves like a spherical micro pulsar. So that nucleons, protons and neutrons, are wave pulsating spherical microformations in space, a *coarse materialization* of physical space itself – an energy compaction, energy vortex or energy thickening of space.

In addition to this overview, it makes sense to stress the following important peculiarity of the all-embracing WM, which is realized practically in the DM that we consider here. We regard the physical (material) field-space of the Universe as an infinite series of spaces embedded in each other (somewhat reminding a set of nesting dolls, or infinite functional series $f(x) = \sum_{k=1}^{\infty} u_k(x)$). This series of spaces expresses the fundamental concept of natural philosophy concerning the infinite divisibility of matter.

Every level of space is the *basis level* for the nearest above-situated level and, simultaneously, it is the level of *superstructure* for the nearest below-situated level. This means that above-situated field-spaces are formed on the basis of below-lying field-spaces. Accordingly, there is no meaning to the concept of a “very last elementary particle” in the common classical sense of this phrase.

Dynamic Model gave rise the domino effect in physics: a chain reaction occurred when a fundamental change of our view about the elementary particles structure caused the discovery of new fundamental parameters, which then caused a change of basic notions, which then caused another change of accepted theories, and so on in linear sequence.

Dynamic Model of Elementary Particles revealed also the next great mystery: why the speed c (equal to the speed of light) plays the fundamental role for the internal energy E of quiescent particles?

In view of the dynamic structure and behaviour of particles, according to the DM, this question has a natural explanation. The speed c is the *innate property of elementary particles*, being the *basis phase speed of their wave exchange* (interaction) with ambient field-space and with particles at the subatomic, atomic and gravitational levels, both in rest and motion.

Accordingly, in the formula $E = m_0 c^2$, E is the energy of wave exchange of matter-space-time of an elementary particle at the levels; or *intrinsic dynamic energy of the particle*, which is regarded as a pulsating microobject of the Universe. Naturally, therefore, that the *rest mass* is improper notion for particles in the DM; rest mass cannot be by the definition, and m_0 is the associated mass of a particle.

All the problems faced by the SM, listed above in Introduction, have found their natural resolutions in the framework of the DM. Before proceed to considering of all these issues in detail, let us further to present the basic notions and definitions inherent in the DM.

3. Basic definitions

We 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 also 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. The latter is naturally realized in theories, including the DM, developed in the framework of the Wave Model. The DM takes into account aforementioned peculiarities of Nature related to the wave character of the phenomena. We will show this.

In full agreement with the axioms of the Dialectical Model of the Universe (presented in L. 6), we regard elementary particles as dynamic spherical formations of a complicated internal structure (not considered here) being in a dynamic equilibrium with environment through the wave process of the definite fundamental frequency ω_{fund} (Fig. 1).

A spherical wave shell bounds the space of an elementary particle, separating it from the ambient wave field. We call this sphere the *characteristic sphere* of a micro-particle. The characteristic sphere restricts the *main part* of the micro-particle from its *field part* merging gradually with the ambient field of matter-space-time.

The main part (core) is the *basis* of a micro-particle, whereas the field part represents its *superstructure*. Thus, the basis space of a micro-particle is restricted by the characteristic sphere, beyond which there is the space of its superstructure. Such a model interprets a micro-particle as a particular discrete physical point of an arbitrary level (as for example, swirls or contractions, *etc.*) of many-dimensional wave space, restricted by the characteristic sphere and being in rest in the field-space.

In the dynamical model presented, according to the definition, the *inner* geometrical space (spherical volume) of an elementary particle, restricted by the wave spherical shell, is an *external* world of the particle. As the external world of the Universe (Fig. 1b), this space (inside of the spherical volume) naturally can be called the *Anti-Universe*. It means that the World (*Being* and *Non-Being*) is presented in the DM through the *Universe* and *Anti-Universe*. Obviously, the spaces of the Universe and Anti-Universe are closed here on each other. Most probably, the main essence of life, its mystery, is hidden in the Anti-Universe.

Longitudinal oscillations of the wave shell in the radial direction provide an interaction of the particle with other objects and the ambient field of matter-space-time. In the dialectical approach, the logical triad of *matter-space-time* expresses an indissoluble bond of *matter* and *space*, being in uninterrupted *motion*, which is characterized by the rate of motion, estimated by *time*. Therefore, it may be makes sense to substitute the above triad with ***matter-space-motion***. The logical pair of *motion-rest* presents an indissoluble bond of motion and rest. *Etc.*

The Universe is an infinite series of material and ideal spaces. Between objects of the spaces it takes place the complicated interactions, which represent by themselves the *exchange* of matter-space-motion-rest (*matter-space-time* for brevity). The exchange of matter-space-time occurs simultaneously in many levels, which are represented by corresponding subspaces of matter of the Universe. These subspaces should be regarded as *embedded* into each other; they form the space of the Universe. The *embedding* is one of the aspects of the physical multi-dimensionality of fields of matter-space-time of the Universe.

As the measure of *intensity of exchange* of matter-space-time, we can take any parameter of exchange. If it is momentum, then we deal with the *rate of exchange of momentum, etc.* In such a broad sense of the word, an equation $\mathbf{F} = \frac{d\mathbf{P}}{dt}$, known as Newton's second law, is a simple writing of the formula of the *vector power of exchange of momentum*.

By virtue of this, we will also call the vector \mathbf{F} the *power of exchange of momentum*. Of course, this power of exchange \mathbf{F} cannot be identified with the scalar power of exchange of energy W : $N = \frac{dW}{dt}$. However, in spite of their difference, both N and \mathbf{F} are powers of exchange, expressed by the language of the concrete measures of exchange, and nothing more. This is why the same term the *power of exchange* is the rightful one as the *measure of the rate of exchange*.

Thus, an existence and interactions of particles are, in essence, a continuous process of wave exchange of matter-space and motion-rest, or, for brevity, *exchange of matter-space-time*. The wider (and, hence, truer) notion ***exchange*** is thus more correct because it reflects behavior of elementary particles in their dynamic equilibrium with the ambient field, at rest and motion, and interactions with other objects (and particles themselves).

In other words, the notion *exchange* is more appropriate from the point of view of the physics of the complex behavior of elementary particles viewed as dynamic microobjects belonging to one of the interrelated levels of the many-level Universe.

A ratio of mass dm and volume dV of elementary particles defines their *absolute-relative density* ε :

$$\varepsilon = \frac{dm}{dV} = \varepsilon_0 \varepsilon_r, \quad (8)$$

where

$$\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3} \quad (8a)$$

is the *absolute unit density*, and ε_r is the *relative density*.

The ratio of mass dm and time dt expresses the *volumetric rate of mass exchange* of the particles with environment; we call this ratio the *exchange charge*, or merely the charge,

$$Q = \frac{dm}{dt} = Sv\varepsilon, \quad (9)$$

where S is the area of a closed surface separating the space of an elementary particle from the surrounding field of matter-space-time, v is a definite *speed of wave exchange* (interaction) at the separating surface. It is natural to present the velocity of wave exchange (interaction) in the form

$$\hat{v} = v(kr)e^{i\omega t}, \quad (10)$$

where

$$k = \frac{2\pi}{\lambda} = \frac{\omega}{c} \quad (11)$$

is the wave number corresponding to the definite fundamental frequency of the field of exchange ω , characteristic at the subatomic level of the Universe.

Strictly speaking, the *exchange charge is the measure of the rate of exchange of matter-space-time*, or briefly the *power of mass exchange*. In this wider sense, the area of exchange S does not necessarily concern the closed surface. In a case of a microobject of the spherical structure, the measure of exchange charge (9) is

$$\hat{Q} = 4\pi a^2 \hat{v} \varepsilon_0 \varepsilon_r, \quad (12)$$

where a is the radius of the wave shell of the microobject.

Resting on the aforementioned definitions, we can begin the consideration of the wave exchange (interaction) of a spherical particle, regarded as continuously oscillating dynamic

wave microformation of the field of matter-space-time, in the field itself, ambient the particle. This is a subject of the next Lecture.

4. Conclusion

Thus, in this Lecture we have drawn the general picture about the structure of elementary particles, and have elucidated what they represent by themselves in accordance with the DM. Simultaneously, looking ahead, we have demonstrated an advantage of this physical model on an example of the presentation of a series of the fundamental constants (parameters) inherent in elementary particles, considered as dynamic microformations in the DM.

The relevant principal notions and definitions were introduced therewith. They originate exceptionally from the accepted wave approach reflecting, thus, the latter. The derivation of all of the numerical values for the new parameters (fundamental constants), mentioned briefly here, will be shown in detail and sequentially in the next Lectures.

The concept of elementary particles, regarded in the DM, basically, as stable and energetic self-oscillating systems of primordial matters, correlates with the general concept on the structure of particles developed by A.M. Mishin in his works [3]. René Descartes was, on the one hand, right saying that “*In the Universe there is nothing except ether and its whirlwinds*”. Under the word “*ether*”, he meant, of course, a pramatter.

Descartes did not believe in an existence of an empty space. We stand in solidarity with this, but share his point of view partially. Why? The WM recognizes the *material-ideal essence of the Universe* where there is no room for emptiness. But apart from *matter*, in the Universe there is also the *not mater*. The latter is the *essence*, qualitatively *polar opposite* to matter, regarded conventionally (for generalization) as an ***ideal*** *essence*, to which relates: spirit, consciousness, thoughts, informational and numerical fields, *etc.*, but by and large, Universal Intelligence. After all, everything that exists is in constant movement, development, following certain Universal Laws that we are trying to know, and not of chaotic.

References

[1] G. P. Shpenkov, *Some Words about Fundamental Problems of Physics: Constructive Analysis*, LAMBERT Academic Publishing, p.116 (2012);
amazon.com/words-about-fundamental-problems-physics/dp/3659237507
<http://shpenkov.com/pdf/Book-2011-Eng.pdf>

[2] L. G. Kreidik and G. P. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and "Electric" Charge*, REVISTA CIENCIAS EXATAS E NATURAIS, Vol. 3, No 2, 157-170, (2001); <http://shpenkov.com/pdf/masscharge.pdf>

[3] Mishin A. M., *The Beginning of General Physics*, The Collection of Articles, Saint Petersburg, L.T. Tuchkov's NTC, 2009, 276 pages.

Lecture 2

The Origin of Mass

1. Introduction

The notion of mass of bodies is one of the first things with which a man familiarizes beginning the study of physics at a school. At the same time the origin of mass of elementary particles, constituents of material bodies, is still a great mystery for humankind due to inability of modern natural science, physics, to reveal its origin. According to the last idea of theorists, an elusive particle, Higgs boson, supposedly, is that particle which is responsible for the existence of mass of all particles. Mainly for this purpose to produce Higgs boson, the Large Hadron Collider (LHC) was built and activated.

It is theorized that the experimental confirmation about an existence of the boson could confirm the predictions and missing links in the Standard Model. However, the prediction of the theory of François Englert and Peter Higgs, which they put forward 50 years ago in 1964 [1, 2], has ended by now in complete failure. This is confirmed by the announced decision of the Nobel Committee for physics to award the Nobel Prize in Physics for 2013 to the aforementioned authors, in actual fact for their long-term (within 50 years) unsuccessful efforts. How it has been done?

The formula of the decision [3] declares that the Higgs *hypothesis* (qualified by Nobel Committee for Physics unfoundedly as the “*discovery*”) only “*contributes to our* (i.e., their) *understanding of the origin of mass*”, like many other hypothesis in physics do the same. Such a statement is indefinite: it admits as correct as well as a wrong “*understanding*” of the nominators and Nobel Prize winners.

Thus, the given streamlined wording accepted by the Nobel Committee, in substance, states about the full recognition of the failure of the Higgs hypothesis and, hence, the Standard Model at all. Actually, according to the formula, the “*discovered mechanism*” does not responsible for the creation of mass of particles, because it only “*contributes to our*

understanding”, that was loudly announced over the world. We recall that the aforesaid hypothesis was “*put forward to rescue the SM from collapse*” [4].

After all, apart from the origin of mass, there is still much, much more waiting, hopelessly, in line for their “*understanding*” in the Standard Model – for the salvation of the latter [5, 6]. Thus, the “*salvation from collapse*” never happened despite great efforts undertaken for the last 50 years, passed from appearing the aforementioned “*salvatory*” hypothesis. The Standard Model, being a dead-end theory, exhausted itself completely and no improvements cannot help it.

Here, we will show the origin of mass that naturally follows from the DM, according to which, as you already know, elementary particles are considered as dynamic spherical microformations – stable energetic self-oscillating systems.

Obviously, we need at the beginning to define the adequate physical conditions required for an existence of such dynamic systems. Thus, the prime problem is to clear understand the origin of these conditions, in particular, to firmly know on which base it were derived the basic equations that led to the key fundamental solutions briefly enumerated in Lecture 1. Then all steps of the theoretical derivation, showing here, will call less questions.

2. Initial conditions and equations

It turns out that in order to come to the desired general equation, describing the state of the particle in accordance with to the DM, it is sufficient to know how, or more correctly, to which law the characteristic spherical wave shell, that behaves as an auto-vibrating system, is obeying, and what specific physical parameter is more adequate for this case.

The main dynamic parameter inherent in the DM that we accepted and used in the derivation is a two-dimensional density of exchange – pressure of the field-space, \hat{p} . This pressure exerts continuous influence upon the surface of the characteristic spherical shell from both sides, responding thus for the pulsation of the shell (see Fig. 1). These pulsations at the definite frequency cause the corresponding wave process that provides exchange (interaction) of the particle with the ambient field of matter-space [6] and with other particles.

The powers of exchange of the field with the element dS of the shell of the particle are

$$d\hat{F}_1 = \hat{p}dS, \quad (1)$$

from one side of the characteristic sphere, and

$$d\hat{F}_2 = (\hat{p} + \frac{\partial \hat{p}}{\partial r} dr)dS, \quad (2)$$

from an opposite side.

In such conditions a resulting action is

$$d\hat{F} = \hat{p}dS - (\hat{p} + \frac{\partial \hat{p}}{\partial r} dr)dS. \quad (3)$$

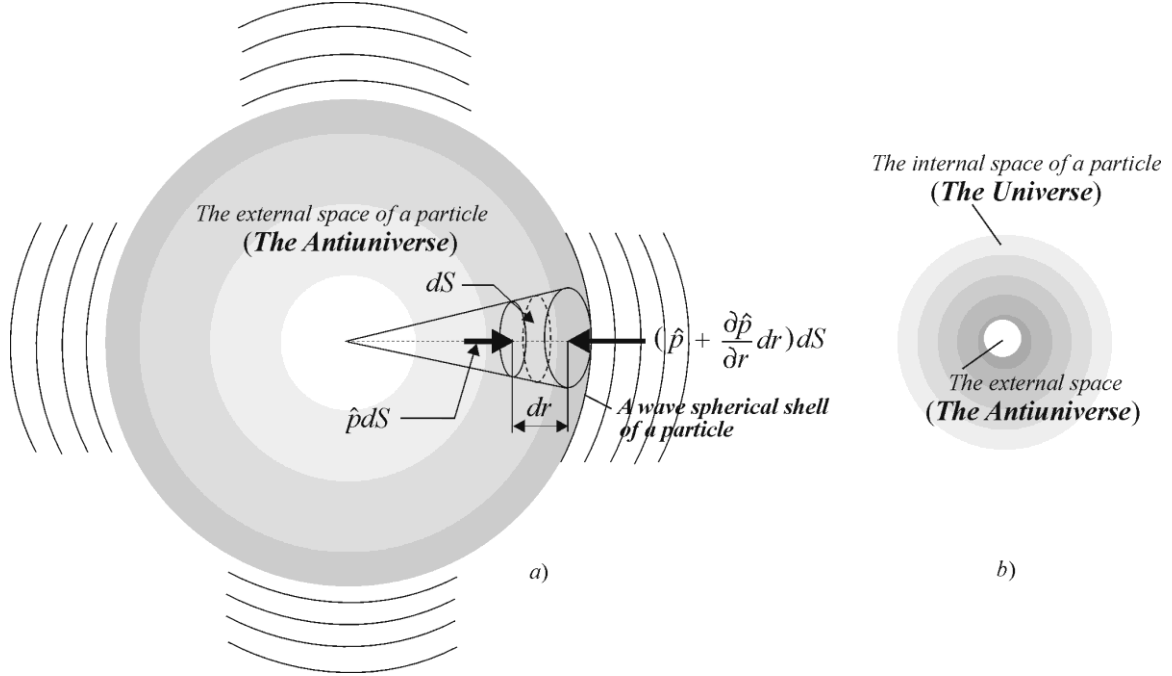


Fig. 1. An element of the volume (a) of the wave shell in a spherical field of exchange: a particle – ambient field of matter-space-time; $\hat{p}dS$ and $(\hat{p} + \frac{\partial \hat{p}}{\partial r} dr)dS$ are powers of exchange of the field with the element of shell dS of the particle, \hat{p} is the two-dimensional density of exchange, or the pressure of the field of exchange. Internal and external spaces of the particle (b).

On the basis of the above condition, expressed by the equality (3), we have come logically and mathematically to the resulting *equations of exchange of mass and motion*, respectively, and to a subsequent series of the discoveries mentioned in Lecture 1. We show further, how it was done.

3. Main stages of the derivation

In a spherical field of a particle (Fig. 1), an *equation of powers of exchange of momentum* for an elementary volume of a characteristic spherical shell, of the area dS and thickness dr , is defined by the equality,

$$dm \frac{d\hat{v}}{dt} = d\hat{F}, \quad (4)$$

where the speed \hat{v} and the power of exchange $d\hat{F}$ are described by the field of binary numbers, expressing the potential-kinetic character of exchange.

The oscillatory-wave (superstructure-basis) energy density \hat{p} , pressure, is equal to

$$\hat{p} = \varepsilon_0 \varepsilon_r c \hat{v}, \quad (5)$$

where ε_0 and ε_r are, respectively, the absolute unit density and the relative density; c is the basis phase speed of wave exchange (interaction); and \hat{v} is the oscillatory speed (the speed of superstructure).

Because $dm = \varepsilon_0 \varepsilon_r drdS$, and $d\hat{F} = -\frac{\partial \hat{p}}{\partial r} drdS$ (3), the equation of exchange (4) takes the following form

$$\varepsilon_0 \varepsilon_r drdS \frac{d\hat{v}}{dt} = -\frac{\partial \hat{p}}{\partial r} drdS. \quad (6)$$

From the latter it follows that

$$\frac{d\hat{v}}{dt} = -\frac{1}{\varepsilon_0 \varepsilon_r} \frac{\partial \hat{p}}{\partial r}. \quad (7)$$

At the same time because the speed of wave exchange (interaction) at the separating surface $\hat{v} = v(kr)e^{i\omega t}$ (see (10), L.1), we have

$$\frac{d\hat{v}}{dt} = i\omega \hat{v}. \quad (8)$$

Thus, on the basis of the equations (7) and (8), the speed of wave exchange at the separating surface of the characteristic sphere can be presented in the following form,

$$\hat{v} = -\frac{k}{\varepsilon_0 \varepsilon_r i\omega} \frac{\partial \hat{p}}{\partial kr}. \quad (9)$$

where $k = \frac{2\pi}{\lambda} = \frac{\omega}{c}$ is the *wave number* corresponding to the definite fundamental frequency ω of the field of exchange characteristic of the subatomic and atomic levels of the Universe.

In a spherical field, a flow of oscillatory energy through an elementary cone is constant. Hence, the oscillatory speed is decreased inversely to a distance from the center of the spherical field. Consequently, a *wave of the density of exchange* has the form

$$\hat{p} = \frac{P_m}{kr} e^{i(\omega t - kr)}, \quad (10)$$

where p_m is the amplitude of the density of exchange at the boundary of the wave zone defined by the condition $kr = 1$.

Taking into account that $\frac{d\hat{p}}{dkr} = -\hat{p}(i + \frac{1}{kr})$, Eq. (9) is transformed and takes the following form,

$$\hat{v} = \frac{\hat{p}}{\varepsilon_0 \varepsilon_i \omega r} (1 + ikr). \quad (11)$$

Hence,

$$\hat{p} = \frac{\varepsilon_0 \varepsilon_i \omega r \hat{v}}{(1 + ikr)}. \quad (12)$$

The more appropriate writing (the form) of the equation for the density of exchange \hat{p} , deferent from (12), which contains all characteristic parameters of the exchange process, is

$$\hat{p} = \frac{\varepsilon_0 \varepsilon_i \omega r}{(1 + k^2 r^2)} \hat{v} (1 - ikr). \quad (12a)$$

An area of the spherical characteristic shell is $S = 4\pi r^2$. Hence, now we have all the data to present the final equation for \hat{F} .

Thus, the power of exchange \hat{F}_s with the ambient field at the boundary of the spherical shell of a particle with the area S and the radius $r = a$ is

$$\boxed{\hat{F}_s = \hat{p} S = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} (1 - ika) \hat{v} i\omega} \quad (13)$$

It is the resulting equation, which led us to the proper solutions. Here they are.

4. The associated nature of mass

Taking into account that $\hat{v} i\omega = \frac{d\hat{v}}{dt}$, an equation of the radial exchange (13) can be rewritten in a customary form of Newton's equation of motion, $F = m \frac{dv}{dt}$:

$$\hat{F}_s = \left(\frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} - \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} k a i \right) \frac{d\hat{v}}{dt} = \hat{M} \frac{d\hat{v}}{dt}. \quad (14)$$

The expression in brackets represents, as we see, a *resulting mass of exchange* \hat{M} : a particle – environment. It is an *associated field mass* of the particle,

$$\hat{M} = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} - \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} k a i. \quad (15)$$

We can present the equation (14) in some other form. Rewriting its right part, with taking into account that $\frac{d\hat{\omega}}{dt} = i\omega\hat{\omega}$, we have in result:

$$\hat{F}_s = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} \frac{d\hat{\omega}}{dt} + \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} k a \omega \hat{\omega}. \quad (16)$$

Let us suppose that the particle, for all that, has also the rest mass, m_0 . In such a case, the equation of radial exchange of the particle through the spherical surface, within which the particle is localized, can be presented in the form of the following equation of powers:

$$m_0 \frac{d\hat{\omega}}{dt} = \hat{F} - \hat{F}_s, \quad (17)$$

where \hat{F} is the power of exchange of the particle with an object in the ambient space; the second term, $\hat{F}_s = \hat{p}S$, takes into account the wave exchange of the particle with the ambient field of matter-space.

Taking into account (16), the equation (17) of powers of exchange, for the particle with the one radial degree of freedom, can be presented in the following way:

$$\left(m_0 + \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} \right) \frac{d\hat{\omega}}{dt} + R\hat{\omega} = \hat{F}. \quad (18)$$

In this equation,

$$R = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} k a \omega \quad (19)$$

is the *coefficient of resistance* or *the dispersion of rest-motion* at exchange.

The equation of powers of exchange (18) is presented in a classical form of Newton's second law, describing the motion in the field-space with the resistance R . At such a description of motion-rest, the expression in brackets represents the *effective mass* m of the particle:

$$m = m_0 + \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2}. \quad (20)$$

The second term in the formula of effective mass is the *associated potential mass* of the particle m_a , or merely the *associated mass of the particle*, or briefly the *mass of the particle*:

$$m_a = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2}. \quad (21)$$

It is the *mass* of the particle in the *longitudinal (central) exchange*.

The effective mass of the particle, formed in the physical space from the space itself cannot have the rest (own) mass m_0 , by definition, as being a pulsating microformation of the space and a self-sustained oscillation system, therefore, in the formula (20) $m_0 = 0$. So that the *effective mass of such a particle is defined only by its associated constituent, $m = m_a$, and it is the field mass in the central exchange*.

Unfortunately, the notion of the rest mass of a particle is still used in modern physics due to unknowing its nature. According to the DM, *mass is associated by its origin* (it is analogous to the hydrodynamic added mass) as being caused by oscillatory-wave perturbation of physical space-matter. The mass of any particles is associated with respect to the deeper level of the field of matter-space.

Thus, we have arrived at the conclusion that *all masses of microparticles in the Universe have the associated field character and that their own (proper, rest) masses do not exist*.

If such situations are possible, when exchange of particles with the ambient field of matter-space at the subatomic level are not occurred, then masses of particles, with respect to this level, are equal to zero and no experiment will find such a world of microparticles. Accordingly, this world will not be cognizable for physics. This concerns the parallel worlds, deeper levels of the Universe.

Below we will show the possibility of the formula (21) by calculating with its help the basic parameters of an electron and a nucleon.

5. Characteristic parameters

Following Eq. (21), knowing the electron mass m_e , we can define the radius of the electron characteristic sphere r_e . For this purpose, bearing in mind that $k^2 a^2 = k_e^2 r_e^2$, we should solve the following third power equation,

$$4\pi \varepsilon_0 \varepsilon_r r_e^3 - m_e k_e^2 r_e^2 - m_e = 0,$$

where $k_e = \frac{2\pi}{\lambda_e} = \frac{\omega_e}{c}$ and $\omega_e = 1.869162559 \times 10^{18} \text{ s}^{-1}$ (see (1), L.1).

The term $k_e^2 r_e^2 \ll 1$, therefore, neglecting it in (21), the theoretical radius of the electron sphere r_e can be estimated by the simplest formula. Removing the aforesaid term from (21) and substituting concrete values for the parameters: $m_e = 9.10938291 \times 10^{-28} \text{ g}$, $\epsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$, and $\epsilon_r = 1$ (at the field level), we arrive at the following value of the radius for the electron characteristic sphere (space),

$$r_e = \sqrt[3]{\frac{m_e}{4\pi\epsilon_0}} = 4.17052597 \times 10^{-10} \text{ cm}. \quad (22)$$

In the DM, just this value of the electron wave shell defines the actual *electron radius*. For comparison, it should be recalled that in modern physics there is the notion of *classical electron radius*. Its accepted value of about three orders less than following from the dialectical physics (22) and equal to

$$r_e = \left(\frac{v_0}{c} \right)^2 r_0 = 2.8179403267 \times 10^{-13} \text{ cm}, \quad (23)$$

Herewith, as is customary in theoretical physics, an electron is usually considered as a point like particle.

Resting upon the formula (21), we can estimate the *associated mass* of a nucleon. In the first approximation, we will assume that the radius of the wave shell of the nucleon is equal to the Bohr radius r_0 , and then the associated mass of the nucleon will take the value

$$m_{nucleon} = \frac{4\pi r_0^3 \epsilon_0}{1 + k_e^2 r_0^2} = 1.679336988 \cdot 10^{-24} \text{ g} = 1843.524424 m_e, \quad (24)$$

where $r_0 = 5.2917721092 \times 10^{-9} \text{ cm}$ is the Bohr radius. This quantity differs by only tenths of a percent from the mass of the proton or the neutron:

$$m_p = 1.672621777 \times 10^{-24} \text{ g} = 1836.15267245 m_e \quad (25)$$

$$m_n = 1.674927351 \times 10^{-24} \text{ g} = 1838.6836605 m_e \quad (26)$$

The following *radius* r_p of the *wave proton sphere* corresponds to the proton mass m_p :

$$r_p = 0.528421703 \times 10^{-8} \text{ cm}. \quad (27)$$

It is actually the true *proton radius*.

For comparison, the so-called *rms* ("root mean square") *charge radius* ascribed to the proton in modern physics is equal to

$$r_{p,rms} = 0.8775 \times 10^{-13} \text{ cm} . \quad (28)$$

that is about five orders less than the value originated from the DM based on dialectics (27).

We see that both above values, (27) (according to the DM) and (28) (according to the SM), are completely incomparable.

The hydrogen atom is a coupled system of the proton m_p and electron-satellite m_e . The displacement of the proton relative to the center of mass of this paired system is

$$r_c = \frac{m_e}{m_p} r_{orb} , \quad (29)$$

where r_{orb} is the disposition of the electron with respect to the center of the mass (Fig. 2). The distance between the centers of the masses of the proton and electron (the Bohr radius) is

$$r_0 = r_c + r_{orb} = r_{orb} \left(1 + \frac{m_e}{m_p}\right) = 5.2917721092 \times 10^{-9} \text{ cm} , \quad (30)$$

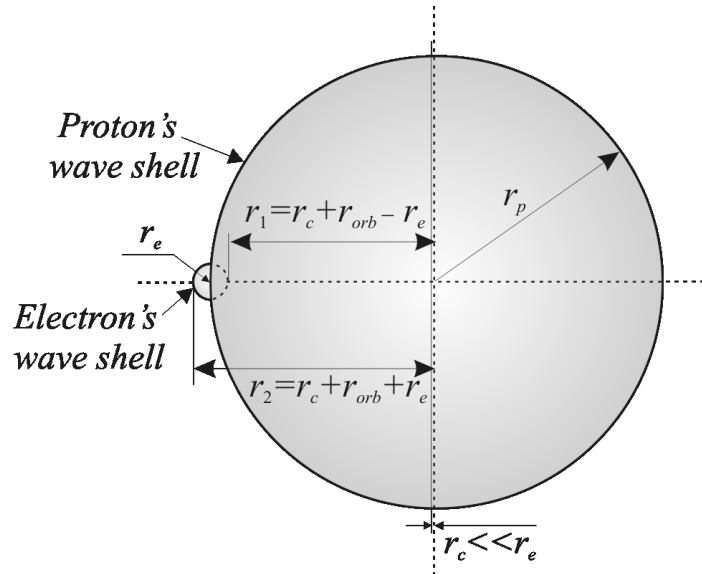


Fig. 2. Geometrical relations in a coupled dynamic system – *electron-proton*.

and diametrically opposite points of the electron sphere will be disposed from the center of the mass of the system at the distances

$$r_1 = r_c + r_{orb} - r_e = 4.87471912 \times 10^{-9} \text{ cm} \quad (31)$$

and

$$r_2 = r_c + r_{orb} + r_e = 5.708824706 \times 10^{-9} \text{ cm} . \quad (32)$$

A difference between the proton radius, $r_p = 5.28421703 \times 10^{-9} \text{ cm}$ (see (27) in L.2.), and the Bohr radius r_0 (30) is relatively insignificant. Hence, one of the aforesaid points of the electron sphere is immersed in the proton atmosphere at the distance of

$$\Delta r_1 \approx -r_e, \quad (33)$$

and the other one is raised over the proton sphere by the distance of

$$\Delta r_2 \approx r_e. \quad (34)$$

Thus, the electron sphere is immersed approximately by half in the proton atmosphere and moving in it, and the other half of the electron sphere is raised over the proton atmosphere. In this sense, the paired proton and electron can compare with the planet Jupiter and its Great Red Spot – a vortex (that is large than Earth) moving in Jupiter's atmosphere and partly rising over it. This vortex is stable and may be is a permanent feature of the planet.

6. The dynamic energy of particles

As we know, the fundamental role which plays c^2 in the famous formula of the rest energy of elementary particles,

$$E_0 = m_0 c^2, \quad (35)$$

was not understood by its creators: N. Umov (1873) and Heviside (1890), and their follower A. Einstein (1905). This formula defines the internal energy of a *quiescent* particle. It is still a great mystery for modern physics, because physicists do not know about the dynamic wave nature of the origin of mass and that the phase speed c is one of the parameters characterizing its behavior as the dynamic formation. Ignorance of the origin of mass makes it impossible to understand in principle from where appeared the speed of light c in the formula.

For this reason, the problem of c^2 is not discussed in the literature on physics at all. Moreover, any propositions on this subject beyond the scope of the SM, trying to shed some light on all this, are suppressed with the tacit consent of leading scholars.

Discoveries of the dynamic structure and behavior of elementary particles and the associated nature of their mass reveal, at last, the nature and role of the constituents, m_0 and c , in the formula (35). From the foregoing material it follows that the rest mass of elementary particles, considered as pulsars of microworld, does not exist; and m_0 in this formula presents, actually, the associated mass of a particle.

Wave exchange (interaction) of the particles is realized on the fundamental frequency of pulsations exciting vibrational ripples in space, and the phase speed of wave propagation of the excitations is equal to the speed of light c . So the speed c is the innate property of

elementary particles as the basis speed of their wave exchange (interaction) with ambient at the subatomic, atomic and gravitational levels, both in rest and motion. Thus, the energy (35) is the energy of wave exchange of matter-space at the subatomic level or the *internal dynamic energy of elementary particles* on this level.

We will turn to the formula (35) once more in the further lectures at the consideration in detail and the derivation of the energetic relations at exchange. Let us make now a short summary about what we have learned in this Lecture.

7. Conclusion

Resting on the Dynamic Model, we have considered the *longitudinal* (central) *exchange* of a particle with environment and *derived the universal equation of longitudinal exchange* on the basis of which has been *discovered the following*.

1. The *dynamic associated nature of mass* at the longitudinal exchange.
2. The *formula for mass* (21) that relates the associated mass with: the *radius of characteristic wave sphere* of elementary particles, the *fundamental frequency of exchange* ω_e , and the *phase speed c of exchange* equal to the speed of propagation of the wave disturbance in the ambient field-space, caused by stable and energetic pulsations (autooscillations) of the characteristic wave shell of the particles.
3. The *rest mass* of a *quiescent* particle does not exist.
4. The true *electron radius* (22).
5. The true *proton radius* (27).
6. The *electron sphere*, limited by the *characteristic wave shell*, is *immersed approximately by half* in the internal proton space (atmosphere) and moving in it, and the *other half of the electron sphere is raised over the proton atmosphere*.
7. The *role that plays the speed of light c* in the mass-energy formula (35).

The phenomenon of *associated mass* exists in liquids and is taken into account in hydrodynamics. There the associated (added) mass is called the *hydrodynamic mass*. More complicated radiators than elementary particles (pulsars of microworld) of higher orders also exist in nature. We mean, for example, so-called zonal and sectorial emitters of the n -th order. One of the characteristic parameters of them is the *associated mass of the emitters*. As far as known from the literature, these notions were introduced first in physics by Rzhevkin S. N. [7], whose scientific interest was focused on acoustic problems.

The discovery of a *natural relation existing between the mass and the speed* in the formula $E_0 = m_0 c^2$ firmly testifies to the correctness of the *dynamic wave concept* about the structure of elementary particles realized in the theory of the DM.

References

- [1] F. Englert and R. Brout, "*Broken Symmetry and the Mass of the Gauge Vector Mesons*", Phys. Rev. Lett. 13, 321 (1964).
- [2] P.W. Higgs, "*Broken Symmetries and the Mass of the Gauge Bosons*", Phys. Rev. Lett. 13, 508 (1964).
- [3] V.G. Rodionov, Y.A. Voronov, G.P. Shpenkov, V.A. Lebedev, I.V. Dmitriev, *An Open Protest of the Russian Physical Society* // Encyclopaedia of Russian Thought, Vol. 20 – Reports to the Russian Physical Society, 2013 (Collection of scientific papers, in Russian).
<http://www.rusphysics.ru/files/ProtestRusPhysSoc.pdf>
- [4] Joanna Rose, Here, at last!
http://www.nobelprize.org/nobel_prizes/physics/laureates/2013/popular.html.
- [5] [1] G. P. Shpenkov, *Some Words about Fundamental Problems of Physics: Constructive Analysis*, LAMBERT Academic Publishing, p.116 (2012);
amazon.com/words-about-fundamental-problems-physics/dp/3659237507
<http://shpenkov.com/pdf/Book-2011-Eng.pdf>
- [6] L. G. Kreidik and G. P. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and "Electric" Charge*, REVISTA CIENCIAS EXATAS E NATURAIS, Vol. 3, No 2, 157-170, (2001); <http://shpenkov.com/pdf/masscharge.pdf>
- [7] Rzhevkin S.N., *Lectures on the Theory of Sound*, Moscow, MSU, 1960, 337 pages;
To the Question on the Added Mass in Heterogeneous Acoustic Waveguides, Acoustic Journal, Vol. XI

Lecture 3

The Nature of Charges

1. Introduction

To the present physicists do not know the true nature of the charges: *electric*, *magnetic*, and *gravitational* as well as they are unable to understand other things that we have already enumerated briefly in Introduction to the first Lecture. Why? There are several reasons responsible for inability of modern physics to solve these problems. We will not repeat again all them here. However, the unequivocal and all-embracing answer to the above question is simple. Let us remind you about it briefly.

The comprehensive analysis that we have performed has revealed the *fundamental flaw of physics*, as a natural science, consisting in the use of the erroneous scientific approach. Namely, modern physics is based on the erroneous paradigm, and owing to this its development is going by an erroneous way. We have analyzed in detail this question and considered different sides of this subject in previous Lectures.

Physics is constantly faced with the numerous problems; one of the most important problems (along with the mass) is the problem of the nature of charges. We understood the essence of this problem, where it came from, in detail, beginning from the time of the discovery of electric charges. In this regard, much has been done. During our studies we have identified one of the most important reasons that caused the gap in our knowledge, and about that we will speak in this Lecture. Our arguments will concern here exclusively the nature of *electric* charges.

Any physical quantity is characterized by the definite dimensionality. So if we know the true dimensionality of the given physical quantity, this without any doubt means that we know the true nature, physical meaning, of the quantity. You should firmly realize that. But what we have in reality. It's amazing, but beginning from the Coulomb's time, physics still does not know the *true dimensionality* of electric charges [1].

Unfortunately, nothing has been done in physics in order to clarify the true dimensionality of electric charges, including in time of an introduction in physics (in 1960) the International System of Units (SI). The replacement of the initial CGS (*centimeter-gram-second*) system with the "rationalized" International System of Units, SI (*meter-kilogram-second-ampere-*

kelvin-candela-mole), did not lead to uncovering the dimensionality of electric charges and, hence, their nature, rather vice versa: the result turned out to be destructive for physics. Really, since then the cognition of the nature of the charges became absolutely impossible.

The undertaken changes, accomplished during the obscure rationalization, have led to an impasse in physics of electromagnetism and have influenced negatively upon development all other branches of physics. If in the case of mass, some efforts to understand its origin, as e.g. the Higgs hypothesis, still are noticeable, then about understanding the nature of electric charges modern physics does not even think after aforesaid “rationalization” and an introduction ultimately into the SI units the unit of the electric charge called the *coulomb*.

Here is a short summary on the current status quo of this problem [1].

2. The modern state of the problem

The mutual force F exerted by one electrostatic point charge q_1 on another q_2 is proportional to the product of the charges divided by the square of their separation r . Discovered first by Coulomb, this law had the form

$$F = k \frac{q_1 q_2}{r^2}. \quad (1)$$

In this functional dependence, k is the unknown at that time coefficient of proportionality. In the *CGSE* system (for electric units), k was accepted as the *dimensionless* magnitude equal to unity, $k = 1$. Accordingly, the Coulomb law has been presented then in the following form (for vacuum),

$$F_{CGSE} = \frac{q_1 q_2}{r^2}. \quad (2)$$

From (2) it follows that the dimensionality of electric charges, expressed in the *CGSE* system of base units existed at that time for physical quantities, is

$$[q] = g^{1/2} cm^{3/2} s^{-1}. \quad (3)$$

In the rationalized modern system of units, *SI*, introduced mainly in order to get rid of incomprehensible fractional powers following from the *CGSE* units (are available in view $g^{1/2}$ and $cm^{3/2}$), Coulomb’s law takes the form

$$F_{SI} = \frac{Q_1 Q_2}{4\pi\epsilon_0 r^2}. \quad (4)$$

where Q_1 and Q_2 are the same point electric charges, but expressed now in *coulombs* (C); ϵ_0 is the so-called *electric constant*.

The unit of the electric charge, **coulomb**, is the derivative of the **ampere** (A): $1\text{ C} = 1\text{ A} \times \text{s}$. The ampere, the unit of electric current, was accepted as one of the base units during the aforesaid “rationalization” and introduced additionally to a triad of truly objective units (*matter*, *space*, and *time*) in the *SI*. Although in actual fact, the **ampere**, defined from Ampere’s law for interacting currents as the derivative unit, is also expressed by obscure half-integer powers of base units like the unit of coulomb. We will show this.

Thus, dimensionality of electric charges Q in SI units is

$$[Q] = 1\text{ C} = 1\text{ A} \times \text{s}. \quad (5)$$

The units of *SI* and *CGS* systems, the coulomb C and the unit of charge $CGSE_q$, are interrelated by the following way:

$$1C = \frac{c_r}{10} CGSE_q = \frac{c_r}{10} g^{1/2} cm^{3/2} s^{-1}, \quad (6)$$

$$1A = \frac{c_r}{10} CGSE_I = \frac{c_r}{10} g^{1/2} cm^{3/2} s^{-2} \quad (7)$$

where $c_r = \frac{c}{c_e}$ is the dimensionless quantity equal to the numerical value of the speed of light, $2.99792458 \times 10^{10}$ ($c_e = 1\text{ cm} \times \text{s}^{-1}$ and $c = 2.99792458 \times 10^{10}\text{ cm} \times \text{s}^{-1}$).

The **electric constant** in (4) is equal to $\varepsilon_0 = 8.854187818 \times 10^{-12}\text{ F} \times \text{m}^{-1}$. It is defined in the *SI* from the following relation,

$$\varepsilon_0 = \frac{10^{11}}{4\pi c_r^2} \text{ F} \times \text{m}^{-1}. \quad (8)$$

Please, look carefully at this strange quantity, at its numerical value and dimensionality, which was/is accepted as the fundamental physical constant. This so-called “constant” has appeared just as a result of tangled manipulations at the “rationalization” of *CGS* into *SI* (that is described in detail in [2], see pages 9-19).

Does it make any physical meaning a quantity (in our case, the “*electric constant*” ε_0) of such a strange dimensionality, as $\text{F} \times \text{m}^{-1}$? In what is strangeness? The matter is that in absolute units of matter-space-time the unit called the *farad* (F) has the dimensionality in meters (m). It is also the dimensionality of electrical capacity, which is expressed thus in physics by both units of measurement, *farad* (subjective) and *meter* (objective). They are related by the following way,

$$1F = \frac{c_r^2}{10^{11}} m \approx 9 \cdot 10^9 m. \quad (9)$$

This means that ε_0 actually is the dimensionless magnitude. Substituting (9) in (8), we find that

$$\varepsilon_0 = \frac{10^{11}}{4\pi c_r^2} \cdot \frac{c_r^2}{10^{11}} = \frac{1}{4\pi}, \quad (10)$$

Eventually, substituting (10) in (4), we arrive at the Coulomb's law in the SI units in the same form just like in the CGSE system (2),

$$F_{SI} = \frac{Q_1 Q_2}{r^2}. \quad (11)$$

What is the difference between two presentations of the law, (11) and (2)? In (11) point charges Q_1 and Q_2 are expressed in *coulombs*, the distance r in *meters*, and the force F_{SI} in *newtons*. Hence, the dimensionality of the charges, originated from (11), is

$$[Q] = [r][F_{SI}]^{1/2} = m \left(\frac{kg \times m}{s^2} \right)^{1/2} \quad (12)$$

Thus, the actual dimensionality of electric charges in *SI* is $[Q] = kg^{1/2} m^{3/2} s^{-1}$, *i.e.*, it is expressed by *fractional powers of reference units* just like the electric charge (3) in Eq. (2) presented in *CGSE* units.

Since $1C = \frac{c_r}{10} g^{1/2} cm^{3/2} s^{-1}$, the unit of the charge, coulomb, presented by three base units of the *SI* system: *matter* (kg), *space* (m), and *time* (s), has the value,

$$1C = \frac{c_r}{10} \cdot \frac{1}{\sqrt{10^9}} kg^{1/2} m^{3/2} s^{-1}. \quad (13)$$

What are the results of the above described “rationalization” *CGS* into *SI* units? As we see, they are not so impressive owing to absurd manipulations. On the merits, these manipulations (called rationalization) turned into a “fig leaf”. They are inept because the same fractional powers, $\frac{1}{2}$ and $\frac{3}{2}$, in objective units of *matter* (it does not matter, g or kg) and *space* (cm or m), respectively, have remained.

Thus, we see that in order to cover up the strange fractional dimensionality, with which physicists were unable to cope, the creators of the *SI* units *introduced a new unit of charge* and called it the **coulomb** (C) (13). According to the transformations conducted with these units, the unit of coulomb was accepted to be equal to the following number of *CGSE* units of charge, $CGSE_q$,

$$1C = \frac{c_r}{10} CGSE_q = 2.997924580 \times 10^9 \text{ g}^{1/2} \text{ cm}^{3/2} \text{ s}^{-1}. \quad (14)$$

Without going in details, let's summarize. As a result of the rationalization, the *derivative unit*, the unit of electric current the *ampere*, was added to a *triad of basic units* of matter, space, and time (*kg, m, s*). This has caused the introduction in physics of the senseless additional constants, *electric* ε_0 and *magnetic* μ_0 , called physical.

Thus, the problem of *fractional powers of base units* in all formulas of electromagnetism has not been resolved and, in fact, implicitly hidden.

As we see, only an imitation of the reform in metrology of electromagnetic processes, but not the reform itself, was carried out. Based on erroneous dimensionalities of electric charge and current, the dimensionalities of all physical quantities of electromagnetism, accepted in contemporary physics, naturally, also turned out to be erroneous. Such are the facts.

An introduction of SI units was one of the key stages influenced the development of physics. On the basis of such an example with the fictitious “rationalization”, physicists have obtained once more a regular lecture on *how to invent* any “physical” constants; and, hence, they obtained the green light to act in such a way further, creating actually by this way a virtual physics.

Let us look, for comparison, at the law of universal gravitation, which has the similar dependence on the distance *r* as Coulomb's law,

$$F = G \frac{m_1 m_2}{r^2}. \quad (15)$$

Here, the coefficient of proportionality *G*, called the *gravitational constant*, was defined both in value and dimensionality; now it is equal to $G = 6.6720 \times 10^{-8} \text{ g}^{-1} \text{ cm}^3 \text{ s}^{-1}$. We see that in this case all is correct with this physical quantity, first of all because its dimensionality is expressed through *integer powers of the base units*. The similar transparent situation must also take place in the case of Coulomb's law.

Thus, without solving the problem with the value and dimensionality of the *k* coefficient in the Coulomb law (1), physics of electromagnetic phenomena (and related to them other branches of physics) will make no headway that is observed at present in reality.

Unfortunately, the erroneous form of Coulomb's law gave rise to a phenomenological system of the notions with measures having fractional powers of base units that are really senseless. As a result, *cognition of the nature of electric charges has become impossible*.

Since the erroneous system of measures of the electromagnetic field involves all physical formulas, *experiments* based on these formulas are *unable to detect the accumulated errors*. Thus, everything is formally as it were “correctly” and “consistent”, although the electron

charge, in particular, is defined incorrectly, qualitatively and also quantitatively. This situation has given rise to numerous additional atomic constants, complicating cognition of the Universe at the atomic level yet more.

Wrong measures give rise to false theories, within the framework of which formally correct results are possible only on the basis of new errors in full agreement with the dialectical law of double negation: $No_1 \times No_2 = Yes$, where No_1 is the initial lie, No_2 is a new lie, and Yes is the formal truth. The result of this course of events can only be one – the dead end in the development [2].

However, not all is so dark; there is a light at the end of the “tunnel”. The matter is that the problem of dimensionality of the charges, including electric, is solved in the framework of the DM.

As follows from the DM, we will show it below, the dimensionality of the “electric” charge is $g \times s^{-1}$; and the dimensionality of the proportionality factor k in the Coulomb law (1) is $[k] = g^{-1} \times cm^3$. It means that the **electric charge is the rate of mass exchange** (interaction). The rate of exchange at the atomic level, as follows from [2, 3], is realized on the fundamental frequency of exchange $\omega_e = 1.869162505 \times 10^{18} s^{-1}$.

The wave radius, corresponding to this frequency is $\lambda_e = 1.603886492 \times 10^{-8} cm$. Both wave parameters, ω_e and λ_e , define, as has been mentioned in previous Lectures, an existing order (internodal distances) in atomic and molecular structures. We hope that this discovery will favor in future the development, in particular, of solid states physics, inevitable reconsideration of its fixed notions, which already are not adequate to reality.

Sooner or later but physicists must understand the great importance of the mentioned above problem with the electric charge, such is dialectics. Indeed, it is impossible all time to conceal unsolved key problems, which restrain the long time enough the development of physics. In any case, discussions *on this subject* will be fruitful for physics.

3. A solution of the problem; the exchange nature of charges

We refer *matter* and *space* to the *material* aspect (side) of the Universe. *Mass* is regarded as a generalized *measure of exchange of motion and matter* or as a *measure of contents* in a wide philosophical sense, which is qualitatively opposite to the *measure of form*. In the previous Lecture, it was shown that mass of elementary particles, which are considering in the DM as pulsating microformations of wave space (or as compact, thickened, space vortices) [4], is dynamic, *associated* (acquired), caused by its dynamic origin from the wave space and the dynamic equilibrium state, behaviour (existence), in this space.

Like the mass, the *charge of the particles* also has the exchange nature. The ratio of associated mass $d\hat{m}$ and time dt (the first time derivative of the associated mass) is the *power (rate) of mass exchange* with the dimensionality $g \times s^{-1}$,

$$\hat{q} = \frac{d\hat{m}}{dt}. \quad (16)$$

This ratio is considered in the DM as the *exchange charge*. Thus, generalizing, we define the charge \hat{q} as the measure of *the rate of mass exchange* of a particle with environment. For brevity, we call this ratio just the *charge*.

According to the accepted definition, in a case of a microobject of the spherical structure, the measure of the exchange charge (16) is

$$\hat{q} = \frac{d\hat{m}}{dt} = S\hat{\omega}\epsilon = 4\pi r^2 \hat{\omega}\epsilon_0\epsilon_r, \quad (17)$$

where r is the radius of the wave shell of the microobject.

Let us proceed to the derivation of the formula for the exchange charge \hat{q} , which will be suitable for the practical applications. We have obtained the following resulting equation of powers of exchange for the spherical dynamic (pulsating) particle in the ambient field of matter-space-time (see L.2, Eq. (11)):

$$\hat{p}S = \hat{F}_s = \frac{4\pi r^3 \epsilon_0 \epsilon_r}{1 + k^2 r^2} (1 - ikr) \hat{\omega} i \omega. \quad (18)$$

This equation contains information about both the *exchange of motion*, if presented in the form $F = m \frac{d\upsilon}{dt}$, and the *exchange of mass*, if presented in the form $F = \frac{dm}{dt} \upsilon$. The first form of the presentations, considered in previous Lecture (L.2, (14)), describes, thus, the *exchange of motion*. Here is its unfolded form,

$$\frac{4\pi r^3 \epsilon_0 \epsilon_r}{1 + k^2 r^2} \frac{d\hat{\omega}}{dt} + \frac{4\pi r^3 \epsilon_0 \epsilon_r}{1 + k^2 r^2} k r \omega \hat{\omega} = \hat{F}_s. \quad (19)$$

With its help we have revealed the origin of mass.

Now let us rewrite Eq. (18) and present in the following form,

$$\left[\left(\frac{4\pi a^3 \epsilon_0 \epsilon_r}{1 + k^2 a^2} i \omega + \frac{4\pi a^3 \epsilon_0 \epsilon_r}{1 + k^2 a^2} k r \omega \right) \hat{\omega} = \hat{F}_s \right]. \quad (20)$$

The equation (18) presented in the form (20) describes now the *exchange of mass*. Indeed, in this case, the unfolded field component of mass exchange \hat{F}_s corresponds to the following general form,

$$\hat{F}_s = \hat{p}S = \frac{d\hat{m}}{dt} \hat{v} = \hat{q} \hat{v}. \quad (21)$$

Thus, the expression within the brackets in (20) constitutes the *potential-kinetic exchange charge* \hat{q} .

Acting by the same way, as in previous Lecture, we should consider the equation of radial exchange of the particle through the spherical surface, within which the particle is localized, in the form of the general equation of powers of exchange for the particle that has both the associated mass m and the rest mass m_0 :

$$m_0 \frac{d\hat{v}}{dt} = \hat{F} - \hat{F}_s. \quad (22)$$

Here \hat{F} is the power of exchange of the particle with an object in the ambient space; $\hat{F}_s = \hat{p}S$ takes into account the wave exchange of the particle with the ambient field of matter-space.

However, we already know that the wave pulsating microformations (which are regarded as the particles according to the DM) do not have the rest mass, *i.e.*, $m_0 = 0$. Hence, taking the latter circumstance into account, we arrive at the following general equation of powers of *exchange*,

$$\hat{F} = \hat{F}_s = \frac{d\hat{m}}{dt} \hat{v} = \hat{q} \hat{v}. \quad (23)$$

Thus, comparing (20) and (23), we see that the *charge of exchange*, $\hat{q} = \frac{d\hat{m}}{dt}$, has the *active-reactive character*, like the associated mass \hat{m} that is naturally, namely:

$$\hat{q} = q_a + iq_r = \frac{4\pi r^3 \epsilon_0 \epsilon_r}{1 + k^2 r^2} k a \omega + i \frac{4\pi r^3 \epsilon_0 \epsilon_r}{1 + k^2 r^2} \omega. \quad (24)$$

The first term q_a ,

$$q_a = \frac{4\pi r^3 \epsilon_0 \epsilon_r}{1 + k^2 r^2} k r \omega, \quad (25)$$

is the *active charge*. The second term q_r ,

$$q_r = \frac{q_a}{kr} = m \omega = \frac{4\pi r^3 \epsilon_0 \epsilon_r}{1 + k^2 r^2} \omega, \quad (26)$$

is the *reactive charge*.

The *active* component q_a defines the *dispersion during exchange*, which in a steady-state process of exchange is *compensated by the inflow* of motion and matter from the deeper levels of space.

The *reactive* component of charge, q_r , is related with the associated mass m (L.2, (19)) by the following fundamental relation for wave processes,

$$q = m\omega. \quad (27)$$

In contemporary physics just this term corresponds to the “*electric charge*”. Further for brevity, we will call it the *charge of exchange* q .

The *dimensionality* of the exchange charge is $g \times s^{-1}$. Thus, the exchange charge q (27) is *determined by the fundamental frequency of the field of exchange* ω , which is *the distinctive “time” frequency of exchange at the atomic and subatomic levels* [5], and the associated mass of the particle, m .

The *active charge* and the (*reactive*) *exchange charge* are related as

$$q_a = qkr. \quad (28)$$

Respectively, the *active* mass of the dispersion at exchange, m_a , corresponding to the active charge q_a , is related with the *associated* mass, m , as

$$m_a = \frac{q_a}{\omega} = mkr. \quad (29)$$

In such a case, the *associated mass* m should be regarded as the *reactive mass*.

4. The exchange charge of the electron

The DM reveals thus the physical meaning of two fundamental notions in physics – the notions of mass and charge. The *exchange charge* is merely the measure of the *rate of exchange of matter-space*, or briefly the *power of mass exchange*; its alternate value changes with the fundamental frequency ω .

The *exchange electric charge* q in $g \times s^{-1}$ is related with the electric charge presented in CGSE units, q_{CGS} , whose dimensionality in the CGSE system is expressed by fractional powers of the units of mass and length, $g^{1/2} \times cm^{3/2} \times s^{-1}$ [5], by the following equality,

$$q = q_{CGS} \sqrt{4\pi\epsilon_0}, \quad (30)$$

where $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$ is the *absolute unit density*. A theoretical derivation of this formula will be discussed in detail in the next Lecture.

The *electron charge* in the SI units is $e = 1.602176565 \times 10^{-19} \text{ C}$ [6]. Because $1\text{C} = 2.997924580 \times 10^9 \text{ CGSE}_q$ (in $\text{g}^{1/2} \times \text{cm}^{3/2} \times \text{s}^{-1}$, see (14)), the *electron charge* in the CGSE units, CGSE_q , is equal to

$$e_{\text{CGS}} = 4.803204506 \times 10^{-10} \text{ CGSE}_q. \quad (31)$$

Hence, from (30) it follows that the *exchange (reactive) charge of the electron* has the following value,

$$e = e_{\text{CGS}} \sqrt{4\pi\varepsilon_0} = 1.702691665 \times 10^{-9} \text{ g} \times \text{s}^{-1}. \quad (32)$$

The electron charge of the value (32) is considered in the DM as an *elementary quantum of the rate of mass exchange*.

5. The fundamental frequency of exchange

On the basis of the relation (27), knowing the values of the *electron exchange charge* e (32) and its *associated mass* m_e , we arrive at the *fundamental frequency* of the wave field of exchange at the *atomic and subatomic levels*,

$$\omega_e = \frac{e}{m_e} = 1.869162469 \times 10^{18} \text{ s}^{-1}. \quad (33)$$

In this formula, $m_e = 9.10938291(40) \cdot 10^{-28} \text{ g}$ is the *electron mass* taken from CODATA Recommended Values of the Fundamental Physical Constants: 2010 [6]. It is regarded in modern physics as the rest mass. However, as was shown in previous Lecture 2, the electron mass accepted in physics, and presented above, is, actually, *associated* and defined by the formula (21, L. 2).

The so-called “*electrostatic field*”, considered as we see by the definition in physics as *static*, is actually an *alternating field* just of this fundamental *exafrequency* ω_e .

The *fundamental wave radius*, corresponding to the fundamental frequency (33) has the value,

$$\lambda_e = \frac{c}{\omega_e} = 1.603886569 \times 10^{-8} \text{ cm}, \quad (34)$$

It is the next important fundamental parameter of the DM. As already mentioned, the double value of the fundamental wave radius, the *fundamental wave diameter* $D = 2\lambda_e = 0.32 \text{ nm}$, correlates with the average value of lattice parameters in crystals, defining an average discreteness of space (the distance between nodes in crystals and molecules) at the subatomic and atomic levels of exchange (interaction).

For the comparison of the characteristic dimensions at the atomic and subatomic levels, related with the fundamental frequency of exchange ω_e , let us recall that the radius of the wave shell of the electron r_e (in fact the *electron radius*), derived from the formula of associated mass $m = \frac{4\pi r^3 \varepsilon_0 \varepsilon_r}{1 + k_e^2 r^2}$ under the condition: $m = m_e$, $r = r_e$, $k_e = \frac{2\pi}{\lambda_e} = \frac{1}{\lambda_e}$, $\varepsilon_r = 1$, $c = 2.99792458 \times 10^{10} \text{ cm} \times \text{s}^{-1}$, is

$$r_e = 4.17052597 \times 10^{-10} \text{ cm}. \quad (35)$$

And the *proton radius* limited like the electron radius by the *characteristic wave shell* (derived from the same formula of mass) is $r_p = 5.28421703 \times 10^{-9} \text{ cm}$; this value is insignificantly different from the Bohr radius, $r_0 = 5.2917721092 \times 10^{-9} \text{ cm}$.

6. Conclusion

Let's summarize what we have learned from this Lecture. Will agree, a truly unique issue has been discussed here. It is closely related to the subject matter considered in Lecture 2 and is a continuation of the latter.

According to the definition of the notion of *exchange charges*, the discovery of the exchange nature of *electric charges* has been made at the derivation as a logical consequence of the relation of the charges with the *associated nature of mass* of particles and their wave behavior in the field-space. As a result, we know now the true *origin*, *value* and *dimensionality*, in particular, of the *electron charge*, which is an *elementary quantum of the rate of mass exchange*.

We have paid attention here only on *electric charges*, but you have to realize that the same *exchange nature* concerns also magnetic and gravitational charges. About them we will speak some later.

A discovery of the nature of the electric charge, along with the revealing of the origin of mass, has pulled a chain of other new discoveries. The knowledge of the true origin of two fundamental physical constants, *mass* and *charge* of the electron, m_e and e , along with the finding of the correct numerical value and true dimensionality of the latter, led naturally (basing on their interrelation (27)) to the discovery of the *fundamental frequency of exchange*

(interaction), ω_e . This frequency defines all processes at the atomic and subatomic levels, in solids and molecules, including the strength of bindings (strong and electromagnetic) and the structure of substances.

In addition to the above triad (m_e, e, ω_e), we should also note in the conclusion other discovered fundamental constants, which are the derivatives of the aforesaid fundamental constants: the *fundamental wave radius* λ_e , characteristic to the levels, and the *electron* and *proton radii of their wave shells*, r_e and r_p .

It should be stressed also that the discovery of the strict conformity of the fundamental wave radius λ_e to the *average value of lattice parameters* in crystals is one of the firm evidences in favor of the validity of the DM, and, hence, in favor of the adequacy of the accepted concept on the wave nature and wave behavior of elementary particles to reality.

The above considered fundamental constants-parameters, old of newly interpreted (m_e, e) and unknown earlier new ($\omega_e, \lambda_e, r_e, r_p$), were/are used at the reconsideration of all physical phenomena in the light of the Wave Model within the theory called the DM, devoted to the structure and behavior of elementary particles and to the applications of this theory.

Without aforementioned fundamental quantities it would be impossible to make a series of other discoveries (which have not yet been considered in these Lectures), for example, such unique ones, as: the discovery of the *background spectrum of the hydrogen atom* and the precise *derivation of the magnetic moments* of nucleons (proton and neutron) and the electron. These issues will be a subject of the consideration in the further Lectures collected in Vol. 3.

References

- [1] G.P. Shpenkov and L.G. Kreidik, *What the Electric Charge is*, 2002; <http://shpenkov.com/pdf/Elec-Charge.pdf>
- [2]. L.G. Kreidik and G.P. Shpenkov, *Foundations of Physics*; 13.644...*Collected Papers*, Bydgoszcz, 1998.
- [3]. L.G. Kreidik and G.P. Shpenkov, *Alternative Picture of the World*, Vol. 1-3, Bydgoszcz, 1996.
- [4] L. G. Kreidik and G. P. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and "Electric" Charge*, REVISTA CIENCIAS EXATAS E NATURAIS, Vol. 3, No 2, 157-170, (2001); <http://shpenkov.com/pdf/masscharge.pdf>
- [5] L. G. Kreidik and G. P. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.; <http://shpenkov.com/atom.html>
- [6] CODATA *Recommended Values of the Fundamental Physical Constants*: 2010; <http://physics.nist.gov/cuu/Constants/>

Lecture 4

The Central Exchange

1. Introduction

The unified description of different physical processes and all known types of fundamental interactions, including gravitational, is yet an unsolved problem of modern physics. All undertaken efforts to construct a unified physical theory turned out to be unsuccessful. The reason is in inability in principle of the Standard Model to solve this problem. We have discussed this in the first Lectures considering in detail conceptual faults of the SM. In order not to be repeated, briefly recall, the SM is not adequate to reality; hence, the problem cannot be solved on its basis in principle [1].

In the framework of the DM, thanks to the discovery of the *universal laws of central and transversal exchanges*, the aforesaid problem, as many others, is solved in a natural way. Here, we concentrate our attention only on the derivation of the *law of central (longitudinal) exchange* and on some important resulting consequences naturally originated from the theoretical derivation of the law [2, 3].

In particular, an important *formula of the correspondence* of the exchange charge q and the coulomb electric charge expressed in CGSE units, q_{CGS} , was deduced therewith. It allowed obtaining the true value and dimensionality of the electron charge e , which, according to the DM, is an *elementary quantum of the rate of mass exchange*.

Moreover, defining the *dynamic energy* of the particles of the subatomic level, we have come to the equation, $W = \int c^2 dm$, uncovering, thus, the true physical meaning of the famous energy-mass formula for the internal energy of *quiescent* elementary particles, $E_0 = m_0 c^2$; revealed thereupon the role that plays the speed of light c in this expression. As it turned out, the speed c is the base (phase) speed of propagation of waves, caused by pulsations of characteristic wave spherical shells of the particles in an ambient field-space. It is the fundamental speed of the wave exchange (interaction) of the particles with ambient, with other particles and wave fields, respectively.

Let us proceed now to the detail description of all stages of the derivation of the aforementioned law of the central exchange.

2. The universal law of central exchange; derivation

The simplest potential of the speed of exchange in a spherical wave field has the following general form,

$$\hat{\Phi} = A \frac{e^{i(\omega t - k(r-a))}}{r}. \quad (1)$$

The first partial derivative of $\hat{\Phi}$ with respect to r defines the radial speed of exchange,

$$\hat{v} = -\frac{\partial \hat{\Phi}}{\partial r}. \quad (2)$$

The wave process has the longitudinal-transverse character. Therefore, the velocity is a complex quantity and has the binary potential-kinetic character. Along with the velocity of the transverse field of kinetic motion, $v = v_k$, there exists the potential longitudinal (or radial) velocity of motion, $iv = v_p$ (details are in [2], pages 339-342; [4], pages 81-83)].

At the boundary condition when the radial speed of exchange (at the wave spherical surface of a particle) follows the law,

$$\hat{v} = iv_0 e^{i\omega t}, \quad (3)$$

we arrive at the following equality,

$$-\frac{\partial \hat{\Phi}}{\partial r} = A \frac{e^{i(\omega t - k(r-a))}}{r} \left(\frac{1 + rki}{r} \right) = iv_0 e^{i\omega t}. \quad (4)$$

From this expression, we find an implicit value of the factor A entered in the equation (1) presented in the general form. At $r = a$, we obtain

$$A = \frac{iv_0 a^2}{1 + ika}. \quad (5)$$

Thus, the potential of the speed of exchange (1) takes the form

$$\hat{\Phi} = \frac{v_0 a^2}{(ka - i)} \frac{e^{i(\omega t - k(r-a))}}{r}. \quad (6)$$

After some elementary operations we can rewrite this expression presenting it in the following form,

$$\hat{\Phi} = \omega \frac{4\pi \varepsilon_0 \varepsilon_r a^3}{(1 + k^2 a^2)} \frac{(ka + i) e^{i(\omega t - k(r-a))}}{4\pi \varepsilon_0 \varepsilon_r r}, \quad (7)$$

where $\omega = \frac{v_0}{a}$. In this expression, the factor,

$$\frac{4\pi\epsilon_0\epsilon_r a^3}{(1+k^2 a^2)} \omega, \quad (8)$$

as you already know, is a product of the associated mass m and the fundamental frequency of exchange ω , *i.e.*, is the exchange charge q ,

$$m\omega = q. \quad (9)$$

Now, introducing the *charge wave of exchange* in the form,

$$\hat{q} = qe^{i(\omega t - k(r-a))}, \quad (10)$$

we arrive at the following expression for the potential $\hat{\Phi}$,

$$\hat{\Phi} = \frac{\hat{q}}{4\pi\epsilon_0\epsilon_r r} (ka + i). \quad (11)$$

We see that the potential of the spherical field of exchange (11) has the *potential-kinetic* character. Introducing new designations, we present it finally in the unfolded form, such as

$$\hat{\Phi} = \hat{\phi}ka + i\hat{\phi} = \frac{\hat{q}}{4\pi\epsilon_0\epsilon_r r} ka + \frac{\hat{q}}{4\pi\epsilon_0\epsilon_r r} i. \quad (12)$$

In this equation, $\hat{\phi}ka$ is the *active potential of dispersion*, and $\hat{\phi}$ is the *reactive potential of exchange*. The latter is equal to

$$\hat{\phi} = \frac{\hat{q}}{4\pi\epsilon_0\epsilon_r r}. \quad (13)$$

The potential of radial exchange $\hat{\phi}$ is determined by the *charge wave of exchange* (10), where q is amplitude of the charge determined by the expression (9).

The potential (13) will not be changed if we will assume that at the field level $\epsilon_r = 1$. Then, the *amplitude* (and also the *mean value*) of the *potential* will be determined by the equality,

$$\phi = \frac{q}{4\pi\epsilon_0 r}, \quad (14)$$

where

$$q = m\omega = \frac{4\pi a^3 \epsilon_0}{1+k^2 a^2} \omega \quad (15)$$

is the *amplitude* (or *mean value*) of the *charge*.

A gradient of the potential of exchange ϕ defines the *intensity* (or *strength*, or *the rate*, or *the vector*) of central exchange E ; its amplitude and mean value is:

$$E = -\frac{\partial \phi}{\partial r} = \frac{q}{4\pi \varepsilon_0 \varepsilon_r r^2}. \quad (16)$$

It should be recalled that everywhere in works discussed in these Lectures we use the *objective system of units* of matter, space, and time (g , cm , and s) and *new fundamental constants-parameters* originated from the DM. In these units, bearing in mind that in the DM $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$, the dimensionality of the intensity of central exchange E is $\text{cm} \times \text{s}^{-1}$.

The vector of central exchange E defines the *dynamic vector* D , equal by the definition to

$$D = \varepsilon_0 \varepsilon_r E \quad \text{or} \quad E = \mu_0 \mu_r D, \quad (17)$$

where $\mu_0 = \frac{1}{\varepsilon_0} = 1 \text{ cm}^3 \times \text{g}^{-1}$ and $\mu_r = \frac{1}{\varepsilon_r}$. The vector D represents the *density of momentum* of exchange at rest-motion; its dimensionality is $\text{g} \times \text{cm}^{-2} \times \text{s}^{-1}$.

Taking into account that $\hat{F} = \hat{F}_s = \frac{d\hat{m}}{dt} \hat{v} = \hat{q} \hat{v}$ (see (23), L.3) and $q = \frac{dm}{dt}$, we arrive at the following equation of the *power of exchange* F corresponding to the *strength-rate of exchange* E (16):

$$F = \frac{dm}{dt} E = q \frac{q}{4\pi \varepsilon_0 \varepsilon_r r^2}, \quad (18)$$

where $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$ is the absolute unit density, $q = m\omega$ is the exchange charge (15).

Thus, we come to the *universal law of central exchange* of the Coulomb kind in the following general form,

$$F = \frac{q_1 q_2}{4\pi \varepsilon_0 \varepsilon_r r^2}. \quad (19)$$

At first glance, judging by the form, the law (19) is the same as Coulomb's law. However, in contents, in physical meaning of their constituents, both laws (Coulomb's law and the Universal law of central exchange) are different.

Namely, in *Coulomb's law*, the nature of electric charges q_1 and q_2 is unknown just as unknown their true (objective) dimensionality, because they are expressed by the subjective (farfetched) unit, *coulomb*, that hidden their true fractional dimensionalities. The term ε_0 is the so-called "electric constant" referred in modern physics to a series of fundamental physical constants [5]. This term has the strange (absurd) dimensionality and, hence,

unintelligible value $\varepsilon_0 = 8.854187818... \times 10^{-12} \text{ F} \times \text{m}^{-1}$, being actually (as shown in the previous Lecture 3) the dimensionless factor equal to the number, $\varepsilon_0 = \frac{1}{4\pi}$ [6].

On the contrary, in the *universal law of central exchange* (19), the nature of charges and their true dimensionalities are known. The charges q_1 and q_2 represent the *rate of mass exchange (interaction)*. Their objective dimensionality is $[q] = g \times s^{-1}$. The factor ε_0 is the absolute unit density, $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$.

Considering the fact that in the DM $q = m\omega$, we present finally the *universal law of central exchange* (19) in the enhanced form distinguishing it from the well-known writing of Coulomb's law, namely, as

$$F = \omega_{fund}^2 \frac{m_1 m_2}{4\pi \varepsilon_0 r^2}. \quad (19a)$$

In this case there will not be a confusion to which theory the given law relates. In the Universal Law (19a), ω_{fund} is the strictly definite fundamental frequency of exchange.

We will repeatedly turn to the law (19a) in the further Lectures revealing gradually its universal meaning. This law allows the description of fundamental interactions existed in nature from a unified point of view, we will show this.

3. Internal dynamic energy of elementary particles

The speed of exchange at the *basis level* is equal to the speed of light c . In this case, an equation of the power of exchange ((23), L.3) takes the form

$$\hat{q}\hat{c} = \hat{F}. \quad (20)$$

Hence, the *energy of mass exchange* (interaction) on the basis level or, in other words, the internal *dynamic energy* of particles of the subatomic level is equal to

$$W = \int qcdl = \int \frac{dm}{dt} c c dt = \int c^2 dm, \quad (21)$$

where $\frac{dl}{dt} = c$ and dl is the displacement of the wave front of exchange at the separating surface of a particle (Fig. 1, L.2). In the case of the differential exchange, we have

$$\Delta W = \Delta m c^2. \quad (22)$$

We arrive at the so-called “*rest energy*” of particles, well known in the form

$$E_0 = m_0 c^2 . \quad (23)$$

The similar dependence, in merits of the contents, has introduced for the first time by N. Umov (1873), then by O. Heaviside (1890), and latter on (2005) by chance in Einstein's manipulation with the fictitious mathematical empty spaces. The physical meaning (the nature) of such a *dependence of the energy of elementary particles on the speed of light* is not (and cannot be) generally understood by existing theories accepted in modern physics in the framework of the SM.

Modern physics does not know the origin of mass, therefore the mass of particles m_0 is considered as the *rest* mass. Let's suppose that this is really so, accordingly, the following question arises, what is the cause of the relationship, which exists between the *rest* mass of a particle m_0 and the *speed* of light c in the formula where *motion is out of the question*? Or, in other words, why does the *speed* of light c play the fundamental role for the internal energy, E_0 , of a *quiescent* (motionless) particle, *i.e.*, of the particle being at rest, as a unit essence, with respect to ambient material objects? The Standard Model of Elementary Particles (SM) is unable to explain this; therefore this issue did not rise even, and still does not arise.

At present, thanks to the theory on the structure of elementary particles – the DM, which revealed the origin of mass, we are able to explain this dependence. According to the DM, elementary particles, being unceasingly pulsating microobjects (energetic self-oscillating systems), acquire the mass owing to the uninterrupted pulsations and during these pulsations; therefore the mass is associated (dynamic) in its origin. No pulsations – no mass.

Such particles naturally possess an internal energy *dependent on the wave speed* of spreading of the pulsations, and due to the wave exchange at the given speed with ambient, supporting such a dynamic state (microformation). Thus, the dependence of the energy on fundamental constants-parameters, m_0 and c (realized in the formula $E_0 = m_0 c^2$), is naturally defined by the dynamic behavior of particles, their *associated mass* m_0 and the *fundamental wave speed* c of the propagation of the pulsations in a surrounding field-space and exchange at this speed. Thus, Eq. (23) presents the *energy of wave exchange* of matter-space-time on the subatomic level or the *dynamic energy of particles of the subatomic level*.

4. The exchange charge of the electron

In the DM, taking into account (14), the measure of energy of exchange of a particle with the surrounding field is defined by the following formula,

$$W = q\varphi = \frac{q^2}{4\pi\epsilon_0 r} . \quad (24)$$

Note, in this expression, $q = m\omega_e$ is the *exchange charge*, $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$ is the *absolute unit density*.

In the electrostatic field theory, in CGSE units, the following coulomb energy corresponds to the energy of exchange (24):

$$W_{CGS} = \frac{q_{CGS}^2}{r}, \quad (25)$$

where q_{CGS} is the coulomb “electric” charge with the fractional dimensionality of objective units.

Assuming, naturally, that $W = W_{CGS}$, we have the equality,

$$\frac{q^2}{4\pi\varepsilon_0 r} = \frac{q_{CGS}^2}{r}.$$

In a result we obtain the following *formula of the correspondence* of the *exchange charge*, q , and the coulomb (in CGSE units) *electric charge*, q_{CGS} :

$$q = q_{CGS} \sqrt{4\pi\varepsilon_0}. \quad (26)$$

From this formula it follows that the *exchange (reactive) charge of the electron* at the level of the fundamental frequency ω_e is

$$e = e_{CGS} \sqrt{4\pi\varepsilon_0} = 1.702691665 \times 10^{-9} \text{ g} \times \text{s}^{-1}, \quad (27)$$

where $e_{CGS} = 4.803204506 \times 10^{-10} \text{ CGSE}_q$ is the electron charge in CGSE units [7, 8], $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$.

Thus, the physical quantity (27) is the *exchange charge of the electron*. It is obtained on the basis of the experimental value of the electron charge expressed in units of CGSE_q .

Let us stress once more that the *dimensionality of the exchange charge* and, hence, the true dimensionality of the “electric” charge, is

$$[q] = \text{g} \times \text{s}^{-1}. \quad (28)$$

Thus, the DM for the first time uncovers the physical meaning (the nature of origination) of both fundamental essences – *mass* and *electric charge*. The charge of exchange (called the “electric” charge in modern physics) is the measure of the *rate of exchange of matter-space-time*, or briefly, the *power of mass exchange*. Its oscillating value is changed with the fundamental frequency ω_e .

The dimensionality of the electric charge q_{CGS} in *CGSE* units of the charge, $CGSE_q$, is

$$[q_{CGS}] = g^{1/2} \times cm^{3/2} \times s^{-1}. \quad (CGS) \quad (29)$$

The dimensionality of the electric charge in *SI* units is expressed in coulombs (C):

$$[q_{SI}] = C \text{ (coulomb)} \quad (SI) \quad (30)$$

In spite of a seeming difference of both dimensionalities, nevertheless the electric charge in coulombs (C), being presented through really basic units of matter (kg), space (m), and time (s), has actually in SI the same fractional dimensionalities as the charge in CGS [6] (see (13), L.3):

$$[q_{SI}] = kg^{1/2} \times m^{3/2} \times s^{-1}. \quad (SI) \quad (31)$$

Specifically, the units of the electric charge in both systems, *CGSE* and *SI*, are as follows:

$$1CGSE_q = 1g^{1/2} \times cm^{3/2} \times s^{-1}, \quad (CGS) \quad (32)$$

$$1C = \frac{c_r}{\sqrt{10^{11}}} kg^{1/2} \times m^{3/2} \times s^{-1}. \quad (SI) \quad (33)$$

where $c_r = c/c_e = 2.99792458 \times 10^{10}$ ($c = 2.99792458 \times 10^{10} cm \times s^{-1}$, $c_e = 1 cm \times s^{-1}$).

The quantities $kg^{1/2}$ and $m^{3/2}$ (or $g^{1/2}$ and $cm^{3/2}$) have no physical sense. For this reason, obviously, modern physics is unable to understand, resting on such nonsensical units, the nature of origination of “electric” charges.

The derived formula of the correspondence between exchange charge q (28) and Coulomb charge q_{CGS} (29), $q = q_{CGS} \sqrt{4\pi\epsilon_0}$ (26), gave us the possibility to replace erroneous values of electric charges used currently in physics with true ones.

5. The fundamental frequency of exchange and wave radius

Thus, the *exchange charge of the electron* e , at the level of the fundamental frequency ω_e , is equal to $e = 1.7026916657 \times 10^{-9} g \times s^{-1}$ (27). The ratio of the electron exchange charge e and associated mass m_e : $\frac{e}{m_e}$, has the dimensionality of frequency, s^{-1} . It is naturally, because this ratio is related with the wave nature and behavior of two its constituents, e and m_e , and follows from the equality $q = m\omega$ ((27), L. 3). The physical meaning of the above

ratio was unknown earlier. This ratio, as you already know, *defines the fundamental frequency* of atomic and subatomic levels ω_e and is, thus, one of the fundamental constants-parameters of the DM.

Let us remind as modern physics, unknowing the origin of mass and the nature of electric charges, interprets (relates to) the analogous ratio.

In modern physics, the ratio of two fundamental constants, the electron charge e and the electron mass m_e , is called the *correlation coefficient* between e and m_e , or *electron charge to mass quotient*. And it is accepted [5], along with e and m_e , also as the fundamental constant, but of an undefined meaning because of the odd dimensionality:

$$-\frac{e_{SI}}{m_e} = -1.758820088 \times 10^{11} \text{ C} \times \text{kg}^{-1}. \quad (34)$$

It is impossible to ascribe any physical meaning to this ratio. For this reason, this ratio is defined in official physics as the *correlation coefficient*. If we substitute in (34) the unit of electron charge presented in coulombs (C) with its actual value, in SI, in objective units of matter, space, and time (kg , m , and s) (33), where $1\text{C} = \frac{c_r}{\sqrt{10^{11}}} \text{ kg}^{1/2} \times m^{3/2} \times s^{-1}$, we come to the following value and dimensionality of the quotient

$$-\frac{e_{SI}}{m_e} = -1.667408919 \times 10^{14} \text{ kg}^{-1/2} \times m^{3/2} \times s^{-1}. \quad (35)$$

It is clear; this ratio is senseless because of the absurd dimensionality, just like the ratio (34), where the unit C , in actual fact, plays the role of a “fig leaf” covering (concealing) the fractional powers at the objective base units of kg and m in the unit of charge.

On the basis of the equation, $q = m\omega$ ((27), L.3), knowing the exchange charge of the electron $q = e$ (27), we have found that the ratio $\frac{e}{m_e}$ defines the *fundamental frequency of the wave field of exchange* (interaction) at the subatomic and atomic levels, which is, actually, the frequency of the so-called “electrostatic” field,

$$\omega_e = \frac{e}{m_e} = 1.869162505 \times 10^{18} \text{ s}^{-1}. \quad (36)$$

where $m_e = 9.10938291 \times 10^{-28} \text{ g}$ is the *associated mass* of the electron.

Present time devices cannot detect exafrequency fields and, therefore, perceive them as static. An amplitude modulation of this exafrequency field at different, but essentially less than ω_e , frequencies gives the whole spectrum of fields which are regarded as electromagnetic. We know that according to the Wave Model static fields do not exist in Nature in principle. Really, the so-called “electrostatic” field is produced by the electric

charge, but the latter, as we now know, has the exchange wave nature and defines the rate of the wave mass exchange with the base speed c . Thus, the “electrostatic” field is, actually, the wave field of the fundamental frequency ω_e .

The alternating field of the fundamental frequency ω_e is responsible for the wave exchange at the atomic and subatomic levels; namely, for the “electromagnetic” interatomic exchange – “molecular interactions”, and for the strong intra-atomic exchange – “nuclear interactions”. It defines, thus, the strong order (correlation) in the relative spatial disposition of atoms in molecules and crystals.

The fundamental frequency ω_e and the phase speed c of the wave exchange at this frequency, characteristic for the atomic and subatomic levels, define the *fundamental wave radius*,

$$\tilde{\lambda}_e = \frac{c}{\omega_e} = 1.603886538 \times 10^{-8} \text{ cm}. \quad (37)$$

We have already touched this issue in previous Lectures.

The value $D = 2\tilde{\lambda}_e = 0.32 \text{ nm}$ correlates with the average value of lattice parameters in crystals, defining an average discreteness of space at the subatomic level of exchange (interaction). It means that the *fundamental wave radius* shows itself as a measure for setting the pitch, providing the definite step in disposition of atoms in crystal lattice. Actually, it was found the full correspondence of the disposition of atoms in crystals with the disposition of the nodes in standing spherical waves, whose parameters are also defined by the fundamental frequency ω_e and, hence, by the corresponding fundamental wave radius $\tilde{\lambda}_e$ [2].

6. Conclusion

A deducing of the next series of new important data, originated from the DM, has been demonstrated in this Lecture. As a result, we in fact approached to the unified description of fundamental interactions. The unified description really becomes possible now due to the discovery of the *universal law of central exchange*, derivation of which we have shown in this Lecture, and also owing to the discovery of a series of new fundamental physical constants-parameters considered in the previous Lectures and, partially, here. We mean, for example, such physical parameters as: the *exchange charge of the electron* $e = m_e \omega_e$, the *fundamental frequency* ω_e and the *fundamental wave radius* $\tilde{\lambda}_e$ of the subatomic and atomic levels, and the *radii of the wave characteristic shells of the electron* r_e and *proton* r_p .

All above enumerated fundamental constants-parameters are unknown for contemporary physics based on the SM. The latter, as we already well understand, is not adequate to reality. Being abstract-mathematical, it does not reflect reality. The aforementioned *fundamental law of the central exchange* is inherent in the DM only, just like the above enumerated fundamental parameters obtained exclusively within the framework of this theory.

Now, for the sake of completeness, we need to proceed to the consideration of the nature of gravitation. It should be understood, how the latter relates to the universal law of central exchange. From the DM it follows that *wave exchange* of elementary particles is realized not only at the *ultimately high* fundamental frequency ω_e (responsible for *electromagnetic* and *strong* interactions), but also at the *extremely low* fundamental frequency ω_g (responsible for *gravitational* interactions). Thus, we have intent to show in the next Lectures how the gravity problem is solved in the DM and which of the fundamental parameters are characteristic for gravitational fields.

Judging by the results already presented in the preceding Lectures, one can come to the conclusion that the DM most likely is the theory adequate to reality, of course, in certain extent. Apparently, for this reason, saying in advance, the solution of the problem on the nature of gravitation was not so difficult to implement in the framework of the DM. It required no special efforts. This issue will be discussed further.

References

- [1] G. P. Shpenkov, *Some Words About Fundamental Problems of Physics: Constructive Analysis*, LAMBERT Academic Publishing, p.116 (2012);
amazon.com/words-about-fundamental-problems-physics/dp/3659237507
<http://shpenkov.com/pdf/Book-2011-Eng.pdf>
- [2] L. G. Kreidik and G. P. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.; <http://shpenkov.com/atom.html>
- [3] L. G. Kreidik and G. P. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and "Electric" Charge*, REVISTA CIENCIAS EXATAS E NATURAIS, Vol. 3, No 2, 157-170, (2001); <http://shpenkov.com/pdf/masscharge.pdf>
- [4]. L.G. Kreidik and G.P. Shpenkov, *Foundations of Physics*; 13.644...*Collected Papers*, Bydgoszcz, 1998.
- [5] CODATA *Internationally recommended values of the fundamental Physical Constants*, 2010; http://physics.nist.gov/cgi-bin/cuu/Value?ep0|search_for=electric+constant
- [6] G.P. Shpenkov and L.G. Kreidik, *What the Electric Charge is*, 2002;
<http://shpenkov.com/pdf/Elec-Charge.pdf>
- [7] Littlejohn, Robert (Fall 2011). "Gaussian, SI and Other Systems of Units in Electromagnetic Theory". Physics 221A, University of California, Berkeley lecture notes. Retrieved 2008-05-06; <http://bohr.physics.berkeley.edu/classes/221/1112/notes/emunits.pdf>
- [8] A.P. French, Edwind F. Taylor (1978). *An Introduction to Quantum Physics*. W.W. Norton & Company.

Lecture 5

Gravitational Field of Elementary Particles

1. Introduction

We continue analyzing consequences originated from solutions of the equation of central exchange (interaction) [1]. The next, but not last, effect of the aforesaid solutions is the discovery of the nature of gravitation.

Currently the gravitational interaction is described, in part, by Newton's theory of “universal gravitation”, and in a general case, by the general theory of relativity, and, in the so-called quantum limit, by till unfinished quantum theory of gravity.

However, it should be stressed once more that none of these theories beginning from Newton' time is unable to explain the nature of gravitation. They all are focused only on the description of experimental facts related to gravitation. Remember, what Newton wrote in his commentary (General Scholium, 1713) to the 2nd edition of his Principia (translation of 1999 from Latin): *“I have not as yet been able to discover the reason for these properties of gravity from phenomena, and I do not feign hypotheses”* (*‘hypotheses non fingo’*, in Latin).

Everything in Nature is interrelated and is in a natural harmony. Therefore, if a theory is correct, the aforementioned harmony and interrelation must be reflected in the given theory by the ability within its framework to describe various fundamental interactions from a unified point of view. Such a description should be noncontradictory, sole and universal for all kinds of fundamental interactions. However, as we know, all attempts undertaken by official physics to construct a unified theory of physics have ended in failure despite enormous efforts. In particular, modern physics in no way can find the relation existed between the gravitational interaction, described by the general relativity theory, and the remaining three types of fundamental interactions (strong, electromagnetic, and weak) which modern physics distinguishes presently.

The main reason for the failure of official physics is an inadequacy of its theories, including general relativity, to reality. All these theories are developed in the framework of the scientifically unsound Standard Model (SM). It is an unambiguous conclusion to which we have come and this view is already shared by many.

Unfortunately, facing the difficulties, mainstream theorists do not want to see and hear about other theoretical approaches which are beyond the framework of the habitual SM. They used to the SM and afraid to overstep the framework of concepts that are developing for a long time in theoretical physics. As a result, gravity is still an official dogma of science, one of the series of inexplicable phenomena.

Let's get back to basics. What we know about two key experimental laws: Newton's law of universal gravitation (1686),

$$F = G \frac{m_1 m_2}{r^2}, \quad (1)$$

and similar, in form, Coulomb's law for interacting point electric charges (1785-1788),

$$F = k \frac{q_1 q_2}{r^2}. \quad (2)$$

In Newton's formula (1), the numerical value and dimensionality of the proportionality factor G , called the gravitational constant, is known from experiment: $G = 6.67384(80) \times 10^{-8} \text{ cm}^3 \text{ g}^{-1} \text{ s}^{-2}$. The proportionality factor k in Coulomb's law is still unknown physical quantity both in magnitude and in dimensionality (see previous Lectures). The *spherical isotropic character* of both laws is not reflected in the above mathematical writing. Moreover, there is no term reflecting the *interrelation of matter and space*.

Identical functional dependence – the subordination of the gravitational and electrostatic interactions to the inverse square law justifies that both of the laws are particular cases of a general inverse square law, which describes both interactions, electromagnetic and gravitational, from a single point of view [2, 3].

Basing on the DM [4], we have obtained the general form of the above laws (see (19a), L.4) called the *universal law of exchange*. It became possible when we have obtained the answers to the following questions:

- 1) What is the mass m of elementary particles, what is its nature?
- 2) What is the charge q , what is its true nature and, hence, the correct dimensionality? Keep in mind in this regard that the dimensionality expressed, without exception, only by integer powers of the objective units (cm , g , and s) can be regarded as correct.
- 3) On which parameters the proportionality factor, k , in Coulomb's law depends, and what are its absolute value and dimensionality?
- 5) How do the parameters, m and q , interrelate?

Now we are able to get the answers to the following questions: depends on whether the gravitational constant G of some parameters? If yes, from what exactly? What is the nature of gravitational fields?

All processes and objects in the Universe have the wave character. It concerns the fields of any nature, including gravitational. Accordingly, fundamental parameters of the wave gravitational field must be defined by the *wave* solutions and be *subjected to the universal law of the central exchange* that we have first began to consider in the previous Lecture. Let us proceed to the continuation of the consideration of this subject.

2. Fundamental frequency of the gravitational field

Thus, with taking into account the relation between the charge of exchange q and the associated mass m , $q = \omega m$ ((15), L.4), the *universal law of central exchange* ((19), L.4) takes the form,

$$F = \omega_{fund}^2 \frac{m_1 m_2}{4\pi \varepsilon_0 r^2}. \quad (3)$$

In this equation all constituent parameters have the strictly defined physical meaning and dimensionalities. Namely, m_1 and m_2 are *associated masses* of interacting particles, ω_{fund} is one of the two *strictly definite fundamental frequencies* of exchange: for the atomic and subatomic levels, it is ω_e ; for the gravitational level, it is ω_g . The factor ε_0 is the *absolute unit density*, $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$. *This law lies in the foundation of Nature.*

Newton's law of universal gravitation is a particular case of the law of central exchange (3). Discovered by Newton in 1687, the law of universal gravitation, according to which every particle attracts every other particle with a force F given by

$$F = G \frac{m_1 m_2}{r^2}, \quad (4)$$

is presented hitherto, as before, in its original form, because the expression, explicit functional dependence, hidden in the gravitational “constant” G was till now unknown for modern physics.

Following the general form of the *law of central exchange* (interaction) (3) (see (19a), L.4), we are able now to present the *law of universal gravitation* (4) in its true form compatible with the law (3). For this aim, the Newtonian formula (4) must be unfolded and rewritten in such a way in order to contain in the denominator the following two missing terms-parameters characteristic for the central exchange, which is, without a doubt, the gravitational exchange (interaction) of material objects:

(1) The coefficient 4π , which expresses the *spherical isotropic character* of the central exchange, as it takes place in (3).

(2) The absolute unite density ε_0 , which expresses the *interrelation of matter and space* (characterized by measures of mass and volume), or *contents* and *form* [3].

Introducing these multipliers in numerator and denominator of (4), we arrive as a result at the law of gravitation in the form,

$$F = \gamma \frac{m_1 m_2}{4\pi \varepsilon_0 r^2}, \quad (5)$$

where $\gamma = 4\pi \varepsilon_0 G$.

Comparing now the central exchange presented in the two forms, (3) and (5), we find the interrelation between the *fundamental frequency of the field of exchange at the gravitational level* ω_g and the *gravitational constant* G :

$$\omega_g = \sqrt{4\pi \varepsilon_0 G}. \quad (6)$$

The value of the constant $G = 6.67384 \times 10^{-8} \text{ g}^{-1} \times \text{cm}^3 \times \text{s}^{-2}$ is known from experiment; and the absolute unit density of matter $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$.

Hence, from (6) it follows that the *fundamental frequency of the wave gravitational field* is equal to

$$\omega_g = 9.15783527 \times 10^{-4} \text{ s}^{-1}, \quad (7)$$

The wave field of this frequency is responsible for *gravitational exchange (interaction)* of elementary particles and, respectively, for gravitational exchange of all objects in the Universe. And, in particular, the discovered physical parameter (7) defines the ordered disposition of orbits of planets and their satellites in the solar system, *etc.*

3. Fundamental gravitational wave radius

Knowing ω_g and assuming that the gravitational interaction relates to the subatomic level where the basis speed $c = 2.99792458 \times 10^{10} \text{ cm} \times \text{s}^{-1}$, we find the *wave gravitational radius* of elementary particles:

$$r_g = \tilde{\lambda}_g = \frac{c}{\omega_g} = 3.27361706 \times 10^{13} \text{ cm} \approx 327.4 \text{ Mkm}. \quad (8)$$

On our Earth, we are inside of a gigantic gravitational wave and, therefore, we perceive gravitational field as stationary, but not as wave. Stellar systems are spherical objects of mega space – atoms of the mega world. Their wave shells, having the gravitational radius $r_g \approx 327.4 \text{ Mkm}$, determine the spatial boundary separating the oscillatory and wave domains of the spherical field-space of stars.

The wave gravitational radius determines, thus, the wave gravitational sphere with the transient wave zone, which divides the spherical space-field of a particle into the near oscillatory domain (domain of basis) and the far wave domain (domain of superstructure).

If the particles form cosmic objects, for example, the stars, then the domain of the gravitational radius (8) (as the transient zone, separating the basis and the superstructure of the field of the stars) must be characterized by a series of rings-shells. In the solar system, they are presented by the rings of asteroids around the Sun, adjoined to the shell of the gravitational radius. In this domain, big planets cannot exist because the transient zone was the place of the most intense motion in the process of the formation of the Solar system.

Thus, originated from the DM, the *law of central exchange* at the level of gravitational fields is presented in the form:

$$F = \omega_g^2 \frac{m_1 m_2}{4\pi \varepsilon_0 r^2}, \quad (9)$$

where ω_g is the *fundamental frequency of the gravitational field of exchange* – the fundamental parameter of the gravitational field unknown heretofore; m_1 and m_2 are the *associated masses* of two particles a distance r apart; $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$ is the *absolute unit density* of matter.

From comparison of two equations: theoretical, originated from the DM (9), and Newtonian, experimental (4), which both relate to the same phenomenon, it follows that

$$G = \frac{\omega_g^2}{4\pi \varepsilon_0}. \quad (10)$$

It should be stressed that 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 λ_e of the subatomic level of elementary particles, shows the indissoluble bond of micro and mega objects of the Universe in the unit complex of the Infinitely Small and Infinitely Big, as the coexisting polar oppositions of dialectical logic, **Yes** and **No**.

4. The universal law of central exchange

Neutrons are the base particles of atomic systems (as the main units of mass). The *gravitational charge* of the neutron is

$$q_g = m_n \omega_g = 1,533870877 \times 10^{-27} \text{ g} \times \text{s}^{-1} \quad (11)$$

where $m_n = 1.674927351 \times 10^{-24} \text{ g}$.

The neutron is simultaneously the *fundamental quantum of mass* and the *fundamental graviton* with the gravitational charge of exchange q_g .

The *universal law of central exchange* (interaction), originated from the DM, can be written in the following form,

$$F = \omega_{fund}^2 \frac{(zm)(Zm)}{4\pi\epsilon_0 r^2}, \quad (12)$$

where z and Z are relative masses of interacting objects, $\epsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$ is the absolute unit density, m is the associated mass of interacting elementary particles, electrons or neutrons.

Coulomb's law of interaction of point charges and Newton's law of universal gravitation are particular cases of this universal law. Actually, the following equations,

$$F_e = \omega_e^2 \frac{(zm_e)(Zm_e)}{4\pi\epsilon_0 r^2} \quad (13)$$

and

$$F_g = \omega_g^2 \frac{(zm_n)(Zm_n)}{4\pi\epsilon_0 r^2}, \quad (14)$$

describe, correspondingly, exchange-interaction at the level of the wave “*electric*” field (13) on the basis of an 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).

5. Gravitational frequency and Earth's and Moon's parameters

Thus, many interesting things originate from the DM. Here we review those of them which are concerned with the discovery of the nature of gravitation and unknown earlier fundamental parameters characterizing gravitational fields. In particular, let us turn a special attention to the following result related with the fundamental frequency ω_g .

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

$$T_g = \frac{2\pi}{\omega_g} = 0.686099402 \times 10^4 \text{ s}. \quad (15)$$

The *azimuthal time wave of the fundamental tone* T_c , corresponding to this period, is:

$$T_c = 4\pi T_g = 8.62177937 \times 10^4 \text{ s} . \quad (16)$$

This value almost coincides with the Earth's day equal to $24 \text{ h} = 8.640 \times 10^4 \text{ s}$.

The *time wave* T_c repeats the structure of a *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 defined by its characteristic wave shell).

Hence, taking into account (15) and (16), the *gravitational "constant"* G (10) can be also presented in the following way,

$$G = \frac{16\pi^3}{T_c^2 \varepsilon_0} . \quad (17)$$

The above relationship shows that the Earth is in the resonance harmonic 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 Mendeleev's Periodic Table, taking a special place in the field-space of the Solar system, and maybe in Cosmos on the whole!

6. Conclusion

Continuing the sequential consideration of all consequences originated from the DM, a main conclusion to which we have come here is the following.

Gravitational fields are really *wave fields*. All the so-called elementary particles existing in Nature, being dynamic pulsating microobjects, cause the gravitational field.

Newton's law of universal gravitation and *Coulomb's law* of the interaction of point charged particles are the *particular cases of the Universal Law of central exchange*.

Elementary particles have the wave gravitational field of an extremely low frequency $\omega_g = 9.15783527 \times 10^{-4} \text{ s}^{-1}$, which is the *fundamental frequency* of their exchange (interaction) *at the gravitational level*. The *gravitational wave radius* corresponding to this frequency is $r_g \approx 327.4 \text{ Mkm}$.

The *gravitational “constant”* G presents the physical quantity functionally dependent on the fundamental frequency ω_g . Here is its found dependence, $G = \omega_g^2 / 4\pi\epsilon_0$.

The *azimuthal time wave of the fundamental tone* T_c , defined by the fundamental gravitational frequency ω_g , $T_c = 8\pi^2 / \omega_g$ s, practically coincides with the duration of Earth's day.

All the data obtained, including mentioned here, justifies that our planet *Earth is in the resonance harmonic bond* with the fundamental gravitational frequency ω_g .

Thus, we can finally conclude that the *gravitational interaction* of bodies is a *resulting wave exchange of all elementary particles*, constituents of the bodies, each one at this extremely low fundamental frequency.

References

- [1] L. G. Kreidik and G. P. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.; <http://shpenkov.com/atom.html>
- [2] G. P. Shpenkov, *The Wave Nature of Gravitational Fields: General Characteristics* (2007); <http://shpenkov.com/pdf/Gravitation.pdf>
- [3] G. P. Shpenkov, *The Nature of Gravitation: a New Insight*. A PowerPoint presentation prepared for the 19th International Conference on General Relativity and Gravitation, 5-9 July, 2010 Mexico City; <http://shpenkov.com/pdf/A1-36-GR19-2010.pdf>
- [4] L. G. Kreidik and G. P. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and "Electric" Charge*, REVISTA CIENCIAS EXATAS E NATURAIS, Vol. 3, No 2, 157-170, (2001); <http://shpenkov.com/pdf/masscharge.pdf>

Lecture 6

Gravitational Wave Shells of Elementary Particles

1. Introduction

The discovery of the nature of gravitation, in the framework of the DM, led to the subsequent discoveries arising out from the first one. In this Lecture we will consider one of such discoveries.

Among unsolved mysteries of modern physics and astrophysics, related with gravitation, still is the cause of an existing order in the arrangement of the orbits of planets at certain mean distances from the Sun [1]. The experimental laws: Newton's law of universal gravitation and Kepler's laws, even though have revealed us the interrelation between the existing sizes (radii) of the planetary orbits and their periods, but these laws are impracticable, they are only stating the facts. Actually, calculating of the orbits on the base of these laws is impossible. Therefore the question of why diameters of orbits are just such in magnitude, but not another, has remained open until now.

The Standard Model has turned out to be helpless here, as in many other cases. Therefore, so far, distances of the planets from the Sun (average radii of the orbits) are calculated by a simple empirical formula proposed yet by J. D. Titius 245 years ago, in 1766, and further popularized by J. E. Bode, in his works of 1772. This formula is called in their honour the Titius–Bode Law (sometimes just Bode's Law). In one version of writing of the law, the average radii of the orbits (in astronomical units) are subordinate to the formula

$$R_i = \frac{D_i + 4}{10}, \quad (1)$$

where $D_{-1} = 0$, $D_i = 3 \times 2^i$, $i \geq 0$.

The values, calculated by this formula, correlate to the astronomical data within the spread of the data, however, not for all the planets. For example, on the calculated orbit for $i = 3$ there is an asteroid belt instead of a planet. The orbits of Neptune and Pluto also fall out of the calculations performed by this empirical formula. Why? Obviously, Bode's mathematical finding was not optimal and, hence, is unsuitable to correctly describe the full range of the planets.

And most importantly, the Titius-Bode empirical law has no theoretical justification. There are no physical parameters characterizing the gravitation field in the formula (1). A conceptual framework for the description of the found dependences (a certain ratio of the radii of the neighbouring orbits) has remained a mystery. There is only a trivial verbal explanation, actually, a statement of a self-evident fact. According to the latter, in the early stage of the formation of the Solar System, the regular structure was forming from alternating regions, in which may or may not stable orbits exist, according to the so-called rule of orbital resonances of an incomprehensible cause of its origin.

2. Theoretical background

In this Lecture we give the first theoretical explanation of the order in an arrangement of the stationary orbits, elucidate causes of the phenomenon. All this for the first time turned out to be possible just on the basis of the data obtained by two theories within the framework of the Wave Model (WM): the Dynamic Model of elementary particles (DM) [2] and the Shell-Nodal Atomic Model (SNAM) [3]. Here they are.

It was considered in previous Lectures, the fundamental frequency of an ultimately low value,

$$\omega_g = 9.158082264 \times 10^{-4} s^{-1}, \quad (2)$$

is characteristic for the wave gravitational field of elementary particles. Gravitational exchange (interaction) of the particles is realised exactly at this frequency. The gravitational frequency ω_g determines the gravitational radius of elementary particles, which represents the elementary radial gravitational wave,

$$\lambda_g = \frac{c}{\omega_g} = 3.274 \times 10^{13} \text{ cm} = 3.274 \times 10^8 \text{ km}. \quad (3)$$

Spherical objects of mega space can be regarded as atoms of mega world. The wave shell of constituent particles of the gravitational radius (3) in stellar systems separates the oscillatory region of a spherical field-space of a star and its wave region [4, 5].

The volumetric mean radius of the Earth is $R_{Earth} = 6.371 \times 10^8 \text{ cm} = 6.371 \times 10^3 \text{ km}$ that is at the 5 orders of magnitude less than the radius of the gravitational wave, λ_g . Therefore, we on the Earth are inside of this giant gravitational wave and, therefore, perceive the gravitational wave field as stationary. As follows from the Universal Law of Exchange, the power of gravitational exchange (the "force" of gravity) of an individual particle,

$$F_{grav} = \omega_g^2 \frac{(Z_1 m_n)(Z_2 m_n)}{4\pi \epsilon_0 r^2}, \quad (4)$$

is negligible because of a very small mass. For example, the neutron mass is only $m_n = 1.674927351 \times 10^{-24}$ g. But a huge number of particles (*e.g.*, the Sun consists approximately of 10^{57} nucleons) compensates for this negligible amount, and in sum, leads to a very significant effect – the tangible gravitational attraction.

In accordance with the postulate, upon which the DM rests, all processes and objects in the Universe have a wave nature and, therefore, subordinate to the universal (“classical”) wave equation,

$$\Delta \hat{\Psi} - \frac{1}{c^2} \frac{\partial^2 \hat{\Psi}}{\partial t^2} = 0. \quad (5)$$

A solution of the radial component $R(r)$ of the wave equation (5) along with the discovery of the wave nature of gravitation and the gravitational frequency ω_g (and, hence, the wave radius λ_g) have resulted in the discovery of the spectrum of wave gravitational shells [1].

In accordance with the solution of the radial equation, the roots of Bessel functions [6] determine (along with the gravitational wave radius (3), effluent from the DM) the radii of wave equilibrium spherical shells of elementary particles by the following equation:

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

where $z_{m,n}$ are solutions of the wave equation (5) (roots, zeros, of Bessel functions). Just this spectrum allowed understanding the reason for the location of the planetary orbits within regions around well-defined distances from the star and the location of the orbits of planetary satellites. This is an extremely important theoretical result [7] for the first time obtained in physics.

3. Planetary orbits of the solar system

Eq. (6) is very simple in form but, at the same time, in contents, it represents a fundamental relationship having a deep physical sense. Namely it reflects the wave nature of objects and a result of their wave exchange (interaction) clearly manifested at the mega (gravitational) level. Eq. (6) includes only two parameters. One of them, the roots of Bessel functions, $z_{m,n}$, is the result of solving the wave equation (5), more precisely, the solution of its radial component. The second parameter is the fundamental physical constant – the wave gravitational radius of elementary particles, λ_g , corresponding to the extremely low fundamental frequency of innate pulsations of the particles, ω_g . It is the result of the corresponding solutions originated from the DM.

The solution (6) is realized in the first approximation in a spectrum of the Keplerian shells-orbits, assuming that the gravitational shells are spherical and, therefore, the orbits are circular (see Table 1).

On the one hand, under the influence of interplanetary gravitational interactions (perturbations), the planets cannot move strictly along circular orbits, to which they naturally aspire constantly as to equilibrium orbits. Mutual perturbations eventually have turned the circular orbits in elliptic. However, because of relatively small eccentricities, the orbits of the planets can be regarded in the first approximation (in particular, for our analysis) as a circular.

On the other hand, it is possible that the planets perform more complex relative motions. Planets on their circular orbits revolve simultaneously in three-dimensional space about these circular orbits, i.e., in the transversal direction with respect to the orbital motion. Namely, they move along a cylindrical spiral, distended for one year, as if it were realized on a torus, strictly along a cylindrical surface of the torus with a helical pitch length of one planetary year that creates the appearance of motion of the planets along an ellipse. Details of this hypothesis one can find in [8].

Table 1

A gravitational spectrum of H -atomic wave spherical shells

s	$z_{m,n} = j_{0,s}$	r, Mkm	Planets*
1	2.4048	787.3	Jupiter (778.57)
2	5.5201	1807.3	Saturn (1433.45)
3	8.6537	2833.2	Uranus (2876.68)
4	11.7915	3860.5	
5	14.9309	4888.4	Neptune (4503.4)
6	18.0711	5916.5	Pluto (5906.5)

*) Planets located in relative proximity to the spherical shells. In brackets there are semi-major axes of elliptical orbits of the planets.

The elliptic orbits of Saturn and Neptune are closer to circular of spherical shells, corresponding to the roots of the extremes of Bessel functions [6], $z_{m,n} = a'_{0,2} = 4.49341$ and $z_{m,n} = a'_{0,5} = 14.0662$: $r = 1471.1 Mkm$ and $r = 4605.3 Mkm$, respectively.

From the formula (6) the following important, in a practical meaning, relation originates:

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

In this expression there is not the characteristic fundamental frequency of the gravitational field, ω_g , which, apparently, was changing during the historical period of the formation of the Universe. If we take, as the basic, a gravitational wave shell of the Sun, e.g.,

on which an orbit of the planet Mercury is located, we arrive at the gravitational spectrum, conditioned by the solutions of the Bessel functions of the first order, $z_{m,n} = j_{1,s}$ (Table 2).

Table 2

A gravitational spectrum of wave spherical shells of elementary particles

s	$z_{m,n} = j_{1,s}$	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 (204.5)	Toro
5	16.47063	248.93 (227.9)	Mars
6	19.61586	296.46	Asteroids
7	22.76008	339.45	Asteroids
8	25.90367	391.49	Asteroids
9	29.04683	438.96	413.77 (1 Ceres) Asteroids
10	32.18968	486.49	Asteroids
11	35.33231	533.99	Asteroids
12	38.47476	581.48	Asteroids
13	41.61709	628.97	1 asteroid
14	44.75932	676.46	
15	47.90146	723.95	
16	51.04354	771.44 (778.57)	Jupiter
...			
30	95.02923	1436.2 (1433.45)	Saturn

Semi-major axes of elliptical orbits of the planets are in brackets. For a small planet Toro, in brackets, a mean distance from the Sun is indicated.

A transient region, between oscillatory and wave, limited by the wave gravitational radius, $\lambda_g = 327.4 Mkm$, is presented by the asteroid belt around the Sun (the orbital radius of the belt is in average within 329.12 - 538.56 Mkm). In the center of the field of asteroids, there is the only dwarf planet, 1 Ceres. There are no large planets there, since in the formation of the Solar System, the transient region was a place of the most intense motion.

4. Orbits of planetary satellites

In addition, in Tables 3, 4 and 5, there are shown the spectra, $r_s(j_{1,s})$ and $r_s(y_{1,s})$, of the wave gravitational shells of Jupiter, Saturn and Uranus. They were obtained from the following relations,

$$r_s(j_{1,s}) = r_1 \frac{j_{1,s}}{j_{1,1}} \quad \text{and} \quad r_s(y_{1,s}) = r_1 \frac{y_{1,s}}{j_{1,1}}, \quad (8)$$

originated from Eq. (7), where $j_{1,s}$ and $y_{1,s}$ are roots of Bessel functions [6]; $\langle r_s \rangle$ are semi-major axes of orbits (a) of planetary satellites known from the astronomic observational data.

Table 3

A spectrum of wave gravitational shells of Jupiter; r_s *kkm*.

s	$r_s (j_{1,s})$	$r_s (y_{1,s})$	$\langle r_s \rangle$ (experimental); semi-major axes, a
1	71.492		
2	130.9	101.3	129,0 (Adrastea), 128 (Metis)
3	189.8	160.38	181.4 (Amalthea)
4	248.6	219.2	221.9 (Thebe)
7	424.7	395.3	421.8 (Io)
11	659.2	629.9	671.1 (Europa)
18	1069.6	1040.3	1070.4 (Ganymede)
32	1890.29	1860.98	1882.7 (Callisto)

$r_1=71.492$ *kkm* is an equatorial radius of Jupiter

Table 4

A spectrum of wave gravitational shells of Saturn; r_s *kkm*.

s	$r_s (j_{1,s})$	$r_s (y_{1,s})$	$\langle r_s \rangle$ (experimental); semi-major axes, a
1	60.268		
2	110.346	85.40	74.5-92.0 (Ring C) 92.0 - 117.5 (Ring B)
3	160.0	135.20	137.67 (Atlas), 139.38 (Prometheus) 133.58 (Pan), 136.5 (Daphnis) 122.2-136.8 (Ring A) 140.210 (Ring F) 165.8 - 173.8 (Ring G)
4	209.56	184.8	185.539 (Minas)
5	259.06	234.3	238.037 (Enceladus)
6	308.53	283.8	294.67 (Tethys) 294,71 (Telesto, Calypso)
7	357.99	333.26	180.0 - 480.0 (Ring E)
8	407.43	382.71	377.42 (Dione, Helene) 377.2 (Polydeuces)
...
11	555.73	531.02	527.04 (Rhea)
25	1247,61	1222.9	1221.865 (Titan)
30	1494.69	1469.98	1500.934 (Hyperion)

$r_1=60.268$ *kkm* is an equatorial radius of Saturn. For rings, the distances to the center of Saturn are indicated.

Table 5

A spectrum of wave gravitational shells of Uranus; r_s *kkm*.

s	$r_s (j_{1,s})$	$r_s (y_{1,s})$	$\langle r_s \rangle$ (experimental); semi-major axes, a
1	25.559		
2	46.8	36.2	49.8 (Cardelia)
3	67.85	57.34	59.2 (Bianka), 66.1 (Portia) 69.9 (Rosalind)
4	88.87	78.37	86.0 (Puck), 76.42 (Perdita) 74.39 (Cupid)
5	109.86	99.36	97.736 (Mab)
6	130.84	120.36	129.9 (Miranda)
9	193.75	183.27	190.9 (Ariel)
13	277.6	267.12	266.0 (Umbriel)
21	445.27	434.79	436.3 (Titania)
28	591.97	581.5	583.5 (Oberon)

$r_1=25.559$ *kkm* is an equatorial radius of Uranus

The correlation between the shown above theoretically derived gravitational wave shells of the Sun and experimentally values for semi-major axes of elliptical orbits of its planets is quite satisfactory. The same inference one can make in respect to the found correlation between gravitational wave shells of the planets, derived theoretically, and semi-major axes of their satellites, taken from the astronomical observations data.

It should be noted the similarity, in form, of the theoretically derived equation (6) for the *spectrum of gravitational wave shells* of elementary particles (and, hence, for the spectrum of planetary and satellite orbits in our Solar System) with the *spectrum of wave shells of atomic and subatomic levels* of exchange (optical spectra). The difference is in their different, on the scale, characteristic frequencies, ω_g and ω_e , (and, hence, the wave radii, λ_g and λ_e) related, respectively, to mega (gravitational) and atomic and subatomic levels. Please, compare both pairs of values:

$$\omega_g = 9.158082264 \times 10^{-4} s^{-1}, \quad \lambda_g = 3.274 \times 10^{13} cm;$$

and

$$\omega_e = 1.869162559 \times 10^{18} s^{-1}, \quad \lambda_e = 1.604 \times 10^{-8} cm.$$

Elementary particles, in particular, nucleons (protons and neutrons), being extremely small and infinitely big at the same time, in full agreement with the DM, representing thus both micro and mega world simultaneously, are described at these levels of the Universe by the same wave equation (5).

The solutions for micro and mega levels of the Universe are similar in many ways. Actually, at the atomic and subatomic levels, the equation for the radii of the wave shells

$$r = \tilde{\lambda}_e z_{m,n}, \quad (9)$$

has the same form as Eq. (6) for the radii of the wave shells of the gravitational level.

Only one difference is here: in (6) there is the gravitational wave radius $\tilde{\lambda}_g$, and in (9) the wave radius $\tilde{\lambda}_e$ of the atomic and subatomic levels. This is not surprising, since the exchange interaction of the particles at both levels of the Universe, to which they belong at the same time, is subject to the Universal Law of Exchange (12) (L. 5).

Thus, for example, H-atoms (to which we refer protons, neutrons and hydrogen atoms) are described at the micro and mega levels by the same wave equation. Accordingly, interactions of particles on both levels must be described as well by the single unified equation. Really, an equation of universal exchange, originated from the DM, which we have already analyzed in previous Lectures, resolves this problem.

5. Conclusion

The mystery of an existing order in an arrangement of the orbits of the planets at the certain average distances from the Sun, as well as of the orbits of the planetary satellites, are now unravelled thanks to the DM and solutions of the wave equation. As it turned out, the planets and their satellites, mutually influencing each other, move along the orbits located in the certain regions of wave space in full conformance to the spectrum (6) derived for the gravitational wave spherical shells of the particles, from which the Sun and planets of our Solar System are made up.

A theoretical basis for the derivation of the spectrum (6), like for other discoveries that we have already considered in these Lectures, is the Wave Model. Herewith, one should be noted the following two concrete independent sources in the framework of the WM that led us directly to the given spectrum.

Firstly, we must keep in mind the solutions within the theory of the DM, which led to the discoveries of the wave nature of elementary particles and the wave nature of their exchange (fundamental interactions) at the levels of the Universe, including gravitational with the characteristic frequency of the gravitational exchange, $\omega_g = 9.158082264 \times 10^{-4} \text{ s}^{-1}$.

Secondly, it is the radial solutions of the universal (“classical”) wave equation (5), expressed by the roots of Bessel functions.

Thus, the Wave Model, that include two theories, the Dynamic Model of elementary particles and the Shell-Nodal Atomic Model, confirms once more its advantage in comparison

with the Standard Model of modern physics. This time the advantage has manifested in the fact of an ability by the WM to explain, on the basis of the discoveries of the nature of gravitation and physical parameters of the latter, the phenomenon of the specific order in the arrangement of planets around the Sun and of planetary satellites, caused by the wave nature of gravitational fields.

Regardless of whether anyone likes it or not (from “credible” theorists, adherents of the SM), but the WM confidently shows itself as a real alternative to the SM, by solving accumulated problems of modern physics. This is clearly seen by the results presented in the Lectures.

References

[1] George Shpenkov, SOME WORDS ABOUT FUNDAMENTAL PROBLEMS OF PHYSICS, LAP LAMBERT Academic Publishing, 2012; amazon.com/words-about-fundamental-problems-physics/dp/3659237507; <http://shpenkov.com/pdf/Book-2011-Eng.pdf>

[2] L. G. Kreidik and G. P. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and "Electric" Charge*, REVISTA CIENCIAS EXATAS E NATURAIS, Vol. 3, No 2, 157-170, (2001); <https://revistas.unicentro.br/index.php/RECEN/article/view/478>

[3] G. P. Shpenkov, *An Elucidation of the Nature of the Periodic Law*, Chapter 7 in a book "*The Mathematics of the Periodic Table*", edited by Rouvray D. H. and King R. B., NOVA SCIENCE PUBLISHERS, NY, 119-160, 2006; <http://shpenkov.com/books.html>

[4] G. P. Shpenkov, *The Wave Nature of Gravitational Fields: General Characteristics* (2007); <http://shpenkov.com/pdf/Gravitation.pdf>

[5] G. P. Shpenkov, *The Nature of Gravitation: a New Insight*. A PowerPoint presentation prepared for the 19th International Conference on General Relativity and Gravitation, 5-9 July, 2010 Mexico City; <http://shpenkov.com/pdf/A1-36-GR19-2010.pdf>

[6] Bessel Functions, part. III, Zeros and Associated Values, in *Royal Society Mathematical Tables*, Volume 7, edited by F. W. J. Olver (University Press, Cambridge, 1960).

[7] G. P. Shpenkov, *A New Theory of Matter-Space-Time: Evidences in Support of An Advantage Over The Modern Theory Accepted in Physics and The Perspective To Be of Use*; A lecture delivered in Military Academy, Warsaw, Poland, at October 20, 2006; <http://shpenkov.com/pdf/Theory-DM-English.pdf>

[8] A. S. Aliev, *Stargazers of the 21st Century*, Journal of the Russian Physical Thought (JRPT), N. 1-12, 2013, p. 162-181, (JRPCS, V. 85, N. 1) (in Russian); <http://shpenkov.com/pdf/JRPM-2013.pdf>

Lecture 7

The Vortical Structure of Gravitational Waves

1. Introduction

Thus we are realized that the gravitational field is a wave field. We also learned from the previous Lectures that the wave gravitational interaction of all objects in the Universe is occurs at the strictly defined fundamental frequency of the extremely low value, ω_g , called gravitational. This frequency, along with the fundamental frequency of the extremely high value, ω_e , is one of the fundamental physical constants-parameters of the atomic and subatomic levels of the Universe, discovered within the framework of the DM.

Now, we intend to pay attention to the gravitational exchange (interaction) from another point of view and discuss the following problem, relevant to gravitation. What is the spatial structure of wave gravitational fields, and what are specific parameters of the wave motion-rest, in particular, in the system of two bodies – a planet and its satellite? This Lecture is devoted to this issue.

2. Basis and superstructure

A wave process is a contradictory complex of *basis-superstructure*. In a wave field of exchange of *basis*, the composite oscillating movement of discrete micro, macro, and mega objects occurs. This oscillatory motion forms together with oscillating objects the *superstructure* of the wave field.

Basis is the continuous facet of the wave process. Waves are propagating in a space with the definite *basis speed*. *Superstructure* represents the discrete (discontinuous) side of the wave process. It is presented by particles of the wave space or objects oscillating with the definite *oscillatory speed* relative to their equilibrium positions in the wave space.

Simultaneously, *superstructure* is also a contradictory discontinuous-continuous complex where the *discontinuous side* is represented by *discrete objects* and the *continuous side* – by *oscillatory rest-motion* of the objects. In just the same way, *basis* is characterized by its own internal continuous and discontinuous sides at the subatomic level.

Thus, the wave motion is a contradictory process of rest-motion. Therefore, it is characterized by two pairs of physical parameters. At the level of *basis*, these parameters are represented by two *strength vectors*, respectively, of rest and motion, E and B .

The dimensionality of the *strength vectors* of basis is $cm \times s^{-1}$. Actually, the *strength* is defined by the ratio of power of exchange F and the exchange charge q ; accordingly, the dimensionality of strength vectors, E and B , is defined by the dimensionalities of F and q : $[E] = [B] = \frac{[F]}{[q]}$. The dimensionality of the exchange charge q , according to the DM, is $[q] = g \times s^{-1}$; the dimensionality of F is $[F] = g \times cm \times s^{-2}$. Hence, $[E] = [B] = cm \times s^{-1}$.

For comparison, the strength vector E is analogous, in particular, to the *electric field strength* vector E . According to modern physics, in the SI units, the dimensionality of the *electric field strength* is *Newton/Coulomb* or N/C . In absolute units of matter, space, and time, the unit of newton has the dimensionality $[N] = kg \times m \times s^{-2}$, and the unit of coulomb – $[C] = kg^{1/2} \times m^{3/2} \times s^{-1}$. Hence, the dimensionality of electric field strength is expressed in modern physics by fractional powers of basic units of matter (kg) and space (m): $[E] = [B] = kg^{1/2} \times m^{-1/2} \times s^{-1}$. Such a dimensionality has no physical meaning. It is erroneous like the dimensionality of the electric charge expressed in coulombs. We have discussed this issue in Lecture 3.

Analogously, the dimensionality of *magnetic flux density* B is also erroneous, because it is expressed by the units with fractional powers, $[B] = kg^{1/2} \times m^{-3/2}$. The dimensionality of the *gravitational field strength* E_g , according to the definition accepted in modern physics, is $[E_g] = \frac{N}{kg} = m \times s^{-2}$, that is the dimensionality of acceleration. We see that all aforementioned parameters for the field strengths (E , B , and E_g) used in modern physics are different.

In the DM all fields are wave, and the description of wave fields in the DM is unified; therefore, the characteristic parameters are also unified. However, we will not consider this question now here. The comprehensive analysis of all units of measurement accepted in modern physics and following from the DM is in the book “*Atomic Structure of Matter-Space*” [1] available online on the Internet.

At the level of *superstructure* the wave motion is also characterized by two parameters relating, respectively, to rest and motion; in this case they are represented by *potential* V_p and *kinetic* V_k speeds.

Coulomb’s and Newton’s laws are, first of all, the *laws of basis*. They are particular cases of the *Unified Law of Exchange* ((19a), L. 4; (12), L. 5), having relation every to one of the two fundamental frequencies, ω_e and ω_g , respectively, in a complicated wave field of matter-space-time of the atomic and subatomic levels. These laws make it possible to describe also,

along with basis, the processes of *superstructure*, i.e. oscillatory processes of rest-motion at micro, macro, and mega levels. In this respect, Coulomb's and Newton's laws can be also regarded as the *laws of superstructure*. We will rest upon these laws here for the description of superstructure.

3. Superstructure of gravitational waves

Let us consider the process of superstructure for the case of the motion of a satellite around a planet, relying on the Universal Law of Exchange in the form,

$$F = \frac{q_g Q_g}{4\pi\epsilon_0 r^2}. \quad (1)$$

This equation describes the exchange (interaction) between a gravitational satellite of mass m , having, respectively, the gravitational charge $q_g = \omega_g m$, and a central gravitational object of mass M and the gravitational charge $Q_g = \omega_g M$. It should be reminded that after the discovery of the origin of mass, under the word *mass* we everywhere keep in mind, of course, the *associated* (dynamic) *mass*.

By analogy with the electric strength vector, there exists the gravitational vector of potential strength of the central spherical gravitational field of exchange E_g . It is the *vector of basis* defined by the ratio

$$E_g = \frac{F}{q_g} = \frac{Q_g}{4\pi\epsilon_0 r^2} = \frac{\omega_g M}{4\pi\epsilon_0 r^2}. \quad (2)$$

The *oscillatory process* of a gravitational satellite of mass m in the central field of an object M is described by the equation,

$$F = \frac{mV^2}{r}, \quad (3)$$

which is the equation of *superstructure*.

For simplicity, let $q_g \ll Q_g$; then the motion of the gravitational satellite of the charge q_g in the central field of the gravitational object of the charge Q_g is expressed by an equality of the equations of the circular motion (3) and the central exchange (2):

$$\frac{mV^2}{r} = q_g E_g = q_g \frac{Q_g}{4\pi\epsilon_0 r^2} = \omega_g^2 \frac{mM}{4\pi\epsilon_0 r^2}. \quad (4)$$

Equality (4) describes the *potential central (longitudinal) exchange*. It determines the *velocity of transversal oscillatory motion* V (consisting of two mutually perpendicular oscillations), which can be presented in the following form,

$$V = \omega_g \sqrt{\frac{M}{4\pi\epsilon_0 r}} = \omega_g \frac{\sqrt{Mk_g / 4\pi\epsilon_0}}{\sqrt{k_g r}} = \omega_g \frac{A_g}{\sqrt{k_g r}} = \omega_g A, \quad (5)$$

where $k_g = \frac{\omega_g}{c} = \frac{2\pi}{\lambda_g} = \frac{1}{\tilde{\lambda}_g} = 3.05472503 \times 10^{-14} \text{ cm}^{-1}$ is the *wave number* of the gravitational field inverse to the fundamental wave gravitational radius $\tilde{\lambda}_g = 3.27361706 \times 10^{13} \text{ cm} \approx 327.4 \text{ Mkm}$ [2];

$$A_g = \sqrt{\frac{Mk_g}{4\pi\epsilon_0}} = \sqrt{\frac{M}{4\pi\epsilon_0 \tilde{\lambda}_g}} \quad (6)$$

is the *wave amplitude* of displacement at the sphere of the fundamental wave radius $r = \tilde{\lambda}_g$ depending on the mass M of the central gravitational object;

$$A = \frac{A_g}{\sqrt{k_g r}} \quad (7)$$

is the wave amplitude of displacement at the sphere of the radius r ; obviously, this amplitude is maximal when r is the radius of the central spherical object.

According to the definition, the wave gravitational radius $\tilde{\lambda}_g$ is the radius of the gravitational wave sphere-shell, at the equator of which one fundamental gravitational wave $\lambda_g = 2\pi\tilde{\lambda}_g$ is located.

We will consider the structure of the process of superstructure for motion-rest of the satellite m (exchange charge q_g) in the central field of the moving object M (exchange charge Q_g) (Fig. 1).

Let the central object M moves along the Z-axis with the velocity v_z and, during a period of motion of the satellite m , covers the distance $\lambda_\zeta = v_z T$ (a step of the screw trajectory) which we term the *beam oscillatory wavelength*. At that v_z is the *longitudinal (beam) velocity* of the oscillatory wave. This wavelength will be also expressed in terms of the radius of oscillatory wave, $\tilde{\lambda}_\zeta = \frac{\lambda_\zeta}{2\pi}$.

Further, we introduce the *oscillatory number* $k_\zeta = \frac{2\pi}{\lambda_\zeta}$ by analogy with the *wave number* $k = \frac{2\pi}{\lambda}$. The oscillatory wave λ_ζ is supplemented, in circular motion, with the *transversal oscillatory wave-circle* $\lambda_t = 2\pi a = VT$, where V is the kinetic velocity and T is the period of oscillation-rotation.

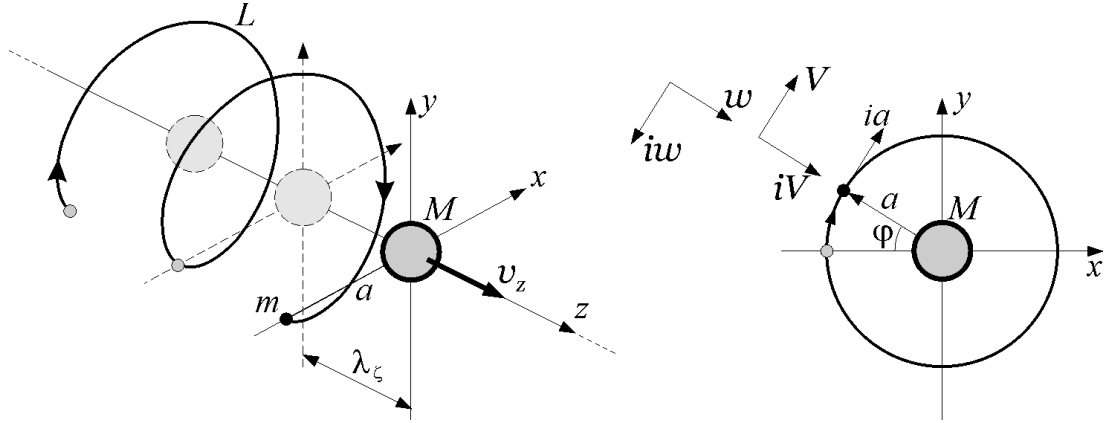


Fig. 1. A scheme and corresponding parameters of wave motion-rest in the system, a “central object M – satellite m ”: L is the unit spiral of motion-rest; λ_ζ is the oscillatory wave (step) of spiral motion; v_z is the velocity of the central object M ; m is the satellite; a is the radius-amplitude of rest (radius of an orbit); ia is the radius-amplitude of motion; V and iV are kinetic and potential velocities; w and iw are potential and kinetic accelerations [2, 3], correspondingly.

The circular spiral motion of the satellite m around the central object M is the superposition of two mutually perpendicular potential-kinetic oscillations in a plane of the space of the central body perpendicular to the Z -axis. We term this plane the *frontal plane*. In a general case, it is not necessarily has to be perpendicular to the Z -axis.

We present potential-kinetic oscillation $\hat{\psi}_x$ along the x -axis in the form

$$\hat{\psi}_x = ae^{-i\omega t}. \quad (8)$$

Potential-kinetic oscillation $\hat{\psi}_y$ along the y -axis is the negation (in terms of the dialectical logic [3]) of potential-kinetic oscillation $\hat{\psi}_x$; so that it has the form,

$$\hat{\psi}_y = i\hat{\psi}_x = iae^{-i\omega t}. \quad (9)$$

Thus, the resulting oscillation in the frontal plane has the form

$$\hat{\psi} = (a + ia)e^{-i\omega t}. \quad (10)$$

Since the frontal plane moves along the Z -axis, the total equation of the *oscillatory wave* (the *wave of superstructure*), just as the wave of basis, must be presented in the following form,

$$\hat{\psi} = (a + ia)e^{-i(\omega t - k_\zeta z)}, \quad (11)$$

where $k_\zeta = \frac{2\pi}{\lambda_\zeta} = \frac{2\pi}{v_z T} = \frac{1}{\tilde{\lambda}_\zeta}$.

Eq. (11) represents the *transversal potential-kinetic gravitational wave* (see Fig. 2).

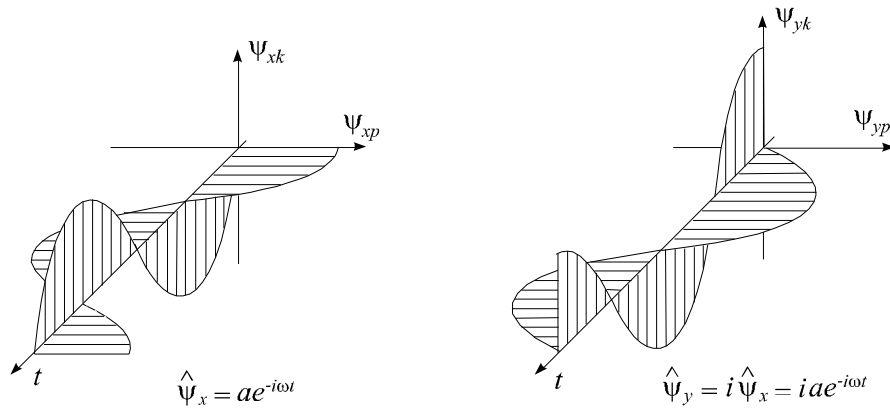


Fig. 2. Graphs of two components ($\hat{\psi}_x$ and $\hat{\psi}_y$) of the transversal potential-kinetic gravitational wave, concerning to the circular motion-rest (11).

With respect to the form, the equation of the wave of the superstructure (11) coincides with the equation of the harmonic wave of basis

$$\hat{\psi} = (a + ia)e^{-i(\omega t - kz)}, \quad (12)$$

where $k = \frac{2\pi}{\lambda} = \frac{2\pi}{cT} = \frac{1}{\tilde{\lambda}}$, and c is the wave basis speed.

It should be noted that the ratio of the *transverse wave* of the superstructure λ_t to the *longitudinal wave* of the basis λ ,

$$\alpha = \frac{\lambda_t}{\lambda} = \frac{2\pi a}{\lambda} = \frac{a}{\tilde{\lambda}} = \frac{v}{c}, \quad (13)$$

where v is the oscillatory speed of the wave of superstructure, and c is the wave speed of basis, characterizes the *scale correlation of superstructure and basis* [4]. This relation is

called in modern physics the *fine-structure constant*, α . We will consider this subject in detail in the following Lectures.

Let us return now to the equation of *potential exchange* (4) and supplement the last with the equation of *kinetic exchange*. To this end, following the dialectical logic [5], it is sufficient to multiply the equation (4) by the unit of negation i :

$$i \frac{mV^2}{r} = i q_g E_g = i \frac{q_g Q_g}{4\pi \epsilon_0 r^2} = i \omega_g^2 \frac{mM}{4\pi \epsilon_0 r^2}. \quad (14)$$

This equation describes the *kinetic (transversal) exchange*, expanding thus the complete characterization of the field of motion of the system. Such an exchange should be expressed by the *transverse law of gravitation*, the law of *non-central exchange*,

$$iF = i \frac{q_g Q_g}{4\pi \epsilon_0 r^2} = i \omega_g^2 \frac{mM}{4\pi \epsilon_0 r^2}. \quad (15)$$

Thus, at the total description of the wave of the superstructure, we should take into consideration two laws, respectively, of *longitudinal* and *transverse* exchanges:

$$F = \omega_g^2 \frac{mM}{4\pi \epsilon_0 r^2} \quad \text{and} \quad iF = i \omega_g^2 \frac{mM}{4\pi \epsilon_0 r^2} \quad (16)$$

The first equation in (16) represents, actually, the law of the (longitudinal) “*electric exchange*”, the second equation – the law of the (transversal) “*magnetic exchange*”. These statements are valid as well for Coulomb’s law.

The laws of longitudinal and transverse exchanges, existing objectively, determine the *longitudinal-transversal* character of rest-motion waves. Therefore, it is necessary to add to the velocity of the transverse field of kinetic motion $V = V_k$ (5) the potential longitudinal velocity of motion $iV = V_p$:

$$V_k = \frac{\omega_g A_g}{\sqrt{k_g r}}, \quad V_p = i \frac{\omega_g A_g}{\sqrt{k_g r}} \quad (17)$$

We perceive the potential longitudinal velocity V_p on the Earth as attraction, because the last (see Fig. 1) “pulls” us to the center of the Earth.

Thus, the transversal potential-kinetic gravitational wave is simultaneously the longitudinal-transversal wave of rest-motion.

4. Hierarchy of cylindrical gravity waves

The longitudinal-transverse field of superstructure, considered above, is characterized by the continuous wave field of motion-rest and the discrete components, one of which is the central object M (of the gravitational charge Q_g), and the other one is its satellite m (of the gravitational charge q_g). Together, the discrete components and wave motion form a *cosmic cylindrical beam* of an elliptic section, in a general case. In the elliptic section, the central object M and the non-central satellite m oscillate around a middle point of material-ideal exchange, termed the center of masses; at that the central object M is in one of the focuses of the ellipse.

Thus, the wave beam represents, at the level of superstructure, two longitudinal-transverse waves: one of them is the central longitudinal-transverse wave of the object Q_g , the second one is the peripheral longitudinal-transverse wave of the satellite q_g embracing the central wave.

The axes of the wave cylindrical field-beam are presented by four beams: a *geometric beam* passing through a geometric center of the elliptic section of wave-beam, a *physical beam* passing through the center of masses, and *two mobile beams* moving in the frontal plane and passing through position points of the object Q_g and the satellite q_g .

The cylindrical gravitational wave of superstructure does not exist by itself separately – it is only an element of the complex discontinuous-continuous galactic field, which is presented by a series of the levels (Fig. 3):

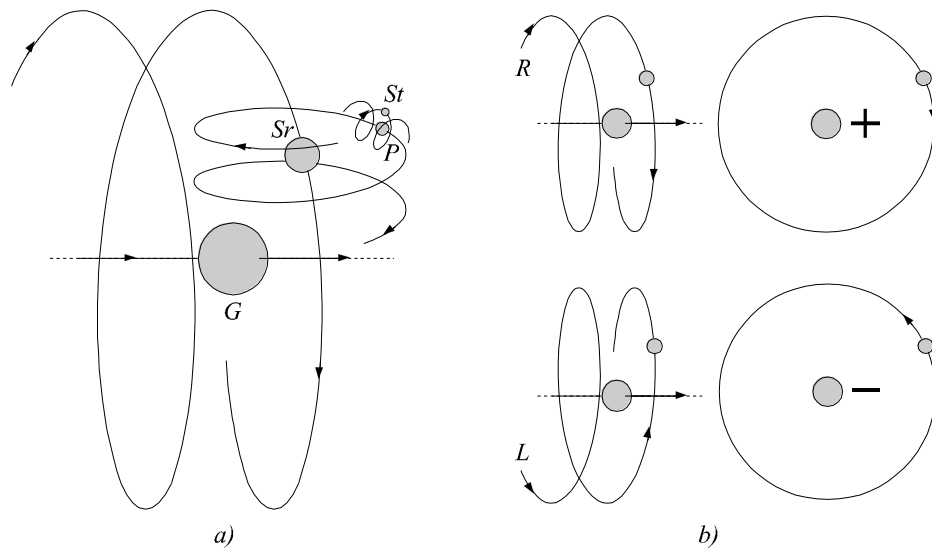


Fig. 3. A graph of the gravitational longitudinal-transverse field of four levels; St is a satellite, P is a planet, Sr is a star, G is a galactic core (a); R is a wave of the right spirality, L is a wave of the left spirality (a negative wave) (b).

- 1) the upper level – the wave “satellite-planet”;
- 2) the first lower level – the wave “planet-star”;
- 3) the second lower level – the wave “star-galactic core”;
- 4) the third lower level – the level of waves of metagalaxies, in which galactic cores are discretenesses of galactic cylindrical spiral waves, *etc.*

The names of waves of the levels are the names of their discrete components, which should be treated as *cosmic gravitons*. Every lower level of the field is the basis for the above field of superstructure. In such a multilevel gravitational field, the upper level wave is a part of the wave of the first lower level, which, in turn, is a component of the wave of the second lower level, *etc.* (Fig. 3a).

5. Conclusion

Thus, we have shown that *gravitational wave field has the vortical structure*. This feature of the wave process has been demonstrated here on a simple example of the system “satellite-planet”.

From the dialectical point of view, a *wave process is a contradictory complex of basis and superstructure*. The continuous side of the wave process is the *basis*, whereas its discrete facet is the *superstructure*. Every lower level of the wave field is the basis for the above field of the superstructure.

At the level of *basis*, parameters of the wave processes are represented by two *strength vectors*, respectively, of rest and motion, E and B , of the dimensionality of speed, $cm \times s^{-1}$. At the level of *superstructure* – by *potential* V_p and *kinetic* V_k constituents of the velocity of transversal circular motion composed of two mutually perpendicular oscillations. We perceive on the Earth the potential longitudinal velocity V_p (see Fig. 1) as *attraction* because the last “pulls” us to the center of the Earth.

Discrete components of gravitational waves should be treated as *cosmic gravitons*.

A total description of the wave of superstructure is required to operate by the laws of longitudinal and transverse exchange. Existing objectively, these laws determine the *longitudinal-transverse* character of waves of rest-motion, which are also the *transverse potential-kinetic* gravitational waves.

References

- [1] L. G. Kreidik and G. P. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.; Chapter 8, *The Physical Metric; the units of dialectical physics and crucial faults of the modern system of units*, p. 363-408;
<http://shpenkov.com/pdf/AtomicStructureChapter8.pdf>

[2] L/G. Kreidik and G.P. Shpenkov, *Foundations of Physics: 13.644 Collected Papers*, Geo. S., Bydgosz - Minsk, 1998, pages 258.

[3] G. Shpenkov and L. Kreidik, *Conjugated Parameters of Physical Processes and Physical Time*, Physics Essays, Vol. 15, No. 3, 339-349, (2002).

[4] G. P. Shpenkov, *On the Fine-Structure Constant Physical Meaning*, HADRONIC JOURNAL, Vol. 28, No. 3, 337-372, (2005).

[5] G. P. Shpenkov, DIALECTICAL VIEW OF THE WORLD: The Wave Model (Selected Lectures); Volume 1, *Philosophical and Mathematical Background*, pages 119 (2013); <http://shpenkov.com/pdf/Vol.1.Dialectics.pdf>

Lecture 8

The Fundamental Regularity Inherent in Wave Processes

1. Introduction

A very important law of Nature related to wave processes has been found in the framework of the DM. What means?

Remember, in the previous Lecture, it was noted that the ratio of the *transversal wave* of superstructure λ_t to the *longitudinal wave* of basis λ ,

$$\alpha = \frac{\lambda_t}{\lambda} = \frac{2\pi a}{\lambda} = \frac{a}{\tilde{\lambda}} = \frac{v}{c}, \quad (1)$$

characterizes the *scale correlation* existed between every of *two characteristic parameters* related, respectively, to *superstructure* and *basis* of waves [1]. In particular, in one of the identical ratios (1), the speed c is the *basis (phase) speed* of the wave propagation, of the wave process. The vector of the basis speed coincides with the wave vector. The speed v is the *oscillatory speed of superstructure* of the wave process; the vector of the oscillatory speed is perpendicular to the wave vector.

In the case when c is the basic speed of atomic and subatomic levels (*i.e.*, equal to the speed of light), and the oscillatory speed is equal to the first Bohr speed, $v = v_0$, we arrive at the ratio,

$$\alpha = \frac{v_0}{c}. \quad (2)$$

The ratio α (2) of the given specific speeds was obtained for the first time by Arnold Sommerfeld. He has come to this expression from another, in essence, considerations – nothing in common with those considered in our Lectures.

In a modified form (also performed by Sommerfeld), α is expressed by three fundamental constants accepted in physics (e , \hbar , and c), and is as follows,

$$\alpha = \frac{e^2}{\hbar c} . \quad (3)$$

The dimensionless number α , presented in the form (3) as the combination of three fundamental constants-parameters became in turn regarded in physics as the separate fundamental physical constant.

What is the nature of the constant alpha, termed after presenting it by the expression (3) as the *fine-structure constant*? This question was a great puzzle from the beginning and is still one of the most outstandingly difficult unsolved problems in modern theoretical physics.

Here is what Richard P. Feynman said in this regard.

"There is a most profound and beautiful question associated with the observed coupling constant, ... It has been a mystery ever since it was discovered more than fifty years ago, ... Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don't know how He pushed his pencil."

[*QED: The Strange Theory of Light and Matter*,
Princeton University Press. (1985) p. 129]

And Max Born stated the following.

"It is clear that the explanation of this number must be the central problem of natural philosophy"

[A.I. Miller (2009), *Deciphering the Cosmic Number: The Strange Friendship of Wolfgang Pauli and Carl Jung*, W.W. Norton & Co, p. 253]

As we have found, the reason of ignorance and, as a result, of ascribing to the *fine-structure constant* alpha an erroneous physical meaning (will be considered below) are due to lack of realization that all objects and phenomena in Nature have the wave nature. In particular, the wave processes caused the origin of elementary particles, including electrons, and determine their behavior.

The discoveries in the framework of the DM of the wave associated nature of the *electron mass* (entering in \hbar and, hence, in α) and the nature and, hence, the true value and dimensionality of the *electron charge* e (also entering in α), were and still are unknown for the most of physicists. For the acceptance of these new discoveries by physical community, one needs much time and efforts. As an effect of such an existed gap in knowledge about the true nature of the aforementioned constituents in the ratio (3), the physical meaning of their combination, *i.e.*, the α -constant itself, naturally remains as before an incomprehensible mystery.

Within the wave Dynamic Model, the problem of the α -constant is solved in a natural way [2, 3], because the nature of all physical constants-parameters in the ratio (3) became understandable on its base. Looking ahead, we can say that α reflects the principal feature of the wave motion: the *scale correlation of **threshold states** of conjugate oscillatory-wave processes inherent in wave processes*. In this Lecture, we will show that.

Let us sequentially proceed now to the detail analysis of this matter and to show how we have come to the aforesaid assertion, actually, to the discovery of the physical meaning of the alpha constant.

2. A current definition of the α -constant

In modern physics, the fine-structure constant α presents a dimensionless quantity formed from a combination of the four fundamental physical constants e , \hbar , c , and ε_0 :

$$\alpha = \frac{e^2}{4\pi\varepsilon_0\hbar c} = 7.297352533 \times 10^{-3}, \quad (\text{SI}) \quad (4)$$

where $e = 1.602176462 \times 10^{-19} \text{ C}$ is the electron charge (in SI units), $\hbar = 1.054571596 \times 10^{-34} \text{ J} \times \text{s}$ is the Planck constant h divided by 2π , $c = 2.99792458 \times 10^8 \text{ m} \times \text{s}^{-1}$ is the speed of light, $\varepsilon_0 = 8.854187817 \dots \times 10^{-12} \text{ F} \times \text{m}^{-1}$ is the so-called “*permittivity of free space*” (or “*electric constant*”) [4-6].

The fine-structure constant (4) is considered in modern physics as a convenient measure of the *strength of the electromagnetic interaction*. In other words, α is regarded as the “*coupling constant*” or the measure of the strength of the electromagnetic force that governs how electrically charged elementary particles (*e.g.*, electron, muon) and light (photons) interact.

The inverse quantity of α is

$$\alpha^{-1} = 137.035999074. \quad (5)$$

For the first time the constant α was introduced by Arnold Sommerfeld (in 1916) during his studies of the Balmer series in the framework of the Bohr Theory [7] (before an introduction of wave mechanics), as the quantity $\alpha = v_0 / c$ (2), where $v_0 = 2.187691251 \times 10^8 \text{ cm} \times \text{s}^{-1}$ is the speed of the electron on the Bohr first orbit in the hydrogen atom. Then, after some simple transformations, Sommerfeld reduced the ratio (2) to $e^2 / \hbar c$ (3) (in the CGSE system).

In such a way thanks to Sommerfeld, it was introduced in physics the constant α in the following two forms, two ratios:

$$\alpha = \frac{v_0}{c}, \quad \text{and} \quad \alpha = \frac{e^2}{\hbar c} \quad (\text{CGSE}) \quad \text{or} \quad \alpha = \frac{e^2}{4\pi\epsilon_0\hbar c} \quad (\text{SI}) \quad (6)$$

Ignoring the original form (2) (shown at left in (6)), Sommerfeld took into consideration only the second form (3) (shown in the middle in (6)). Because the same three fundamental constants entered in (3), enter in the formula of spectral terms, defining the amount of the *fine structure splitting*, he called the ratio of α (3) the *fine-structure constant*.

The fine-structure constant α enters also in the so-called “*relativistic correction*” for the formula of spectral terms (derived earlier by Sommerfeld), when the hydrogen atom is calculated by Dirac’s relativistic wave mechanics.

3. Problems related to the α -constant

From the above ratios (6), it follows that α has a double meaning. The first of them (2) (presented at left in (6)), lying in the ratio of the speeds, v_0 and c , has *never been discussed*.

The second meaning ascribed to alpha, regarded as the aforesaid “*coupling constant*”, from our point of view is *doubtful*. Why? Let us examine this. The second ratio in (6) *states only the fact* that α is a combination of the physical constants (e , \hbar , and c) regarded in physics as fundamental. As is commonly believed in theoretical physics, these constants characterize, respectively: the discrete nature of electric charges (e), quantum theory (\hbar), and relativity theory (c).

However, the *reduced Planck constant* $\hbar = h/2\pi$ (or Dirac constant) entered in α , although considered in physics as fundamental, *is, actually, not fundamental*, because, being originated from the Bohr Theory, it represents the *combination of three truly fundamental quantities* – electron mass m_e , the Bohr speed v_0 , and the Bohr radius r_0 .

Thus, we should recognize that the principal question of modern physics about the true physical meaning of the ratios in (6) remains open and waits its solution. What do they really express? We will try to explain this.

From our point of view, the reasons of such a gap in knowledge on this matter is an absence in contemporary physics of an appropriate concept on the *nature of mass and charge of elementary particles*, and hence, on the origin of *electron mass* and *electron charge*. Both these parameters enter in the formula of the α -constant (6). As was mentioned above, \hbar , originated from the Bohr Theory, is the combination of three constants-parameters, $\hbar = f(m_e, v_0, r_0)$, that includes the electron mass m_e of an unknown nature. What is the origin of mass of the electron?

In previous Lectures, basing on the *Dynamic Model of elementary particles* (DM), put forward first in the last two decades [3], and other new data presented in [8], we elucidated the physical meaning of the aforementioned constituents of the α -constant (m_e , e , and ϵ_0). The DM uncovered the origin of mass and the true dimensionality of electric charges, and hence, the *true physical meaning of the electron charge e* that became the first principal key for resolution of the problem with the fine-structure constant physical meaning. The second such key, taken into consideration in the DM, was the awareness that *wave processes* as a phenomenon have the *collective nature*.

From the ratios (6) it follows that the electron charge in SI units can be presented in the form of the following equality:

$$e = \sqrt{4\pi\epsilon_0\hbar v_0} . \quad (7)$$

The “fundamental” constant $\hbar = \frac{h}{2\pi}$, entered in the above formulas, is in essence (in its origin) the *orbital moment of momentum*, P_{orb} , of the electron on the Bohr first orbit (of the radius r_0); it has the form

$$\hbar = P_{orb} = m_e v_0 r_0 . \quad (8)$$

where $m_e = 9.10938291 \times 10^{-28} \text{ g}$ is the electron mass, $r_0 = 0.52917721092 \times 10^{-8} \text{ cm}$ is the Bohr radius.

The Planck constant h , by its origin, is the physical quantity equal to the *orbital action of the electron* on the Bohr first orbit in the hydrogen atom, *i.e.*, equal to its *orbital moment of momentum* P_{orb} multiplied by 2π :

$$h = 2\pi P_{orb} = 2\pi m_e v_0 r_0 , \quad (9)$$

Putting (8) in (7), we arrive at the formula of electron charge expressed through the electron mass m_e and two characteristic parameters, v_0 and r_0 , related to the steady-state orbiting of the electron around a proton in the hydrogen atom:

$$e = \sqrt{4\pi\epsilon_0 m_e v_0^2 r_0} . \quad (10)$$

Since $4\pi\epsilon_0 = 1$ [9], the dimensionality of the electron charge, following from (10), expressed by truly absolute units of *matter, space and time* (kg, m, s), is

$$[e] = kg^{1/2} \times m^{3/2} \times s^{-1} . \quad (11)$$

The same dimensionality of the electron charge follows from the Coulomb’s law

$$F_{SI} = \frac{e^2}{4\pi\epsilon_0 r^2}, \quad (12)$$

We see that dimensionality of the electron charge e is expressed with use of the nonsensical fractional powers of absolute units of matter and space; this justifies that something wrong with the constituents of the given equalities, for α [4] and Coulomb law [12]. Hence, both expressions in essence of the content are misunderstood. For this reason, in particular, the ratio α is wrongly interpreted.

As was discussed in previous Lectures, it is impossible to reveal the nature (a physical meaning) of electric charges of such a strange (rather senseless) dimensionality formed on the basis of meaningless *fractional powers* of reference units. Obviously, the dimensionality problem is hidden in the coefficient of proportionality k (unknown both in value and dimensionality) between the resulting force F and interacting electric charges q_1 and q_2 in Coulomb's law $F = k \frac{q_1 q_2}{r^2}$,

Remember, the coefficient k was first accepted (in the CGSE system) to be equal to the *dimensionless* unit, $k = 1$, resulted in $[q] = g^{1/2} \times cm^{3/2} \times s^{-1}$. Later on, in the SI units, the factor k gained the following quantity, $k = \frac{1}{4\pi\epsilon_0}$, of the strange “dimensionality”, $m \times F^{-1}$ (due to the obscure “constant” ϵ_0 , expressed in $F \times m^{-1}$), which in turn led to the dimensionality of electron charge in coulombs, $[e] = C$.

Applying (12) to the latter expression, we found that k is in essence the *dimensionless* unit, because the “*electric constant*” ϵ_0 turns out to be equal, actually, to the number $\frac{1}{4\pi}$ [8 - 10]. Thus, we have as before $k = 1$, and $[e] = kg^{1/2} \times m^{3/2} \times s^{-1}$.

The DM revealed the true physical meaning of the electric charge, which is one of the fundamental notions of physics. It turned out that it has the *exchange nature*. The *dimensionality* of the exchange (“*electric*”) charge is $g \cdot s^{-1}$. The *exchange* charge is the measure of the *rate of mass exchange*, or briefly, the *power of mass exchange*. And the electron charge e is the *minimal quantum of the rate of mass exchange*. We have analyzed this issue in detail in previous Lectures.

This discovery made it possible to understand many things, including, in particular, the physical meaning of the ratio alpha (4) called the fine-structure constant; moreover, not only by the form, but also in contents.

4. Interrelationship of basis and superstructure

A wave process is a contradictory complex of *basis-superstructure*. In a wave field of exchange of the *basis*, the composite oscillating movement of discrete micro, macro, and mega objects occurs. This motion forms together with the objects the *superstructure* of the wave field.

Thus, the *basis* is the continuous side of the wave process, whereas the *superstructure* represents its discrete side. In turn, the superstructure is a contradictory discrete-continuous complex where the discrete side is represented by an object with a mass m , and the continuous side is represented by the oscillatory rest-motion of the object. *Mutatis mutandis*, the basis is characterized by its own internal continuous and discrete sides at the subatomic level.

In other words, a *wave motion* is the *mass process* having the binary character. It means that the wave process of any subspace of the Universe runs simultaneously at the two levels: the level of *basis* and the level of *superstructure*. The *basis level* embraces an interaction of particles between themselves in a subspace. This interaction gives rise to its own *superstructure* – the wave motion – the dynamic collective interaction of particles with the subspace. Here, the *basis* is the *cause* and *superstructure* is the *effect*. Thus, any wave process is a contradictory complex of *basis* and *superstructure*, of *cause* and *effect*.

At the same time the wave motion is a contradictory process of *rest-motion*. The latter is characterized by strength vectors of rest E and motion B , at the level of the basis, and, respectively, by potential V_p and kinetic V_k speeds [9, 10], at the level of the superstructure.

Let us turn to an example. An interaction of atoms between themselves in a string (fixed from both ends) is a process occurring at the level of *basis* of the string. A disturbance of the equilibrium interaction (caused by an external influence) leads to the expansion of this disturbance along a string, which has the wave character. With this the *oscillatory* speed v of every atom of the mass m of the string (in the wave of the expansion) and the *wavelength* itself λ_v represent the collective parameters of the wave motion related to the level of *superstructure*.

The energy of the wave quantum of *superstructure*

$$E = h \frac{v}{\lambda_v} \quad (13)$$

generates, at the level of basis, the equal energy of the wave quantum of *basis*

$$E = h \frac{c}{\lambda}, \quad (14)$$

where c is the *basis* speed.

For instance, the wave motion of a string with the frequency of the fundamental tone ν_1 and wavelength λ_1 generates in a surrounding air an acoustic wave of the same frequency, but with the basis (sound) speed in air c and the wavelength λ_a different from λ_1 :

$$\nu_1 = \frac{1}{T_1} = \frac{\nu}{\lambda_1} = \frac{c}{\lambda_a}. \quad (15)$$

The similar situation takes place under disturbance of the hydrogen atom, where ν is the orbital (oscillatory) speed of the electron – superstructure of the H-atom, and c is the wave speed of emission of the excess energy at the transition of the exited H-atom into the equilibrium state.

The speed c , equal to the speed of light in the last example, is the basis speed of exchange of matter-space-time of the longitudinal (radial) wave field of the proton with the transversal (cylindrical) wave field of the orbiting electron at the *fundamental frequency of exchange* inherent in the subatomic and atomic levels ω_e .

During the motion in a *transient process*, the electron in the hydrogen atom causes the wave perturbation. The myriad of particles of the subelectronic level is involved in this process. They have nothing in common with the mathematical points-photons of zero rest mass and zero rest energy. They represent a huge world of particles-satellites of electrons. For them, Earth is in the highest degree the “rarefied” spherical space. These particles pierce the Earth just freely as asteroids pierce the space of the solar system and galaxies. Just their directed motion, fluxes, called “*magnetic field*”, surrounds a conductor with a current, a bar magnet, our Earth and fills up interplanetary, interstellar, and intergalactic spaces. It is the cylindrical field-space of the subelectronic level.

In a wave process, the associated mass m determines the associated action

$$\hbar_\nu = m\nu a, \quad (16)$$

where a is an amplitude of displacement, which is inseparable from the wave action,

$$\hbar_c = mca. \quad (17)$$

The simplest relation α , characterizing the scale correlation of the superstructure and the basis, is the ratio of the *transverse* wave of the superstructure $\lambda_t = 2\pi a$ to the *longitudinal* wave of the basis $\lambda = c/\nu$ [12] (Fig. 1):

$$\alpha = \frac{\lambda_t}{\lambda} = \frac{2\pi a}{\lambda} = \frac{a}{\tilde{\lambda}} = \frac{\nu}{c}, \quad (18)$$

where $v = \omega a$ is the oscillatory speed of the wave of superstructure, and c is the wave speed of basis. The same result gives the ratio of the actions (16) and (17).

Thus (18) represents the elementary relations existed between *amplitude* of oscillations, *wavelengths* and *speeds* inherent in the wave process, regarded as a two-level longitudinal-transversal wave system.

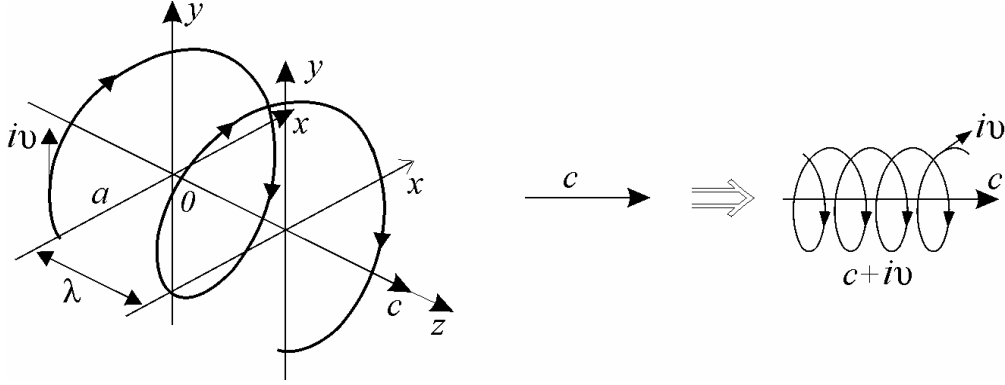


Fig. 1. A graph of the longitudinal-transversal wave field; c is the wave (beam) speed of basis, v is the circular frontal speed of superstructure.

In the Dynamic Model of elementary particles (DM) the speeds v and c have the analogous meaning, namely v is the oscillatory speed of boundary wave shells of particles and c is the base wave (phase) speed of their wave exchange at the subatomic and atomic levels. The ratio of these speeds reflects the firm interrelation, existing between *active* and *reactive exchange charges*, Q_a and Q , related to these speeds:

$$\frac{Q_a}{Q} = ka = \frac{\omega a}{c} = \frac{v}{c}. \quad (19)$$

The *maximal possible* value of the ratio of oscillatory and wave speeds (21), which the coupled particles can reach, is in the case, when oscillatory speed in (19) v is equal to the speed of the electron on the Bohr first orbit, *i.e.*, when $v = v_0 = 2.187691417 \times 10^8 \text{ cm} \times \text{s}^{-1}$:

$$\alpha = \frac{v_0}{c} = 7.29735308 \cdot 10^{-3}, \quad (20)$$

In modern physics the numerical (dimensionless) value of (20) is called the fine-structure constant. Inverse value of the ratio (20), called the *inverse fine-structure constant*, is

$$\alpha^{-1} = 137.035989. \quad (21)$$

According to the CODATA (2012) recommended values, $\alpha^{-1} = 137.035999074(44)$.

Thus, the maximal oscillatory speed which a lighter particle of superstructure can have, with respect to the basis speed c of its interaction (binding) with the conjugate heavier particle of the basis, at equilibrium, is defined by the ratio:

$$\alpha = \frac{v_{\max}}{c} = \frac{v_0}{c}. \quad (22)$$

Generalizing, we can say that this ratio expresses the *scale correlation* of basis and superstructure of wave field-spaces, *i.e.*, conjugate oscillatory-wave processes in the Universe at different its levels.

Let us verify the validity of the last statement and consider the wave process at another level, for example, at the level of an acoustic field perceived by man.

5. Thresholds parameters at the acoustic level: an example

One of the dynamic parameters of man is the *threshold of audibility*. The latter is equal to the sound pressure $P_{\min} = 2 \times 10^{-4} \text{ dyne} \times \text{cm}^{-2}$ at the frequency nearly $\nu = 1122 \text{ Hz}$ in the air under normal conditions (300 K temperature and 1 atm pressure). The acoustic action h_a and acoustic pressure P are related by the equality

$$h_a = \frac{mP}{\rho\nu}, \quad (23)$$

where m is the average mass of air molecules, and ρ is the density of air.

Hence, the minimal acoustic action $h_{a,\min}$ on the threshold of audibility of man, corresponding to the minimal sound pressure P_{\min} , is

$$h_{a,\min} = \frac{m_r u P_{\min}}{\rho\nu} = 6.627 \times 10^{-27} \text{ erg} \times \text{s}, \quad (24)$$

where $m_r = 28.96$ is the average relative mass of air molecules, $\rho = 1.293 \times 10^{-3} \text{ g} \times \text{cm}^{-3}$ is the density of air under normal conditions, $u = 1.66053873 \times 10^{-24} \text{ g}$ is the unified atomic mass unit.

We see that the action $h_{a,\min}$ (24), related to the *acoustic process*, practically coincides with Planck's action (the Planck constant) $h = 6.6260693 \times 10^{-27} \text{ erg} \times \text{s}$, relevant to the *electromagnetic processes*.

It is no wonder, Nature demonstrates the perfect harmony within any one and between different its levels. A human body contains 9.5% hydrogen atoms; therefore, some of the

sensitive parameters of man, at the atomic level, coincide with one of the basic parameters of the hydrogen atom, which is its orbital moment of momentum h .

It should also be noted that at the level of the threshold of audibility the minimal threshold amplitude of acoustic oscillations a_{min} , at the frequency 1781.25 Hz, is

$$a_{min} = \frac{P_{min}}{2\pi\rho v_a v} = 4.1696 \times 10^{-10} \text{ cm}, \quad (25)$$

where $v_a = 3.3146 \times 10^4 \text{ cm} \times s^{-1}$ is the (basis) speed of sound in air under normal conditions. The resulting value coincides with the theoretical radius of the electron sphere r_e ,

$$r_e \approx \left(\frac{m_e}{4\pi\epsilon_0} \right)^{1/3} = 4.169586917 \times 10^{-10} \text{ cm}, \quad (26)$$

obtained from the formula ((20), L. 2) in the framework of the Dynamic Model of elementary particles, where $k^2 r_e^2 \ll 1$ and $\epsilon_r = 1$.

On the upper acoustic *threshold of pain*, at the sound pressure $P_{max} = 10^4 \text{ dyne} \times \text{cm}^{-2}$, the threshold oscillatory speed is

$$v_{osc,max} = \frac{P_{max}}{\rho v_a} = 2.418 \times 10^2 \text{ cm} \times s^{-1}. \quad (27)$$

The ratio of the obtained *threshold oscillatory* speed $v_{osc,max}$ to the base wave speed in air, sonic speed, $c = v_a$, is equal to

$$\alpha = \frac{v_{osc,max}}{v_a} = \frac{1}{137.08023}. \quad (28)$$

The resulting value (28), related to the wave process at the acoustic level, practically coincides with the value (20), $\alpha = \frac{1}{137.035989}$, obtained from the ratio related to the wave process running at the electromagnetic field level.

At the electromagnetic field level, the "*threshold*" speed of oscillations (of superstructure) is equal to the Bohr first speed v_0 , and the wave speed (of basis) is equal to the speed of light c . In the above sense, the Bohr speed v_0 is the *threshold* (limit) *speed* of the electron on the stationary (first) orbit nearest to the proton wave sphere in the hydrogen atom.

Thus, the found regularity expressed by the ratios of the characteristic speeds of basis and superstructure in two different wave processes, belonging to two different levels,

electromagnetic (20) and acoustic (28), confirms the above conclusion that the ratio of the speeds has the universal character inherent in wave processes.

6. Conclusion

All arguments presented above show that the so-called "*fine-structure constant*" of the microworld, α , accepted in modern physics as a convenient measure of the *strength of the electromagnetic interaction*, expresses, in reality, the *scale correlation of threshold states of conjugate oscillatory-wave processes* at the different levels of the Universe, including atomic and subatomic. In other words, α reflects the *scale correlation of basis and superstructure* of wave field-spaces in the Universe, having the contradictory spherical-cylindrical character, as, for example, it takes place in the field-space of the hydrogen atom.

The hydrogen atom represents the dynamic coupled centrally-symmetrical system. The central key constituent by mass – proton has the *spherical wave field*. By this radial field, proton relates (exchanges) with the surrounding field-space and with the orbiting electron. The orbital motion, in turn, is associated with the *cylindrical wave field*.

The behavior of both dynamic constituents of the proton-electron system, proton and electron, are described, accordingly, by spherical and cylindrical wave functions [8], which are, naturally, *harmonically interrelated* in the system. Thus, in point of fact, the alpha constant (its magnitude) reflects such a *harmonic interrelationship* between two constituents not only of the given system, but as well as between the constituents of the similar conjugated systems. This follows from all of the data obtained within the DM.

Just this peculiarity should be regarded as a generalizing physical meaning laying in the numerical value of the alpha constant reflecting the regularity in Nature. The ratio (2) obtained for the first time in physics demonstrates such a harmonic interrelation existed, in particular, in the hydrogen atom.

For mainstream physicists the physical meaning of α , originated from the DM and considered in detail here, is still unknown. Accordingly, not yet known, how long the “*coupling constant*”, or the “*fine-structure constant*” α , placed in a series of the truly fundamental physical constants, will remain in physics as a mystic dimensionless number and be regarded as a convenient measure of the *strength of the electromagnetic interaction*.

References

- [1] L/G. Kreidik and G.P. Shpenkov, *Foundations of Physics: 13.644 Collected Papers*, Geo. S., Bydgosz - Minsk, 1998, pages 258.
- [2] G. P. Shpenkov, *On the Fine-Structure Constant Physical Meaning*, HADRONIC JOURNAL, Vol. 28, No. 3, 337-372, (2005).

- [3] L. Kreidik and G. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and 'Electric' Charge*, "Revista Ciencias Exatas e Naturais", Vol. 3, No 2, 157-170 (2001); <https://revistas.unicentro.br/index.php/RECEN/article/view/478>
- [4] P.J. Mohr, B.N. Taylor, J. Phys. Chem. Ref. Data **28**, 1713 (1999).
- [5] P.J. Mohr, B.N. Taylor, Rev. Mod. Phys. **72**, 351 (2000).
- [6] P.J. Mohr, B.N. Taylor, Phys. Today **53**, BG6 (2000).
- [7] A. Sommerfeld, *Atombau und Spectrallinien*, I Band, Friedr. Vieweg & Sohn, Braunschweig, 1951.
- [8] L. Kreidik and G. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.
- [9] G.P. Shpenkov and L.G. Kreidik, *What the Electric Charge is*, 2002; <http://shpenkov.com/pdf/Elec-Charge.pdf>
- [10] L. Kreidik and G. Shpenkov, *Philosophy of Contents-Form and Coulomb's Law*, Proceedings of The Twentieth World Congress of Philosophy, Copley Place, Boston, Massachusetts, USA, 10-16 August, 1998; <http://www.bu.edu/wcp/Papers/Scie/ScieShpe.htm>

Lecture 9

The Physical Meaning of the α -Constant

1. Introduction

We are continuing consideration of the physical meaning, which is inherent in the α -constant. This time we turn to the α -constant presented in the form of the third ratio in (6) (L. 8), $\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c}$. Relying, as usual, on the concepts and formalism of the dialectical Wave

Model that we use in all our studies, we proceed to the derivation of the α -constant in the presented above conventional form that contains four basic physical constants accepted in physics: e , \hbar , c , and ϵ_0 . But this time we will perform the derivation by another way, namely, considering the energy features of wave processes [1].

Further, taking into account that the constant \hbar itself is the combination of three independent fundamental constants, we will reduce the relation α to the proper form contained only truly fundamental constants.

Finally, we will show what number in physics, from fundamental ones, relates to the number α . As a result, we will give readers a total understanding of the physical meaning of the fine-structure constant α .

2. The energies of wave exchange and their interrelation

Let a set of quasiparticles of a microlevel, representing an elementary mass-volume, moves (oscillates) regularly with an average speed v by the exponential law

$$\hat{u} = v(kr)e^{i\omega t}. \quad (1)$$

If this motion imposes on the wave motion with the speed c , the *total energy* of a quasiparticle is presented as

$$E = \frac{m(c + \hat{v})^2}{2} = \frac{mc^2}{2} + mc\hat{v} + \frac{m\hat{v}^2}{2}. \quad (2)$$

The constituent,

$$E_{cv} = mc\hat{v}, \quad (3)$$

of the total energy (2) takes into account the transfer of the additional energy caused by the ordered motion of a quasiparticle. This energy can be also obtained by the following way [2, 3].

For the mass exchange process, with the base speed c at the level, the following equation is valid:

$$F = \frac{dm}{dt} c. \quad (4)$$

Hence, the energy of the wave mass exchange is

$$\hat{E}_{cv} = \int F d\hat{\Psi} = \int \frac{d\hat{\Psi}}{dt} c dm = c\hat{v} \int dm = mc\hat{v}, \quad (5)$$

where $\hat{\Psi}$ is the displacement at the motion with the speed \hat{v} . The corresponding *energy density* of the mass exchange is

$$\hat{w}_{cv} = \varepsilon_0 \varepsilon c \hat{v}. \quad (6)$$

The wave flow of motion with the resulting energy density (6) is perceived physiologically as “*pressure*”, and therefore it is called a ***pressure***. On the level of solids this (kinematic-dynamic) energy density is termed a ***stress***.

The first term in (2) is the *kinematic energy* of the basis level,

$$E = \int m \frac{dc}{dt} dl = \frac{mc^2}{2}. \quad (7)$$

The *carrier energy of mass exchange* at the basis level, where $\frac{\langle dl \rangle}{dt} = c$, we call it the ***dynamic energy of a particle at the basis level***, is

$$E_c = \int F \langle dl \rangle = \int c \frac{dm}{dt} \langle dl \rangle = c^2 \int dm = mc^2, \quad (8)$$

We arrive at the value, which recalls in form the well-known in physics (owing to Einstein) “*relativistic*” energy of particles. The latter appears in manipulations with the fictitious mathematical empty spaces, which were the subject of an interest of some famous

scientists, including Einstein. In his formula, the energy $E = m_0 c^2$ (obtained in 1907) is rest energy, because m_0 is *rest mass*. Since contemporary physics is based on the questioned at present manipulations (relativity theory) and the Standard Model of Elementary Particles (SM) (used the notion of rest mass), it cannot explain of principle the nature of the aforementioned “rest” energy.

The first step on the way of understanding of the aforementioned fundamental expression (8), from our standpoint, must be uncovering the origin of mass that has been undertaken in our works [2, 3].

The corresponding to (8) the *density of the dynamic energy* is

$$w_c = \varepsilon_0 \varepsilon c^2. \quad (9)$$

The third term in (2) is the oscillation energy,

$$E = \frac{m \hat{v}^2}{2}. \quad (10)$$

The mass exchange energy at the oscillation level, where $F = \frac{dm}{dt} \hat{v}$ and $\hat{v} = \frac{d\hat{\Psi}}{dt}$, is

$$E_v = \int F \langle d\hat{\Psi} \rangle = \int \frac{dm}{dt} \hat{v} \langle d\hat{\Psi} \rangle = \hat{v}^2 \int dm = m \hat{v}^2. \quad (11)$$

The density of the dynamic energy at the oscillation level (superstructure) is

$$\hat{w}_v = \varepsilon_0 \varepsilon \hat{v}^2. \quad (12)$$

On the level of solids, the energy density (12) is termed a ***modulus of elasticity***.

The densities of mass exchange energy at the basis-superstructure level \hat{w}_{cv} (6) and the basis level \hat{w}_c (9) are related by the equality

$$\hat{w}_{cv} = \frac{\hat{v}}{c} \hat{w}_c. \quad (13)$$

The ratio of the density \hat{w}_v (12) to \hat{w}_{cv} (6) leads to the similar relation, $\hat{w}_v = \frac{\hat{v}}{c} \hat{w}_{cv}$.

The experimental data shows that the maximal value of the ratio $\frac{\hat{v}}{c}$ under which solids destroy, called the *ultimate stress*, is approximately equal to α , namely

$$\frac{\hat{v}}{c} \approx \frac{1}{137}. \quad (14)$$

Note that at the level of solids, the basis speed c is equal to the sound speed in them.

Let us turn now to the case, when the oscillatory speed of a quasiparticle v is equal to the oscillatory speed v_0 of the electron on the Bohr first orbit r_0 and its mass m is equal to the associated mass of the electron m_e . The electron mass is defined by the formula ((19), L. 2),

$$m_e = \frac{4\pi r_e^3 \varepsilon_0 \varepsilon_r}{1 + k_e^2 r_e^2} \quad (15)$$

where r_e is the radius of the electron sphere ((28), L. 8), $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$, and $\varepsilon_r = 1$ (at the field level) [4]. The term $k_e^2 r_e^2 \ll 1$, hence, we neglect the latter [3]. Thus, the following formula is valid for the estimation of the electron mass,

$$m_e = 4\pi \varepsilon_0 r_e^3. \quad (15a)$$

If we apply Eq. (15a) and Eq. $e = m_e \omega_e$ ((27), L. 3) to (11), and take into account the condition of the circular motion (for a cylindrical field) [3], *i.e.*, Kepler's third law,

$$v^2 r = \text{const}, \quad (16)$$

we arrive at the energy of mass exchange at the *oscillatory* level in the following form:

$$E_v = m_e v_0^2 = \frac{m_e^2 v_0^2}{m_e} = \frac{m_e^2 \omega_e^2 v_0^2}{(4\pi \varepsilon_0 r_e^3) \omega_e^2} = \frac{e^2}{4\pi \varepsilon_0} \cdot \frac{v_0^2}{r_e^3 \omega_e^2} = \frac{e^2}{4\pi \varepsilon_0 r_0}. \quad (17)$$

The *oscillatory-wave* energy of mass exchange (5) under above conditions is

$$E_{vc} = m_e v_0 c. \quad (18)$$

The ratio of the resulting energies of mass exchange, oscillatory (17) and oscillatory-wave (18), defines the *fine-structure constant* in the form ((3), L. 8) which, according to the definition, contains the fundamental physical constants, e , \hbar , c , and ε_0 :

$$\alpha = \frac{E_v}{E_{vc}} = \frac{v_0}{c} = \frac{e^2}{4\pi \varepsilon_0 m_e v_0 r_0 c} = \frac{e^2}{4\pi \varepsilon_0 \hbar c}. \quad (19)$$

It is obvious that in the case of the ratio of *oscillatory-wave* energy (18) and *wave* (*dynamic*) energy (8), equal under the above conditions to $E_c = m_e c^2$, we arrive at the same formula ((6), L. 8), so that finally we have

$$\alpha = \frac{E_v}{E_{vc}} = \frac{E_{vc}}{E_c} = \frac{v_0}{c} = \frac{e^2}{4\pi\epsilon_0\hbar c}. \quad (20)$$

Thus, this time considering the energies of particles, participating in the wave motion, we come again to the same fundamental ratio of two characteristic speeds inherent in wave processes.

It not be amiss to remind that in the formulas of the DM, including presented here, the constant ϵ_0 is the absolute unit density, $\epsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$, and the electron charge e is an elementary quantum of the rate of mass exchange, its value and dimensionality is $e = 1.702691627 \times 10^{-9} \text{ g} \times \text{s}^{-1}$ (compare with $\epsilon_0 = 8.854187817 \dots \cdot 10^{-12} \text{ F} \cdot \text{m}^{-1}$ and $e = 1.602176462 \cdot 10^{-19} \text{ C}$ in accepted value of α (4), L. 8).

3. The proper forms of the α -ratio

Let's convert the α -constant, presented in the form,

$$\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c}, \quad (21)$$

to such an alternative new form, with respect to (21) and to the original form,

$$\alpha = \frac{v_0}{c}, \quad (22)$$

in which the value of α will depend solely on the truly fundamental physical constants, reflecting to a greater extent, than in (22), the wave nature of objects and phenomena in the Universe reflected in the α -constant.

For that we should, first, take into account that the true meaning of the “fundamental” constant \hbar , entered in (21) is the *orbital moment of momentum* of the electron on the Bohr first orbit in the hydrogen atom,

$$\hbar = m_e v_0 r_0, \quad (23)$$

where v_0 is the oscillatory speed of the electron on the Bohr first orbit, and r_0 is the radius of this orbit.

Second, the electron charge e in (21) also depends on the wave fundamental parameters, because it equals to

$$e = m_e \omega_e, \quad (24)$$

where ω_e is the fundamental frequency of the atomic and subatomic levels.

Thus, substituting (23) and (24) into (21), we obtain

$$\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c} = \frac{m_e \omega_e^2}{4\pi\epsilon_0 v_0 r_0 c} \quad (25)$$

The electron mass m_e , entered in the above formulas, has the associated character and also depends on the fundamental wave parameters, following the formula ((19), L. 2),

$$m_e = \frac{4\pi r_e^3 \epsilon_0}{1 + k_e^2 r_e^2} \quad (26)$$

where r_e is the wave shell of the electron, $\epsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$ is the absolute unit density,

$k_e = \frac{1}{\lambda_e} = \frac{\omega_e}{c}$ is the fundamental wave number, λ_e is the fundamental wave radius.

Substituting it into (25), and taking into account (22), we arrive at the final expression for α in the following form,

$$\alpha = k_e r_e \sqrt{\frac{r_e}{r_0(1 + k_e^2 r_e^2)}} \quad (27)$$

Because $k_e^2 r_e^2 \ll 1$, Eq. (27) can be presented in the simplest form,

$$\alpha = k_e r_e \sqrt{\frac{r_e}{r_0}} \quad (28)$$

Now substituting numerical values for all physical quantities in the formula (27),

$$k_e = \frac{\omega_e}{c} = 0.623485517 \times 10^8 \text{ cm}^{-1} \quad (29)$$

$$r_e = 4.17052597 \times 10^{-10} \text{ cm} \quad (30)$$

$$r_0 = 0.52917721092 \times 10^{-8} \text{ cm} \quad (31)$$

we obtain the following values for the alpha-constant, α , and the inverse alpha-constant, α^{-1} ,

$$\alpha = 0.0072973516 \quad (32)$$

$$\alpha^{-1} = 137.036015 \quad (33)$$

For comparison, the CODATA recommended value for α^{-1} is

$$\alpha^{-1} = 137.035999074(44) \quad (34)$$

Calculations made by the formula (28) give the value,

$$\alpha^{-1} = 136.989711. \quad (35)$$

Thus, the data presented here (and in Lecture 8) convincingly prove the wave nature lying in the base of the fine-structure constant α .

4. An analysis of the obtained relation

The formula (28) determines the relation between speeds and radii of two certain wave surfaces-shells. Because

$$k_e r_e = \frac{\omega_e r_e}{c} = \frac{v_e}{c}, \quad (36)$$

we have two different expressions for α ,

$$\alpha = \frac{v_e}{c} \sqrt{\frac{r_e}{r_0}} \quad \text{and} \quad \alpha = \frac{v_0}{c} \quad (37)$$

from which it follows that

$$\frac{v_0}{v_e} = \sqrt{\frac{r_e}{r_0}} \quad (38)$$

Really, in motion, the field of any particle, including an electron, is *cylindrical*, representing a wave trajectory, where the speed of transversal oscillatory motion is

$$v = \frac{\omega a}{\sqrt{kr}}. \quad (39)$$

In (39), a is the constant of the field equal to the amplitude of oscillations at the wave cylindrical surface at $kr = 1$. This formula determines the relation between speeds and radii of two arbitrary wave surfaces-shells:

$$v = \left(\frac{r_0}{r} \right)^{\frac{1}{2}} v_0. \quad (40)$$

If we rely upon the Bohr radius r_0 and Bohr speed v_0 , the speed v_e of the field at the surface of the wave shell with radius r_e must be equal to

$$v_e = \left(\frac{r_0}{r_e} \right)^{1/2} v_0 = 7.792757402 \times 10^8 \text{ cm} \times \text{s}^{-1}, \quad (41)$$

where $v_0 = 2.1876911263 \times 10^8 \text{ cm} \times \text{s}^{-1}$, $r_e = 4.17052597 \times 10^{-10} \text{ cm}$.

Hence, knowing the speed v_e and the radius r_e , obtained from the formula of mass (26), and using the formula for the charge ((26), L. 3) (neglecting the term $k_e^2 r_e^2$, which is $\ll 1$), we find the exchange charge of the electron

$$e = 4\pi r_e^2 v_e \varepsilon_0 = 1.702691627 \times 10^{-9} \text{ g} \times \text{s}^{-1}. \quad (42)$$

This value is in full agreement with the experimental value ((31), L. 3) reduced to the same dimensionality, $\text{g} \times \text{s}^{-1}$, by the formula ((30), L. 3) from the known value in CGSE units.

On the basis of elementary relations of amplitude-wave ((1), L. 8), we can write

$$\frac{v_e}{c} = \frac{r_e \omega_e}{c} = \frac{a_e}{\lambda_e} = \frac{a_e \omega_e}{c}. \quad (43)$$

From this it follows that the radius of electron sphere r_e is the *fundamental quantum amplitude of oscillations* of matter-space, $r_e = a_e$. On the other hand, an equatorial electron circumference $2\pi r_e$, as an elementary electron wave of basis, is located two times at the Bohr radius, $r_0 \approx 2(2\pi r_e)$, as if it is the radial wave. Apparently, this relation is not the case. In this sense, the nucleon sphere is the binary electron wave.

5. Discussion and conclusion

We brought above the quite strong arguments, which prove that the fine-structure constant α defines the scale correlation of basis and superstructure of wave processes and the correlation between speeds and radii of two definite wave surfaces-shells.

The fundamental physical constants e , c , ε_0 , and m_e (entered in \hbar) constituting the fine-structure constant α (21), have obtained in the dialectical approach, realized in the DM, a new physical meaning. These constants played the key role in revealing and understanding the physical meaning of α .

The *speed of light* c is the *basis wave speed of exchange* of matter-space-time at the subatomic level, or the *fundamental period-quantum* of the field of speed of exchange. The constant ε_0 is the *absolute unit density* equal to $1 \text{ g} \cdot \text{cm}^{-3}$, m_e is the *associated mass* of an electron, e is the *elementary quantum of the rate of mass exchange*.

In view of the approach used here, the energy $E = m_0 c^2$ is the *carrier energy of mass exchange at the basis level*, i.e., it is the *dynamic energy of a particle at the subatomic level*.

From one side, the constant α (22) represent the *ratio of two characteristic speeds* in the hydrogen atom, namely the threshold oscillatory speed v_0 and the basis wave speed c .

From another side, the fine-structure constant α in the form (21) is presented as the combination of basic physical constants. Namely it contains the *dynamic parameters of the system of the hydrogen atom* in the equilibrium state (e, m_e, v_0, r_0, c).

The hydrogen atom represents the simplest proton-electron system, which radiates electromagnetic waves under definite conditions. Therefore it is no wonder that the parameters of α , enumerated above in brackets, enter in the formula of spectral terms of the hydrogen (and hydrogen-like) atoms. With this, three truly fundamental constants-parameters united in the product, $\hbar = m_e v_0 r_0$, became considered in contemporary physics together as if it was an independent separate fundamental physical constant. Related to this is the origin of the idea (put forward first in 1916 by Sommerfeld) that alpha in the form of the combination of the parameters, e, \hbar , and c , characterizes the strength of the electromagnetic interaction.

The third presentation (27) contains principal *fundamental wave parameters* (ω_e, c, r_0, r_e) of wave formations: the fundamental frequency ω_e and the basis speed c of the wave exchange (interaction) at the atomic and subatomic levels, and the radii of wave shells of the proton and electron, r_0 and r_e .

Here are collected together three considered above explicit forms of the α -constant presentations:

$$\alpha = \frac{v_0}{c}, \quad \alpha = \frac{e}{4\pi\varepsilon_0\hbar c}, \quad \alpha = \frac{r_e\omega_e}{c} \sqrt{\frac{r_e}{r_0 \left(1 + \frac{r_e^2\omega_e^2}{c^2}\right)}} \quad (43)$$

Because $\frac{\omega_e}{c} = \frac{1}{\lambda_e} = k_e$, $\omega_e r_e = v_e$, and $\frac{r_e^2\omega_e^2}{c^2} \ll 1$, the third expression in (43) is reduced to the simplest form

$$\alpha = \frac{v_e}{c} \sqrt{\frac{r_e}{r_0}}. \quad (44)$$

Substituting in place of α its value $\alpha = \frac{v_0}{c}$, we get the following result,

$$\frac{v_0}{v_e} = \sqrt{\frac{r_e}{r_0}}. \quad (45)$$

Thus α has an unequivocal relation of to the third Kepler law, $v^2 r = \text{const}$ (16), because the equality (45) directly follows from the given law also.

In addition, let's coming back to Feynman's expression, "... where this number for a coupling comes from: is **it related to pi** or perhaps to **the base of natural logarithms**? Nobody knows." In this connection, we have all grounds to state the following.

Within the framework of the Wave Model it was found that along with the mathematical constant $\pi = 3.14159 \dots$ and the base of natural logarithms $e = 2.718281 \dots$ (aforementioned by Feynman), it exists in the Universe another *constant* also *irrational*, namely, the *fundamental period-quantum* $\Delta = 2\pi \lg e = 2.72875\dots$, which follows from the *Law of the Decimal Base* [5-8].

Look carefully, it turns out that the cardinal number of the *inverse "fine-structure"* constant (33), $\alpha^{-1} = 1.37036015 \times 10^2$, correlates with the sufficient accuracy with the hundredfold measure of the *fundamental half-period* equal to

$$\frac{1}{2} \Delta = \pi \log e = 1.364376354\dots \quad (46)$$

And the cardinal value of α^{-1} , calculated from (28),

$$\alpha^{-1} = 1.36989711 \times 10^2, \quad (47)$$

correlates with the fundamental half-period (46) with the relatively greater precision.

Really, a harmonic bond of all phenomena in Nature, according to the Wave Model, is defined by the fundamental frequencies of wave fields-spaces setting the rhythm for running of all processes in Nature. The fundamental period Δ of the Decimal Code of the Universe (considered in Vol. 1 of the Lectures) is that number, which conditions the fundamental wave relations (see L. 6, Vol. 1), including, of course, the α -relations considered here and presented by the equalities, (43) and (44).

Thus, the mystery of α is naturally and consistently revealed in the framework of the wave DM. Convincing proofs justify in favor of the wave nature of the fine-structure constant α . No wonder, therefore, that its value is related to the fundamental frequency of atomic and subatomic levels ω_e and to the fundamental quantum-period Δ of the Decimal Base (the Decimal Code of the Universe) [8].

References

- [1] G. P. Shpenkov, *On the Fine-Structure Constant Physical Meaning*, HADRONIC JOURNAL, Vol. 28, No. 3, 337-372, (2005).
- [2] L. Kreidik and G. Shpenkov, *Alternative Picture of the World*, Vol. 1-3, Geo. S., Bydgoszcz, 1996.
- [3] L. Kreidik and G. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.
- [4] L. Kreidik and G. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and 'Electric' Charge*, "Revista Ciencias Exatas e Naturais", Vol. 3, No 2, 157-170 (2001); <https://revistas.unicentro.br/index.php/RECEN/article/view/478>
- [5] G. Shpenkov, *Conjugate Fields and Symmetries*, Apeiron, Vol. 11, No. 2, 349-372, (2004); <http://redshift.vif.com/JournalFiles/V11NO2PDF/V11N2SHP.PDF>
- [6] L. Kreidik and G. Shpenkov, *Philosophy and the Language of Dialectics and the Algebra of Dialectical Judgments*, Proceedings of The Twentieth World Congress of Philosophy, Copley Place, Boston, Massachusetts, USA, 10-16 August, 1998; <http://www.bu.edu/wcp/Papers/Logi/LogiShpe.htm>
- [7] L. Kreidik and G. Shpenkov, *Interrelation of Values of Base Units and Fundamental Constants with the Fundamental Quantum of Measures*, in Foundations of Physics: 13.644...Collected Papers, Geo. S., Bydgoszcz, 55-68 (1998); <http://shpenkov.com/pdf/Metrology.pdf>
- [8] George Shpenkov, SOME WORDS ABOUT FUNDAMENTAL PROBLEMS OF PHYSICS, LAP LAMBERT Academic Publishing, 2012; <https://shpenkov.com/pdf/FundPhysProb.pdf>; <http://shpenkov.com/pdf/Book-2011-Eng.pdf>

Lecture 10

Fundamental Quanta of the DM

1. Introduction

From previous nine Lectures we have learned a lot, without any exaggeration, about the capabilities and achievements of the theory of the DM. Now we would like to draw some interim outcomes. Specifically, the present consideration is devoted again to those fundamental parameters, inherent exceptionally only in the DM, which were unknown for physicists up to publication (in 1996) of three volumes of a book “*Alternative Picture of the World*” [1-3].

The Dynamic Model of elementary particles revealed an existence of absolutely unknown earlier new fundamental physical constants-parameters characterizing processes in Nature and explained their physical meaning. Here they are:

$$\omega_e, \omega_g, \hat{\lambda}_e, \hat{\lambda}_g.$$

These are the *fundamental frequencies* of the atomic and subatomic, ω_e , and gravitational, ω_g , levels, and corresponding to them the *wave radii*, $\hat{\lambda}_e$ and $\hat{\lambda}_g$. Nobody never even could suppose about their existence. Therefore, they have never been mentioned earlier in physics.

Thanks to the DM, the well-known for physicists fundamental parameters, such as

$$c, e, r_e, m_e, \epsilon_0, \alpha, \dots$$

have obtained the unknown earlier physical interpretation. In particular, the DM revealed the unknown earlier physical meaning, the nature, of the *speed* c , known in physics only from one side merely as the speed of light, and explained the origin of the *fine-structure constant* α , giving an answer to the question where from it came.

As concerns the *electrons mass* m_e , *electron charge* e , and *electron radius* r_e , their true nature also for the first time was discovered within the new approach. The discovery of the origin of mass of elementary particle, including the *electron mass* m_e , has shown that mass

has dynamic (*associated*) wave nature and the rest mass of particles does not exist, even of quiescent particles.

As the fundamental physical constant, the electron charge e has obtained now *not only the true value, but also the true dimensionality*, different from those accepted in physics, which turned out to be erroneous. We have come to the similar conclusion, revealing the true meaning of the “electric constant” ϵ_0 introduced erroneously in physics, and still considered as the fundamental physical constant. The concept on the electron size has also obtained an adequate physical meaning, which led us, in particular, to the discovery of the true value of the electron radius r_e .

Let us remember now what we have learned from previous Lectures about the physical meaning of the aforementioned physical constants.

The *fundamental frequency* ω_e , equal to

$$\omega_e = 1.869162505 \times 10^{18} \text{ s}^{-1}, \quad (1)$$

is the unknown earlier fundamental parameter of Nature; it is responsible for the exchange (interaction) at the atomic and subatomic levels of the Universe ((37), L. 4). This frequency defines an average discreteness of space at these levels. Actually, the *fundamental wave radius* of the field of the exchange ((38), L. 4), corresponding to this frequency (1), is

$$\tilde{\lambda}_e = 1.603886538 \times 10^{-8} \text{ cm}. \quad (2)$$

And a double value of the radius, $D = 2\tilde{\lambda}_e = 0.32 \text{ nm}$, correlates with an average numerical value of *lattice parameters* in crystals.

The *fundamental frequency* ω_g , equal to

$$\omega_g = 9.159248527 \times 10^{-4} \text{ s}^{-1}, \quad (3)$$

is also the unknown earlier fundamental parameter of Nature; it is responsible for the exchange (interaction) at the *gravitational* (mega) level ((7), L. 5). Thus, ω_g is the *frequency of gravitational wave field*. This frequency defines the *gravitational wave radius* of elementary particles, or in other words, the *radial elementary gravitational wave* ((8), L. 5),

$$\tilde{\lambda}_g = 3.273111949 \times 10^{13} \text{ cm} \approx 327.3 \text{ Mkm}. \quad (4)$$

The fundamental constant of physics, $c = 2.99792458 \cdot 10^{10} \text{ cm} \cdot \text{s}^{-1}$, considered in modern physics, in particular, as the speed of light in vacuum, has the deeper physical meaning. Namely it is the *basis speed of wave exchange* of matter-space at the atomic and subatomic levels.

The *electron charge* ((31), L. 3), according to the DM, has the following value and dimensionality,

$$e = 1.702691627 \times 10^{-9} \text{ g} \times \text{s}^{-1}. \quad (5)$$

This physical parameter differs in a cardinal way, by the magnitude and dimensionality, from the electric charge ascribed to the electron in modern physics. As concerns the physical meaning of the electron charge (5), as it turned out, it is an *elementary exchange charge*, or an *elementary quantum of the rate of mass exchange*, or an *elementary power of exchange*.

The *electron radius* is, in essence, the radius of electron's wave shell. Calculated from the simplified formula ((15a), L. 9), it is equal to

$$r_e = 4.16958795 \times 10^{-10} \text{ cm}. \quad (6)$$

This value, as we see, by three orders of magnitude is more than the size ascribed to the electron in modern physics.

In this Lecture, we continue the consideration of only some of the above enumerated fundamental physical constants, are available in view the following of them:

$$c, \omega_e, \text{ and } e.$$

The matter is that for these parameters we have additional ideas concerning the deepest sense inherent in them, which has not yet been considered in Lectures, and will try to share these ideas with you. According to our analysis the deeper physical meaning of the constants, to which we have come in a result, apparently, does really exist [4].

Let us begin the consideration of the stated above issue from elucidating of our more expanded insight into the speed of light c ((8), L. 9).

2. Speed of exchange, c

The speed of light c enters in a famous “relativistic” expression for energy of particles,

$$E = mc^2 \quad (7)$$

which was introduced in physics in 1905, about ten years earlier than an introduction of the fine-structure constant a (1916). Eq. (7) was obtained by Einstein in result of transformations of mathematical (fictitious, empty) spaces; and from that time this equation began considered as *mass-energy equivalence*.

So, much time has passed since. However, hitherto physicists do not know an answer to the principal question, what is the nature of the relationship, which exists between the *rest mass* of a particle m_0 and the speed of light c in the formula of the rest energy, $E_0 = m_0 c^2$,

where motion is out of the question? Or, in other words, why does the *speed* of light c play the fundamental role for the *internal* energy of a *quiescent* particle? Or, what is common between the speed of light and the rest mass of the particles? Why they are related to each other by the product (7)?

The DM has clarified these questions, revealed the role played by c in the aforementioned energy expression (see also L. 2), explaining thus the physical meaning of the product of mass with the speed of light squared. Unfortunately, through ignorance by the majority of scientific community of the works, obtained within the theory of the DM, the found physical meaning of c and its role in the formula (7) are not yet noticed by modern physics. Accordingly, the present *status quo* with this matter is as before, i.e., the following.

Contemporary physics ascertains only the fact of the direct relation existed between the energy and the rest mass of particles, and regards c^2 merely as the coefficient of proportionality without any comments, without examining of any objective content. The matter is that the Standard Model of Elementary Particles (SM) cannot shed light on this matter in principle. The SM was designed within the framework of Quantum Field Theory (QFT), consistent both with Quantum Mechanics and the Special Theory of Relativity. However, QFT is not applied to General Relativity and, therefore, the SM also cannot unify gravitation with other fundamental interactions.

For these and many others reasons, it is widely recognized that the SM "*will not be the final theory*" and "*any efforts should be undertaken to finds hints for new physics*" [5]. Experimentalists and theorists all over the world are actively trying to find ways to move beyond the current particle physics paradigm. There are many ideas to replace the SM. Mainstream theorists believe that one of the most promising theories is the String Theory and its derivatives.

In the SM, particles are considered to be points. In String Theory, a "string" is a single fundamental building block for all particles. There are different theories of strings, including superstrings and heterotic strings. There is also an underlying theory called M-theory of which all string theories are only. M-theory considers that all the matter in the Universe consists of combinations of tiny membranes, *etc.* However, the String Theory is far from complete, if this ever happens at all; many problems with its development are still open. Moreover, new problems appear in the course of time.

As follows from the data obtained for the last two decades, one of the promising "*hints for new physics*" [5] is the *Dynamic Model of Elementary Particles* (DM) [6]. The latter reveals, along with many others things, the mystery of the formula (7) (see (8), L. 9)) and logically and non-contradictory elucidates, as we have seen from the previous Lectures, the nature of the fine-structure constant α .

According to the DM, particles are pulsating microobjects formed in the wave space from the space itself, it means that they are dynamic formations, but not static. For them, the speed

of light c is their base wave (phase) speed on which they realize an interaction, *i.e.*, ceaseless wave exchange of matter-space and motion-rest (matter-space-time for brevity) with environment.

In the framework of the DM, the mass-energy formula (7) obtains its natural physical explanation, and the presence of the speed c in it becomes meaningful. Namely the energy (7) is an *internal dynamic energy of a particle* (reminiscent of a micropulsar) of the subatomic level, or in other words, it is the (carrier) *energy of the mass exchange* at this level.

Let us consider the physics of mutual transformations of basis and superstructure, for example, in a wave process at the *galactic field level* [4], taking into account that the *speed of light is the base (beam) speed of the wave process*. We assume that the propagation of waves (including the light range of waves) with the basis speed c runs like propagation of any material waves, for example, acoustic waves in air or other material media. And the absolute speed of every object is a multidimensional (multilevel) speed, irrespective of any frames of reference, because it is determined by (takes into account) the speeds at all interrelated levels (micro-, macro-, mega-) in the Universe.

During the definite time interval, for some reasons, the beam speed of a wave-basis can rise. The latter does not influence on the total energy of the wave system, which remains equal to zero. It is because in the course of raising the field of motion, the field of rest also rises by the same value. Actually, the additional growth of kinetic energy is compensated in Nature by the increase of potential energy by the same amount, but opposite in sign.

When the beam speed reaches the speed of light c and exceeds it, the superstructure begins to be forming. The latter is realized in an appearance of two mutually perpendicular longitudinal-transverse waves of the oscillatory type. The resulting speed of such a system, as the vector sum of the initial beam speed c and the additional speed of the superstructure v , forms the screw cylindrical wave (Fig. 1) with the right or left spiral trajectory.

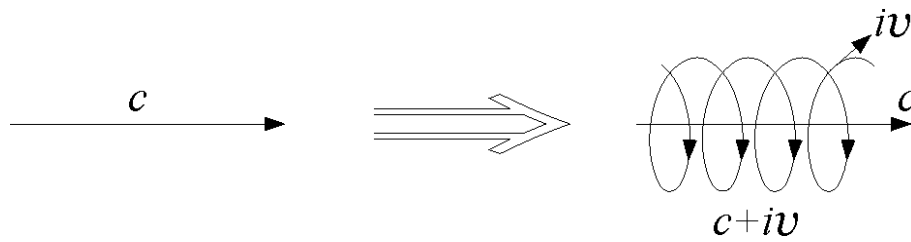


Fig. 1. Transformation of the beam speed c ; iv is the circular frontal speed.

Thus, during the formation of superstructure, the beam speed of the wave is transformed into the screw speed. Hence, the *absolute* speed of an object-satellite, moving along the screw trajectory, will be equal to

$$\hat{C} = c + iv, \quad (8)$$

and the modulus of the speed is

$$|\hat{C}| = \sqrt{c^2 + v^2}, \quad (9)$$

where iv is the *frontal kinetic speed of the superstructure*, negating the speed of the basis.

In turn, when the frontal speed iv , as the beam speed v , exceeds the light speed c , i.e., the wave of superstructure becomes the base wave, one more superstructure rises, *etc.* As a result, the absolute speed of the n -wave level takes the following form

$$\hat{C} = nc + iv. \quad (10)$$

All this allows us to state that the *speed of light c is the fundamental period-quantum* of the field of speed of material-ideal exchange by matter-space-time and the modulus of speed of an arbitrary level of basis-superstructure is determined, to within the period c , by the formula (9). At considerable absolute speeds, the mutual speed of the nearest galaxies can reach the speeds compared with the period-quantum of speed c as it is observed in astronomy. Apparently, the motion of galaxies with approximate light speeds is partially closed at the wave motion of the basis of the microworld.

The fundamental period-quantum of the wave speed of exchange c defines, as we already know, an average discreteness of space at the subatomic level of exchange (interaction). Actually, the double value of the *fundamental wave radius*, equal to

$$D = 2\tilde{\lambda}_e = 2 \frac{c}{\omega_e} = 3.207773076 \times 10^{-8} \text{ cm}, \quad (11)$$

correlates with the average value of lattice parameters in crystals.

Let us remind also the following relevant questions considered in previous Lectures. Taking into account the elementary relations ((1), L. 8) existed in wave processes between two particular speeds, oscillatory and wave, and also between amplitude of oscillations, a , and the wavelength, λ , we have arrived at the following ratios (used in (43), L. 9):

$$\frac{v_e}{c} = \frac{r_e \omega_e}{c} = \frac{a_e}{\tilde{\lambda}_e} = \frac{a_e \omega_e}{c}. \quad (12)$$

From the latter it follows that $r_e = a_e$. It means that the radius of the *electron sphere* r_e can be considered as the *fundamental quantum-amplitude of oscillations* of the field of matter-space-time. The value of the theoretical radius of the electron sphere, originated from the formula of electron mass in the DM ((26), L. 9), neglecting the term $k_e^2 r_e^2 \ll 1$, is

$$r_e = \left(\frac{m_e}{4\pi\epsilon_0} \right)^{1/3} = 4.17052597 \times 10^{-10} \text{ cm}, \quad (13)$$

where $m_e = 9.10938291 \times 10^{-28} \text{ g}$, $\epsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$.

The radius r_e restricts the main part of an electron from its field part. The latter is gradually merging with the ambient field of matter-space-time. The oscillatory speed of exchange at the electron sphere (13) is

$$v_e = r_e \omega_e = 7.795390769 \times 10^8 \text{ cm} \times \text{s}^{-1}. \quad (14)$$

An equatorial electron circumference $2\pi r_e$, regarded as an elementary electron wave of basis, is located two times at the Bohr radius, because

$$r_0 \approx 2(2\pi r_e), \quad (15)$$

as if it were the radial wave. In this sense, the wave sphere of H-atom is the binary electron wave.

Let us return now to the condition, $v = \frac{\omega a}{\sqrt{kr}}$ ((39), L. 9), obtained from the solutions of the wave equation in cylindrical coordinates [7]. We will apply it to the speeds of transversal oscillatory motion and the radii of two wave surfaces, r_0 and r_e . Then, the speed of oscillatory motion v_0 on the surface of a sphere of the Bohr radius r_0 , calculated on the basis of the aforementioned condition, is turned out to be equal to

$$v_0 = v_e \left(\frac{r_e}{r_0} \right)^{1/2} = 2.188430401 \times 10^8 \text{ cm} \times \text{s}^{-1}. \quad (16)$$

The speed obtained almost coincides in value with the Bohr speed. This fact indicates that the proton and electron are formations of the same hierarchical level of the field of basis-superstructure.

3. Frequency of exchange, ω_e

Let us discuss now the quantitative sense of the fundamental frequency ω_e . To this end, we will consider the wave motion of an electron in a uniform kinetic (magnetic) field of the subatomic level of matter (Fig. 2).

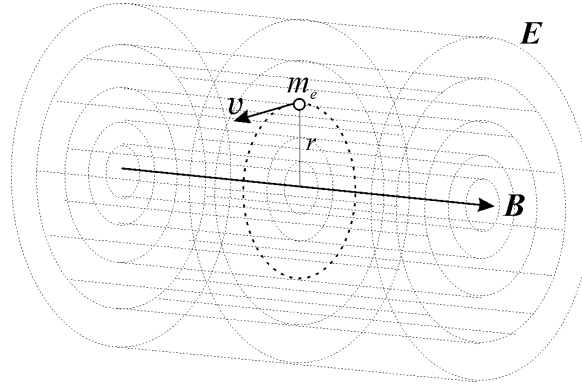


Fig. 2. An electron wave of superstructure; a cylindrical kinetic field is defined by the kinetic \mathbf{B} -vector, a transverse potential field – by the potential \mathbf{E} -vector; both fields represent the longitudinal-transverse field of matter-space-time of the subatomic level.

When the longitudinal wave of superstructure is equal to zero, we have only the transversal wave of superstructure, which is represented by a circular motion and described by the following tautological equation

$$\frac{m_e v^2}{r} = \frac{e}{\omega_e} v \omega = e \left(v \frac{\omega}{\omega_e} \right) = eE = \frac{v}{c} e \left(c \frac{\omega}{\omega_e} \right) = \frac{v}{c} eB, \quad (17)$$

where

$$E = v \frac{\omega}{\omega_e} \quad (18)$$

is the *potential strength vector*, the vector of superstructure;

$$B = c \frac{\omega}{\omega_e} \quad (19)$$

is the *kinetic strength vector* of basis; at that

$$E = \frac{v}{c} B. \quad (20)$$

The complex vector of the field can be presented in two ways:

$$\hat{B} = E + iB \quad \text{or} \quad \hat{B} = B + iE. \quad (21)$$

The second measure of the vector \hat{B} is preferred because the kinetic field \mathbf{B} generates its own negation – the transverse potential field \mathbf{E} . More exactly, both fields always exist together.

When the \mathbf{B} -field strength is increasing, the frequency of electron oscillations ω proportionally increases as well, as follows from the equations (17):

$$m_e \omega = e \frac{B}{c} \quad \text{or} \quad \omega = \omega_e \frac{B}{c}. \quad (22)$$

Hence, when $B \rightarrow c$, the frequency of electron oscillations $\omega \rightarrow \omega_e$, *i.e.*, ω tends to the limit value, *i.e.*, to the fundamental frequency of the atomic and subatomic levels ω_e (the frequency of the “electrostatic” field). It is the kinetic-potential field of the subatomic level of matter-space-time.

Thus, the *fundamental frequency* ω_e is the limiting frequency of the subatomic potential-kinetic (“electromagnetic”) field-space of basis, which determines the fundamental wave radius of minimal length $\tilde{\lambda}_e$ and the minimal quantum-period of time T_e with the time wave radius T_{re} :

$$\tilde{\lambda}_e = \frac{c}{\omega_e}, \quad T_e = \frac{2\pi}{\omega_e}, \quad T_{re} = \frac{1}{\omega_e} = \frac{T_e}{2\pi}. \quad (23)$$

The *fundamental wave radius* $\tilde{\lambda}_e$ of the field-space is simultaneously the radius of the fundamental wave of atomic spaces, which determines one-half of the mean value of the interatomic (in terms of the conventional nuclear model of atoms) distance in crystals.

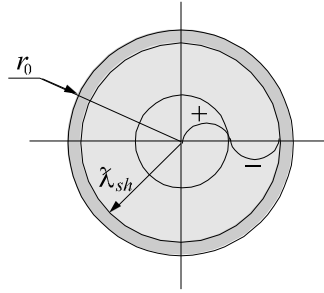


Fig. 3. Parameters of the neutron sphere; r_0 is the radius of the neutron sphere; $\tilde{\lambda}_{sh}$ is the wave-radius of a wave sphere of the half-tone, described by Bessel functions of the half-integer order $\nu=1/2$ (the last define integer optical spectra in the Balmer series).

It is possible that an electron basis wave, as the wave of superstructure, has its continuation at the level of the superstructure. So, if this takes place, such a wave forms the fundamental frequency of the electron level,

$$\omega_s = \frac{c}{\tilde{\lambda}_s} = c \times 3 \sqrt{\frac{4\pi\epsilon_0}{m_e}} = 7.18836089 \times 10^{19} s^{-1} = 38.457656 \omega_e, \quad (24)$$

where

$$\tilde{\lambda}_s = r_e \quad (25)$$

is the wave radius of the electron sphere. The electron sphere can form a half-wave (half-tone) (Fig. 3), then

$$\omega_{sh} = \frac{c}{2\tilde{\lambda}_s} = \frac{c}{\tilde{\lambda}_{sh}} = 3.594180445 \times 10^{19} \text{ s}^{-1} = 19.228828 \omega_e. \quad (26)$$

The frequency (26) defines the wave

$$\lambda_{sh} = 2\pi\tilde{\lambda}_{sh} = 0.5240837504 \times 10^{-8} \text{ cm}, \quad (27)$$

which is located, approximately, one time at the Bohr radius. This wave forms the sphere which is located near the surface of neutron sphere.

4. Power of exchange, e

We can rewrite the first equation of (22) in the following way

$$m_e \omega = e \frac{B}{c} \quad \Rightarrow \quad q_e = e \frac{B}{c}, \quad (28)$$

where the product of the electron mass m_e by the frequency of oscillations ω ,

$$q_e = m_e \omega, \quad (29)$$

represents the *kinetic charge of the electron in the wave of superstructure* or, in other words, the kinetic charge of wave motion (Fig. 3). In that case, in accordance with the second equation of (28), at $B \rightarrow c$, the kinetic charge of electron q_e , increasing, reaches the limiting maximal value e :

$$q_e \rightarrow e = m_e \omega_e. \quad (30)$$

Therefore, the *electron charge* (as mass power of exchange) e , apparently, should be regarded as *one of the limiting quanta* by which microparticles can exchange. Moreover, the electron is a particle of the minimal mass characterized by the limiting power of exchange e . Hence, it is reasonable to substitute the words “*electron charge*” for the “*elementary quantum of power of exchange*” or, simply, the “*elementary quantum of exchange*”. Of course, it is only an assumption, and hence we need to treat it that way.

Let us imagine, if it is possible, that exchange does not occur; then the associated mass and the associated charge of particles vanish and, hence, they would not be physically detected.

5. Conclusion

In the framework of the wave approach realized in the DM, the nature of the fundamental physical constants, which we have once again considered here, has found an additional expanded interpretation.

As has been elucidated in this Lecture, the *basis (phase) speed of wave exchange of matter-space at the atomic and subatomic levels* c (known in modern physics, in particular, only from the one side as the speed of light) may be additionally interpreted as the *fundamental period-quantum of the field of speeds* of the material-ideal exchange.

The *fundamental frequency* of atomic and subatomic levels ω_e , in fact, the frequency of the so-called “electrostatic field”, can be additionally regarded as the *limiting frequency of the subatomic potential-kinetic* (“electromagnetic”) *field-space of basis*. This frequency determines both the fundamental wave radius λ_e of the minimal length and the minimal quantum-period of time T_e with the time wave radius T_{re} .

The *fundamental wave radius* λ_e is the radius of the *fundamental wave of atomic spaces*; it determines one-half of the mean value of interatomic distances in crystals.

The electron is one of the limiting quanta of exchange and, as the particle of minimal mass with the limiting power of exchange e , it is interpreted as the *elementary quantum of the power of exchange*.

The radius of an electron sphere r_e can be additionally regarded as the *fundamental quantum-amplitude of oscillations* of the field of matter-space.

The concepts touched in this Lecture, on an existence in the Universe of the fundamental *period-quantum* of the speed c , the fundamental *quantum-amplitude* of oscillations r_e , etc., were put forward for the first time in 1998 [4]. We hope that all these notions, just like a new concept on the physical meaning of the fine-structure constant α , and others revelations of the DM, will be in a nearest future examined by different independent research laboratories for compliance them to reality.

All enumerated and considered above fundamental parameters-constants were used in analysis and reconsideration, from the point of view of the DM, of a series of known physical phenomena which by this time we have managed to complete. The latter will be the subject for the next series of the Selected Lectures that will be prepared and collected in Vol. 3.

References

[1] L. G. Kreidik and G. P. Shpenkov, *Alternative Picture of the World*, Volumes 1: *Mathematical Expression of the Main Categories of Philosophy and Logic, Kinematics and Dynamics of Exchange*; Geo. S., Bydgoszcz, 1996. 158 p.

[2] L. G. Kreidik and G. P. Shpenkov, *Alternative Picture of the World, Volumes 2: Structure of Space of the Universe, Electrostatic and Electromagnetic Fields, Particles and Exchange in the Electromagnetic Field*; Geo. S., Bydgoszcz, 1996. 164 p.

[3] L. G. Kreidik and G. P. Shpenkov, *Alternative Picture of the World, Volumes 3: Atomic Structure of Matter-Space-Time and Physical properties of Substance, Physics and Philosophy*; Geo. S., Bydgoszcz, 1997, 186 p. <http://shpenkov.com/alt.html>

[4] L/G. Kreidik and G.P. Shpenkov, *Foundations of Physics: 13.644 Collected Papers*, Geo. S., Bydgosz - Minsk, 1998, pages 258; <http://shpenkov.com/found.html>

[5] L. Simons, *Fundamental Interactions*, Chapter: “Atomic and Condensed Matter Physics” of the NuPECC report devoted to “Impact and Applications of Nuclear Science in Europe”, 21-23 November, 2001 Dourdan (France).

[6] L. Kreidik and G. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and ‘Electric’ Charge*, "Revista Ciencias Exatas e Naturais", Vol. 3, No 2, 157-170, (2001); <http://shpenkov.com/pdf/masscharge.pdf>

[7] L. Kreidik and G. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.; <http://shpenkov.com/atom.html>

Lecture 11

Fundamental Interactions: A Unified Description

1. Introduction

The *strong* interaction joins together nucleons in atoms; *electromagnetic* interaction binds atoms in molecules. The *weak* interaction is responsible for radioactive decay and transformation of atoms. Every day we are exposed *gravitation* and *electromagnetism*. These four types of interactions (or “forces”): *gravitational*, *electromagnetic*, *strong* (nuclear), and *weak* are conventionally regarded in physics as fundamental, which, in all likelihood, are not reducible to relations among particles by a more basic interaction. The strength of the interactions differs greatly in magnitude.

Modern physics describe every observed physical phenomenon by a theory that relates, mainly, to any one of the aforesaid fundamental interactions. However, all in Nature is harmonically interrelated and, hence, such a harmonic interrelationship exists between the corresponding physical force fields that must be reflected in an adequate generalized theory. Physicists, apparently, understand this. For this reason, they are attempting to create a unified theory in order to describe all aforesaid interactions, called fundamental, on a single theoretical base.

Thus, it is usually recognized that all fundamental forces eventually must be described in terms of a single field. However, beginning from Einstein, who unsuccessfully attempted to unify the general theory of relativity (gravitation) with electromagnetism, this problem has not been solved. A Unified Field Theory (UFT), sometimes referred to as a Uniform Field Theory, despite all the efforts is not able to solve this, just like the “Theory of Everything” and the Grand Unified Theory, which also unsuccessfully trying to find a solution.

From our point of view, as yet the *physical nature* of “different” interaction forces, as for example, gravitational, *remains incomprehensible* (undiscovered) by existing theories of modern physics based on the Standard Model (SM), the creation of a unified theory just on the basis of the SM to explain from a single position all kinds of interactions, including gravitational, is not a solvable task *in principle*.

According to the present understanding, all theories of the SM look today logically inconsistently, and to find among them a natural harmonic bond is impossible in principle.

The reason for this, as shown in Vol. 1 of the Lectures, lies in the *erroneous abstract-mathematical paradigm*, i.e., in the improper conceptual basis of these theories.

The way out of this situation can be only one – it is the creation of a new, in principle, consistent *physical* theory (model) based on *adequate* and *fairly reasonable axioms*. All appearances, such a consistent physical theory, developed in the last two decades, is the Wave Model. Why? The matter is that the WM has already proven its advantage transcending the SM in all respects. A main reason for such a breakthrough in physics is that the WM is based, as we already know from the Lectures, on a single postulate, which entirely reflects reality and, therefore, does not call doubts. This postulate ascertains the fact that all objects and phenomena in Nature have the wave nature.

Really, the oscillatory-wave processes are characteristic of the whole of Nature: from elementary particles and atoms to galaxies, from living cells to communities of organisms. With this a division of animate and inanimate nature is arbitrary, since there is no "inanimate". The oscillatory-wave processes play a prominent role in the neuro-psychological life of man, and even in the sphere of social phenomena, *etc.*

The Dynamic Model (DM) of elementary particles, a theory developed within the WM, along with Shell-Nodal Atomic Model have led us to the discovery of a unified equation, which makes it possible to describe the aforesaid fundamental interactions regarded in physics as fundamental, excepting weak, from a unified point of view (see L. 4 and 5).

This equation in the form, $F = \omega_{fund}^2 \frac{(zm)(Zm)}{4\pi\epsilon_0 r^2}$ ((12), L. 4), is one of the mathematical representations of the *Universal Law of Central Exchange*; where z and Z are relative masses of interacting objects, $\epsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$, m is the mass of a nucleon or an electron.

In this Lecture, we will show on concrete examples how this law, discovered thanks to the DM for the first time in physics, works in practice.

2. Basic equations and the data

Basing on the *unified approach*, developing in the DM [8], and the corresponding formula, there is the possibility to compare the “*strengths*” of the fundamental interactions distinguished in modern physics (excluding weak interactions), which is impossible to perform in the SM. For this, we have to take into account the fact that every particular type of the fundamental interactions (exchange) is defined by the corresponding *exchange charge* inherent in the given exchange (electromagnetic, gravitational, or strong).

According to the DM [8], the *universal law of central exchange* has the form

$$F = \frac{q_1 q_2}{4\pi\epsilon_0 r^2}, \quad (1)$$

where q_1 and q_2 are *exchange charges* having the dimensionality $g \times s^{-1}$, $\varepsilon_0 = 1 g \times cm^{-3}$ is the *absolute unit density*. The factor 4π in the denominator of (1) expresses the spherical character of the field of the central exchange [8].

The exchange charges q_1 and q_2 are defined in full agreement with the formula,

$$q = m\omega, \quad (2)$$

by the *associated masses* of interacting particles and the *fundamental frequencies*, on which they, as dynamic formations, perform exchange (interact) with an environment at the level of basis. Accordingly, taking into account (2), the *universal law of central exchange* (1) takes the following explicit (expanded) form,

$$F = \omega_{fund}^2 \frac{m_1 m_2}{4\pi \varepsilon_0 r^2}. \quad (3)$$

Here ω_{fund} is one of the fundamental frequencies of the basis level, ω_e or ω_g ; m_1 and m_2 are associated masses of interacting particles.

At the *atomic and subatomic levels*, the fundamental frequency of exchange is

$$\omega_e = \frac{e}{m_e} = 1.869162505 \times 10^{18} s^{-1}. \quad (4)$$

The *fundamental frequency of the gravitational level* ω_g is defined from the expression,

$$G = \frac{\omega_g^2}{4\pi \varepsilon_0}. \quad (5)$$

Eq. (5) is obtained in result of the comparison of the universal law of central exchange (3) with the particular case of this law – the Newton law of universal gravitation,

$$F = G \frac{m_1 m_2}{r^2}, \quad (6)$$

where $G = 6.67384 \times 10^{-8} cm^3 \times g^{-1} \times s^{-2}$ is the Newtonian constant of gravitation.

From (5) we find that the gravitational frequency has the following value,

$$\omega_g = \sqrt{4\pi \varepsilon_0 G} = 9.15783 \times 10^{-4} s^{-1}, \quad (7)$$

As the measure of interconnection of two particles of the mass m , at a distance r apart, one can serve the quantity presented in the form of the potential energy of mass exchange (taken from [2]),

$$E = -\omega^2 \frac{m^2}{8\pi\epsilon_0 r} = -\frac{q^2}{8\pi\epsilon_0 r}, \quad (8)$$

dependent on the exchange charges, $q = m\omega$. The frequency ω represents in this expression either frequency ω_e (4), for the case of strong and electromagnetic interactions, or ω_g (7), for the case of gravitational interactions. The mass m is equal to the associated mass of a nucleon m_n , for the strong and gravitational interactions; or to the associated electron mass m_e , for the case of electromagnetic interactions.

The electron exchange charge (the *minimal quantum of the rate of mass exchange*),

$$e = m_e \omega_e = 1.702691698 \times 10^{-9} \text{ g} \times \text{s}^{-1}, \quad (9)$$

responses for the strength of *electromagnetic interactions*, in particular, for interatomic bonds in molecules and crystals.

3. Estimations

After the substitution of all the necessary data into the formula (8), we arrive at the following value of the *electron binding energy*,

$$E_e = \frac{e^2}{8\pi\epsilon_0 \tilde{\lambda}_e} \approx 4.49 \text{ eV}, \quad (10)$$

where $\tilde{\lambda}_e = \frac{c}{\omega_e} = 1.603886538 \times 10^{-8} \text{ cm}$ is the fundamental wave radius, the characteristic distance in wave atomic spaces defined by the fundamental frequency of the subatomic level ω_e (4); $\epsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$ is the absolute unit density.

The resulting energy $E_e = 4.49 \text{ eV}$ predetermines the electron work function of solids. For instance, the electron work function is in the range of $4.25 \div 4.67 \text{ eV}$ for mono- and polycrystals of Al, B, Bi, W, Fe, Co, and Cu, [3, 4]. The value of energy (10) practically coincides with the dissociation energy of the molecules: H_2 (4.48 eV), HD (4.51 eV), HT (4.52 eV), and correlates also with the break energy of bindings in molecules and radicals. For instance, reactions $\text{H}_2\text{O} \rightarrow \text{H} + \text{OH}$ and $\text{N}_2\text{O} \rightarrow \text{NO} + \text{N}$ require the energy of 5.0 eV , $\text{NaOH} \rightarrow \text{Na} + \text{OH}$ requires 4.8 eV .

The binding energy (of the electron level) per mole of substance defines the characteristic dissociation energy of chemical bonds,

$$E_{d,mol} = \frac{e^2 N_A}{8\pi\epsilon_0 \tilde{\lambda}_e} = 433.121 \text{ kJ} \times \text{mol}^{-1} = 103.449 \text{ kcal} \times \text{mol}^{-1}, \quad (11)$$

where N_A is the Avogadro number. This value is consistent with the experimental data for the break energy of chemical bonds in CH_4 ($101 \text{ kcal} \times \text{mol}^{-1}$), C_2H_4 ($104 \text{ kcal} \times \text{mol}^{-1}$) [6], etc.

Obviously, the break energy must be approximately twice as much if two bonds are broken simultaneously. Actually, a breakdown of the O_2 molecule with two similar bonds requires about $179 \pm 17 \text{ kcal} \times \text{mol}^{-1}$.

The electron-binding energy at the distance of the Bohr radius r_0 is

$$E_e = \frac{e^2}{8\pi\epsilon_0 r_0} = 2.18 \times 10^{-11} \text{ erg} = 13.60 \text{ eV}. \quad (12)$$

This value coincides with the ionization energy of the electron in the hydrogen atom.

Strong (nuclear) interactions are defined by the *rate of mass exchange* (exchange charges) of *nucleons*. For example, let us take neutrons. The *exchange charge* of a neutron is

$$q_n = \omega_e m_n = 3.1307 \times 10^{-6} \text{ g} \times \text{s}^{-1}, \quad (13)$$

where $m_n = 1.674927351 \times 10^{-24} \text{ g}$ is the neutron mass. Hence, in the case of the *shell-nodal atomic model*, multicenter or molecule-like [7, 8], which originates from the WM (we will consider this atomic model later) and taking into account the DM of neutrons [1, 2], the energy of intraatomic internodal bindings between two separate neutrons (situated in two conjugated nodes of the same molecule-like atom), for example, of the length $r = 1.20 \cdot 10^{-8} \text{ cm}$, has the value,

$$E = \frac{q_n^2}{8\pi\epsilon_0 r} = 20.29 \text{ MeV}. \quad (14)$$

The rate of mass exchange of such a value provides the high stability of atomic structures, and is characteristic for strong (nuclear) interactions.

The resulting value correlates with the experimental data for the binding energy of a neutron in a carbon nucleus and with the threshold energy of (γ, n) reactions [5] equal to 18.7 MeV ; and it is close to the threshold energy 20.3 MeV of $(n, 2n)$ reactions [5] (p. 887), etc.

In accordance with the DM, elementary particles do not have the rest mass. The mass of the particles, as dynamic microobjects, has *associated* character [1, 2] and is defined by the formula,

$$m = \frac{4\pi r^3 \varepsilon_0}{1 + k_e^2 r^2}, \quad (15)$$

where r is the radius of the pulsating wave shell of a particle, $\varepsilon_0 = 1 \text{ g} \times \text{cm}^{-3}$, $k_e = \frac{2\pi}{\lambda} = \frac{\omega_e}{c}$.

If one assumes that the external and internal spaces of hydrogen atoms are delimited by the Bohr radius $r_0 = 0.52917721092 \times 10^{-8} \text{ cm}$, we obtain from (15) that the mass of the hydrogen atom $m_H = 1843.524607 m_e$.

The *rate of mass exchange* (or in other words *exchange charge*) responsible for internodal bindings between constituent nucleons (hydrogen atoms) in nodes of other atoms ($z \geq 2$) is then equal to

$$q_H = \omega_e m_H = 3.138953779 \times 10^{-6} \text{ g} \times \text{s}^{-1}. \quad (16)$$

The rate of mass exchange of such a value determines the high stability of atomic structures. Actually, the energy of interchange (interaction) of two separate hydrogen atoms (situated in two conjugated nodes of the same atom) being apart at the distance $r = 1.40 \times 10^{-8} \text{ cm}$ (that is the length of double bindings in graphite [8, Fig. 10, p. 295]), is equal to

$$E = \frac{q_H^2}{8\pi\varepsilon_0 r} = 17.478 \text{ MeV}. \quad (17)$$

This value correlates with the experimental data for the binding energy of neutron in a carbon nucleus and with the threshold energy of (γ, n) reactions [5] equal to 18.7 MeV . If we shall take the length $r = 1.31 \cdot 10^{-8} \text{ cm}$ quoted in [9], corresponding to the isolated double binding in $\text{C}=\text{C}=\text{C}$ and $\text{CH}_2=\text{C}=\text{O}$ structures, the resulting internodal energy of interaction of the constituent hydrogen atoms, namely 18.679 MeV (following from (17)) coincide essentially with the above threshold energy of (γ, n) reactions. Accepting $r = 1.15 \cdot 10^{-8} \text{ cm}$ we arrive at the energy $E = 21.4 \text{ MeV}$ that is close to the threshold energy 20.3 MeV of $(n, 2n)$ reactions in $^{12}_6\text{C}$ isotope [5] (p. 887), etc.

The energy of interchange (interaction) of two separate H-atoms situated in two conjugate nodes of the same atom being apart at $r = 1.45 \cdot 10^{-8} \text{ cm}$, is equal to 16.875 MeV . The taken distance r is the length of single binding between two internal nodes in the shell-nodal structure of the carbon atom [7, 8]. This distance is also equal to the averaged characteristic length of different bindings with participation of oxygen ($\text{S}-\text{O}$, $\text{C}-\text{O}$, $\text{N}-\text{O}$, $\text{B}-\text{O}$, etc. [9]). The obtained energy correlates with the experimental value for the binding energy of neutron in an oxygen nucleus and with the threshold energy of (γ, n) reactions in the nucleus, equal to $16.3 \pm 0.4 \text{ MeV}$ [5].

Exchange *gravitational charges* of H-atoms, to which we refer protons, neutrons and hydrogen atoms, defines the *strength of gravitational interactions*, which are realized on the fundamental frequency ω_g of the gravitational field (7). For the estimation, we take the average associated mass of H-atoms equal to the unified atomic mass unit (constant)

$$m_u = \frac{1}{12} m(^{12}\text{C}) = 1.6605389213 \times 10^{-24} \text{ g}. \quad (18)$$

We consider the H-atom of the mass m_u as the fundamental quantum of mass and, simultaneously, as the *fundamental graviton* with *gravitational charge* of exchange q_G equal to

$$q_G = m_u \omega_g = 1.52069419 \times 10^{-27} \text{ g} \times \text{s}^{-1}. \quad (19)$$

The energy of fundamental interactions (interchange) on every level (see, for example, (10) and (14)), originated from the universal law of exchange (1), is defined by the square of the exchange charges. In this connection, let the relative number measuring the energy (strength) of the *electromagnetic interaction* is about 1. Then, on this scale, the *strong interaction* has the order of

$$\frac{q_n^2}{e^2} = 3.4 \times 10^6, \quad (20)$$

and the *gravitation interaction* has the order of

$$\frac{q_G^2}{e^2} = 0.8 \times 10^{-36}. \quad (21)$$

Hence, the strengths of three fundamental interactions: *strong*, *electromagnetic*, and *gravitational*, relate approximately as

$$10^6 : 1 : 10^{-36}, \quad (22)$$

overlapping the range of 42 decimal orders in magnitude.

We would like at the end to stress once more that the unified estimation demonstrated here for the strengths of three fundamental interactions is based on a single theoretical concept of exchange interaction covered by the *universal law of central exchange* (3).

4. Conclusion

Recognition of the *wave nature* of all phenomena and objects in the Universe has requested the development of an adequate physical theory of elementary particles, corresponding to such a wave nature. As a result of the efforts undertaken in this direction, a

new theory called the Dynamic Model (DM) of elementary particles was created. Main features of the DM were consistently considered in all eleven Lectures.

In conclusion to this Lecture, the last in this series (Vol. 2), it makes sense to remind the following. According to the DM an existence and interactions of the particles are, in essence, a continuous process of the wave *exchange* of matter-space and motion-rest or, for brevity, *exchange of matter-space-time*.

The notion *exchange* used in the DM, instead of the notion *interaction*, reflects the behavior of elementary particles in their dynamic equilibrium with the ambient field, at rest and motion, and interactions with other objects (and particles themselves). In other words, the notion *exchange* (first introduced in the work [10]) is more correct and appropriate from the point of view of the physics of complex behavior of elementary particles regarded in the DM as the wave dynamic (pulsating) microobjects, belonging to one of the interrelated levels of the many-level Universe.

The notion of *rest mass* is not appropriate in principle for elementary particles, considered in the DM as dynamic formations. The *associated nature of mass* of the particles, as the field mass of the central wave exchange, naturally originates from the model. Being confident that the DM, in general approach, reflects the structure of elementary particles quite correctly, we should agree with its outcome that the rest mass of the particles actually does not exist.

The *power of mass exchange*, i.e., the rate of exchange of mass, defines the *exchange charge* or simply the charge of elementary particles. An analogue of the exchange charge of the DM is the “*electric*” charge in contemporary physics.

The correctness of the DM is reinforced by the fact that from this theory it naturally and logically originates the following important findings.

- 1) The *fundamental law of central exchange* $F = \omega_{fund}^2 \frac{m_1 m_2}{4\pi \epsilon_0 r^2}$ (3) (of the Coulomb

kind), which *unifies the fundamental interactions* distinguished in contemporary physics as electromagnetic, gravitational, and nuclear.

- 2) The formula of *dynamic energy of mass exchange* of the subatomic level $E = mc^2$ ((8), L. 9).

- 3) The *fundamental frequency of exchange*, $\omega_e = \frac{e}{m_e} = 1.869162505 \times 10^{18} s^{-1}$ (4), at atomic and subatomic levels, i.e., the frequency of the field regarded heretofore in contemporary physics as “electrostatic”.

- 4) The *fundamental wave radius* ($\lambda_e = \frac{c}{\omega_e} = 1.603886538 \times 10^{-8} cm$), defining the average distance, $a = 2\lambda_e$, in ordered material structures (the lattice constant, or lattice

parameter, refers to the constant distance between unit cells in a crystal lattice) of about $3.2 \times 10^{-8} \text{ cm}$ (3.2 \AA).

5) The *fundamental gravitational frequency* $\omega_g = \sqrt{4\pi\epsilon_0 G} = 9.15783 \times 10^{-4} \text{ s}^{-1}$ (7) and the *wave gravitational radius* of elementary particles $\tilde{\lambda}_g$ (6.4).

6) The *energy of interchange* in atoms (“nuclear forces”); *etc.*

Plentiful results obtained in the DM, including enumerated above, have revealed a series of the unknown earlier fundamental regularities in Nature. It is not surprising, therefore, that it became possible now the description of the fundamental interactions, including gravitational, on the basis of a single theoretical concept.

During the last three decades, physicists-theorists all over the world adamantly trying to develop the String Models in order to replace the SM dominating currently in physics. But all their efforts, generally, are unsuccessful, as might be expected. We have considered this question in the first Lectures of Vol. 1.

The DM basically differs not only from the SM but also from String Models, because it is based on the theoretical physics paradigm adequate to reality, unlike standard and string models. According to the DM, elementary particles are *finite-infinite* in size. A spherical wave shell pulsating with the exafrequency ω_e defines the *finite size* of the particles. The fundamental frequency ω_e is responsible for the interaction of particles at the micro level (atomic and subatomic).

The *infinite size* of particles has no boundary, but it includes a far remote zone, a spherical wave shell, pulsating with the fundamental frequency ω_g . This shell divides the oscillatory domain from the wave domain 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*. This means that *wave fields of all particles (and, hence, all objects) in the Universe are overlapped*.

Gravitational fields, just like electromagnetic, are *longitudinal-transversal* wave fields. Both above fields are subjected to the *Universal Law of Exchange*, discovered in the framework of the DM also. Analytical formulas of fundamental (carrier) frequencies of the fields, ω_e and ω_g , were unknown earlier. They gave us the opportunity to calculate with a high accuracy the numerical values of these frequencies, (4) and (7).

The existence of gravitational frequency ω_g and gravitational wave radius $\tilde{\lambda}_g$ of elementary particles, along with fundamental frequency ω_e and fundamental wave radius $\tilde{\lambda}_e$ of the subatomic level, shows an indissoluble harmonic bond of micro and mega objects of the Universe in the unit complex of the Infinitely Small and Infinitely Big.

We hope that the data obtained within the DM and presented in these Lectures will stimulate the corresponding theoretical research everywhere. We mean the future studies on the new conceptual basis that we use in our research now and which showed its advantage in the theories of the WM, including the DM. It is necessary also to continue the reconsideration of established obscure (and erroneous) dogmatic statements accumulated in all domains of physics, including high energy physics, elementary particles physics, *etc.*, started on the new basis first in the works enumerated in the references.

References

- [1] L. Kreidik and G. Shpenkov, *Dynamic Model of Elementary Particles and the Nature of Mass and 'Electric' Charge*, "Revista Ciencias Exatas e Naturais", Vol. 3, No 2, 157-170 (2001); <http://shpenkov.com/pdf/masscharge.pdf>
- [2] L. Kreidik and G. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p.
- [3] P. Babichev, et al., *Physical Quantities*, Reference Book, Atomenergoizdat, Moscow, 1991, Table 23.1, p. 568, (in Russian).
- [4] H. B. Michelson, *The work function of the elements and its periodicity*, J. Appl. Phys., 48, 4729-4733 (1977).
- [5] *Tables of Physical Quantities*, Reference Book (in Russian), Edited by I.K. Kikoin, M., Atomizdat, 1976, pp. 891-892.
- [6] V.I. Vedeneev, et al., *The Chemical Bond Brake Energy* (in Russian), Moscow, 1962; A.P. Babichev, et al., *Physical Quantities*, Reference Book, Atomenergoizdat, Moscow, 1991.
- [7] G. P. Shpenkov, *An Elucidation of the Nature of the Periodic Law*, Chapter 7 in "*The Mathematics of the Periodic Table*", edited by Rouvray D. H. and King R. B., NOVA SCIENCE PUBLISHERS, NY, 119-160, 2006.
- [8] G. P. Shpenkov, *Physics and Chemistry of Carbon in the Light of Shell-Nodal Atomic Model*, Chapter 12 in "*Quantum Frontiers of Atoms and Molecules*", edited by Putz M. V., NOVA SCIENCE PUBLISHERS, New York, 277-323, 2011 (pdf).
- [9] A. J. Gordon and R. A. Ford, *The Chemist's Companion: A Handbook of Practical Data, Techniques and References*, Wiley-Interscience, New York, 1972.
- [10] L. G. Kreidik and G. P. Shpenkov, *Alternative Picture of the World*, Vol. 1-3; Geo. S., Bydgoszcz, 1996. p. 158, 164, and 186; <http://shpenkov.com/alt.html>