DIALECTICAL VIEW OF THE WORLD

The Wave Model
(Selected Lectures)

George P. Shpenkov

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Contents

Lecture 1

Dialectical Aspects of Measures in Physics

1. Introduction

Numerous discoveries of the Dynamic Model are a real breakthrough. They put an end to the existing stagnation in physics. New discoveries favored the revision of other established tenets in all branches of modern physics, whose theories still strictly adhere to the Standard Model. The undertaken revision touched inevitably the modern *system of units*.

Strange unreal dimensionalities of physical quantities, characterized actually by *fractional powers* of objective units of matter (*kg*) and space (*m*), are the basis of International System of Units (SI). They have obtained its origin due to the *erroneous dimensionality* of electric charges, $g^{1/2} \cdot cm^{3/2} \cdot s^{-1}$, originated from Coulomb's law.

In order to cover up these absurdities, such a "dimensionality" has been tacitly hidden in the SI units under the name of *coulomb*. It should be recalled that the system of units SI was built to substitute the CGS systems, CGSE and CGSM, contained fractional dimensionalities. Thus, the CGSE unit of charge, CGSE_q, of the dimensionality with *fractional powers* of objective units of *matter* and *space* ($g^{1/2}$ and $cm^{3/2}$) was replaced by the new unit, *coulomb*, having the integer dimensionality (the exponent at the unit is equal to 1, $coulomb \equiv coulomb^1$). Thus, in fact, the following transformation, declared by the creators of the SI as the "*rationalisation*", was made in result,

$$g^{1/2} \cdot cm^{3/2} \cdot s^{-1} \quad \Rightarrow \quad coulomb$$

Obviously, this fact covered up, but not solved, the problem of fractional powers and, hence, cognition of the nature of electric charges has been postponed indefinitely. It is clear that it is impossible to understand the nature of charges, which have the dimensionality in $g^{1/2} \cdot cm^{3/2} \cdot s^{-1}$ or in *coulombs*. The fully formed resulting state with aforesaid erroneous measures has impacted the dimensionalities of all physical quantities of electromagnetism and, finally, the dimensionalities of all other physical quantities in all branches of physics since they are related with electric charges in a varying degree.

We have began turning to this problem first in Lecture 3 of Vol. 2 in connection with the *discovery* of the *true dimensionality of electric charges*, $g \cdot s^{-1}$, and, hence, due to revealing *their true nature*. That physical quantity, what is hidden under the name the *electric charge*, has proven the *fundamental parameter of exchange* (interaction) of elementary particles, namely, it is the parameter characterizing the *rate of their mass exchange*.

The given discovery gave the possibility to correct erroneous dimensionalities of all physical quantities accepted in physics. Thus, in the light of the discoveries arising from the DM, the time has come when the modern system of units, SI, must be removed from physics and substituted with a new one based on the aforesaid revelations. Just to this matter, we devote the first five Lectures of this cycle.

The physical metrics presents by itself the notes of natural science (just as the notes in music). Ignorance of the essence of measures-notes in natural science (in particular, in electrodynamics) forms a formal knowledge, which hinders the development of physics making it impossible the cognition of many phenomena of nature.

Historically, *kinematic* and *dynamic* metrics were constructed, mainly, on the basis of mechanics with basic measures of *mass M*, *length L*, and *time T*. Unfortunately, since then, these measures became to be regarded only as the *mechanical measures*, but not as the *main (basic) measures-notes*, reflecting the *fundamental sides of the Universe*. Such philosophy deeply took roots in contemporary science, although, all known systems of measures in physics are just variations of the same fundamental triad of *M*, *L,* and *T*.

Further, owing to a wide variety of measures, the definite opinion, that units *M*, *L*, and *T* have an arbitrary character (can be any in value), has been fully formed. It happened also because nobody undertook for long time a deep analysis of the metrology of Earth's nations, and only beginning from 1996 the authors of the book "*Alternative Picture of the World*" [1] did it at last.

Their analysis showed that a variety of measures of nations is subordinated to strict regularities of *necessity-chance*. And in this contradictory pair, the *chance is secondary*: it is only a dust on the way of the historical born of predetermined "*magic*" (*reference*) units (measures) – the gram *g*, the centimetre *cm*, and the second *s*. We will uncover their "magic" feature further. These units are a result of the *necessary* world process.

One may express the following supposition, which is verified over all data contained in the authors' first three books [1-3]. In shoreless spaces of the Universe, where life, like the Earth, exists, people obligatory choose, as basic, the "*magic*" measures (*g, cm, s*) or their decimal parts and decimal powers; because just these measures have the ecumenical character and are formed do not following people's will, as it is usual to assume. Reference (basic) units are the *universal quanta of the Universe*. Believers of a mechanical picture of probabilistic chaos, developed on the basis of formal logic, do not understand it and for this reason their picture of the World has nothing in common with reality [4].

2. Presentations of physical quantities

Principal interrelated sides of a system, like any object of thought, are its *basis* and *superstructure*. This indissoluble pair expresses the general feature of investigated objects. *Basis* is the foundation on which the *superstructure* rests upon (or towers above).

Thus, the *basis* and the *superstructure* are highly spacious notions of dialectics. Indeed, any structures of nature and human society have always their own basis, which, figuratively speaking, is the foundation of an arbitrary "structural building", and own superstructure being (in this sense) a part of the "building", leaning on the foundation.

It is difficult to give an exact definition of the *basis* and the *superstructure*, because they are extremely extensive notions. For example, the basis of a man is his body, whereas his mind represents the superstructure. Or, the part of a complex system, dirigible by complicated controlling devices, relates to the basis, while the controlling devices themselves constitute the superstructure of the system, *etc*.

It should be noted that the *superstructure* is, usually, the principal element of a system, which leans upon the *basis*. In any State, governmental institutes represent the highest level of the *superstructure*; its effectiveness defines the degree of development of the State.

A physical quantity is a system of its *basis* (***B***) and *superstructure* (***S***). The *basis* of a physical quantity is its *quantitative-qualitative measure;* the *superstructure* is *a system of its signs of quality*.

Total knowledge about a simple physical quantity, as an elementary *informational system of units*, can be depicted, for example, in the form of the simplest graph presented in Fig. 1.

A scalar physical quantity F is usually presented in the following forms:

1. The *abstract-abstract* form: $F = Q\ \ M^k \cdot L^l \cdot T^m$.
2. The *abstract-concrete* form: $F = Q\ \ g^k \cdot cm^l \cdot s^m$.
3. The *concrete-concrete* form: $F = \#\ \ g^k \cdot cm^l \cdot s^m$.

Vector quantities $\boldsymbol{F}$ have the analogous form.

Before appearing of electrodynamics, derivative (compound) measures were presented through the product of basis measures to the integer powers. They fall into two classes of *kinematic* and *dynamic* measures.

The *kinematic class* is defined by the measures,

$$K = Q_K \cdot L^l \cdot T^m, \tag{1}$$

where Q_K is the *quantitative* value of a kinematic measure K; l and m are integers.

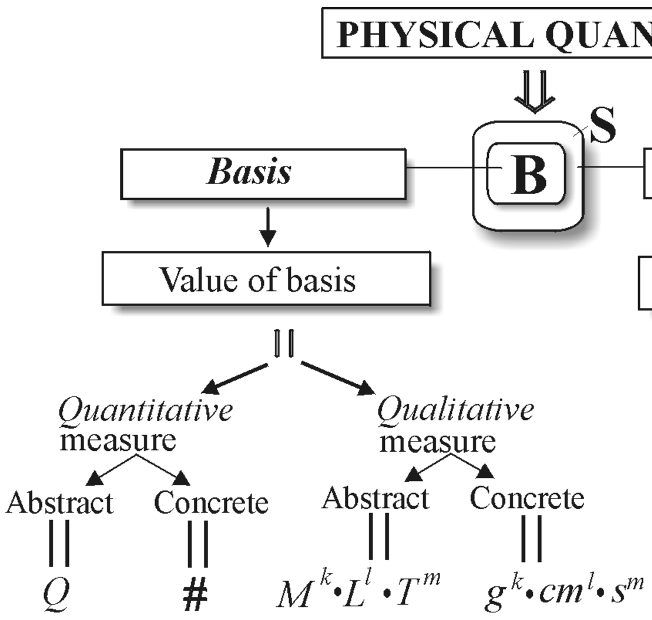

Fig. 1. A graph of a simple physical quantity. A physical quantity is a system of basis ***B*** (a core of a measure) and superstructure ***S*** (a shell of a measure).

The *dynamic class* constitutes measures of the following form,

$$D = Q_D \cdot \varepsilon_0 \cdot L^l \cdot T^m, \tag{2}$$

where $\varepsilon_0 = 1\, g \times cm^{-3}$ or, in a general case, $\varepsilon_0 = \frac{M}{L^3}$. Q_D is the quantitative value of a dynamic measure D.

Sometimes there is the necessity to operate with the quantity inverse to ε_0, *i.e.*,

$$\mu_0 = \frac{1}{\varepsilon_0} = 1\, cm^3 \times g^{-1}. \tag{3}$$

Formulas of dimensionalities were first introduced by a French mathematician J.B.J. Fourier (1768-1830) in his analytical heat theory. These formulas, marked the beginning of metrology in physics, have obtained the further development in the works of Maxwell and other physicists of the 19th and 20th centuries.

As shows the dialectical analysis of measures, every physical quantity, expressing some physical quality, is defined by the measure on the basis of reference measures with the dimensionality inherent only to this quality.

All measures of the same dimensionality define the *class of qualitatively similar physical quantities*, related to one many-sided physical property of the same nature. Such a class, we designate by the symbol $D(k,l,m)$, where k, l, and m are, correspondingly, the powers of measures of mass *g*, length *cm*, and time *s*. The measures of various *D*-classes are uniquely defined and connected by three numbers (exponents) *k*, *l*, and *m*.

One may speak also about classes of a *quantitative similarity*, but we do not consider them here because it does not essential matter.

During development of electrodynamics, the *confusion* with notions of *magnetic* and *electric quantities* has occurred. It happened because physically *different* notions A_E and A_H quite often have obtained the *same* name:

$$nomA_E = nomA_H = A, \tag{4}$$

where *nom* is the symbol of a name of a physical quantity.

Obviously, these notions, being different, must have different names:

$$nomA_E = B_E, \qquad nomA_H = B_H. \tag{5}$$

An absurd situation, arose as a result, is defined by the following formula,

$$(nomA_E \neq nomA_H)_{obj} \wedge (nomA_E = nomA_H)_{subj}. \tag{6}$$

This formula expresses a case, when *objectively different* (marked by the subscript *obj*) notions, $nomA_E \neq nomA_H$, *subjectively* (marked by the subscript *subj*) *were equated*, $nomA_E = nomA_H$.

Different notions, *i.e.*, notions belonging to different *D*-classes (if there are not theoretical errors, what about we will make sure in the following consideration), are characterized by measures of different dimensionality:

$$(nomA_E \neq nomA_H) \qquad \Leftrightarrow \qquad (\dim A_E \neq \dim A_H), \tag{7}$$

where

$$\dim A_E = M^k \cdot L^l \cdot T^m, \qquad \dim A_H = M^p \cdot L^q \cdot T^r. \tag{8}$$

If two parameters, A_E and A_H, reflecting different sides of a physical process are called with the same name, then, the incorrect conclusion arises in result:

$$(nomA_E = nomA_H)_{subj} \qquad \Rightarrow \qquad (\dim A_E \neq \dim A_H)_{obj}. \tag{9}$$

It means that "*the same (subjectively) physical magnitude can have different dimensionality in various systems*". Different dimensionalities are the objective fact. However, they actually represent different physical magnitudes, which *subjectively* were claimed as identical. These reasoning concerns, in particular, two different notions: *electric current* and *circulation* considered in detail in Lectures 8 and 9 of Vol. 3.

Some physicists of the 19th century have understood this absurdity. As Hertz noted, faults of electrodynamics are very difficult to eliminate. Therefore, he added, it is necessary to rest upon a series of premises, accepting them as true. Of course, Hertz has regarded such a status quo in electrodynamics as temporary.

Poincaré has written that Maxwell has constructed his theory by means of "*sleight of finger*". He had in mind the logical conditionality of Maxwell's theory. It did not cost anything for Maxwell to exclude any term in his constructions, to replace an unsuitable sign in an expression by the inverse one, to substitute a meaning and designation of some letter, *etc*. Maxwell's free method has generated a confusion of notions. By virtue of this many began to assume that "the same physical magnitude can have different dimensionalities in various systems of units" and they have tried to substantiate similar statements using erroneous examples. On this basis, they have concluded that dimensionality of the same physical magnitude has a conditional character.

Formal logic promoted such the mixture of notions. It was unable on the basis of "plane" judgements either only *Yes* or only *No* to distinguish many-sidedness of properties of different objects and phenomena, which in themselves are usually complicated. It concerns properties of the second and third order of distinctions, *i.e*., fine but essential differences.

As a result, different properties with different dimensionalities were called by metaphysics with the same name that generated a myth about a different dimensionality of "*the same magnitude in different systems of units*" (here and further, the quotes emphasize such erroneous judgements, defined by the formula (4)).

Planck has asserted that dimensionality is not a property, connected with an essence, but it represents merely some conditionality, defined by a choice of a system of measures

The polar point of view has held Sommerfeld. He has openly written: "We do not hold Planck's view according to which a question about the real dimensionality of a physical quantity is deprived a sense".

Formal logic is also disposed to another extreme, when the same object of thought obtains different names since its properties are some changed in different physical processes. One can say that Formalism regards an object in different states as different objects and gives them different names:

$$(nomA_1 = nomA_2 = nomA_3 = ...)_{obj} \qquad \Rightarrow \qquad (nomA_1 \neq nomA_2 \neq nomA_3 \neq ...)_{subj}, \quad (10)$$

where 1, 2, 3, … are subscripts indicating different states of the same object A; the subscript *obj* means the objectivity of this fact, *subj* – the subjectivity of names.

As an example of such an extreme, it can serve the notions of "*hydrogen atom*", "*proton*", and "*neutron*". Soddy noted in his time that the term "*proton*" is incorrect because a proton is the *hydrogen ion* and nothing more. It should be added to this that "*neutron*" is also a *hydrogen atom*; therefore, the aforementioned triad of particles should be joined together and be called with one name: "*hydrogen atoms*" or briefly H-atoms. In such a case, under different transformations and atomic (nuclear) disintegrations, not only ionized atoms of helium, but also *H*-atoms are emitted. From this point of view, the very unpleasant questions arise to the *proton-neutron* atomic model.

Truth turns out first of all in a concrete analysis; therefore, it makes sense at the first stage to consider a series of pairs of notions and the correlation between them. At the second stage, it is necessary to analyse their measures and, in conclusion, to demonstrate their true physical sense in an example of the spherical field of matter-space-time.

3. Basis and superstructure of physical quantities

A quantitative-qualitative facet of the wave triad of matter-space-time is the *physical quantitative-qualitative field-space* $\hat{\mathfrak{R}}$. This is the field-space of zero dimensionality, localized in the physical space of the Universe and, at the same time, being beyond it. This *ideal field-space* induces, in the ideal space of thought, the numerical field $\hat{\boldsymbol{D}}$, which is the field of measures of dialectical judgements.

Any number *Z* of the $\hat{\boldsymbol{D}}$-field is the system of its basis *B* and superstructure $\{S\}$:

$$Z = B^{\{S\}}\,. \qquad (11)$$

When it is necessary to note that *B* is the basis of the number *Z*, we write $B = bas(Z)$.

The superstructure (or *adbasis* in Greek-Latin) $\{S\}$ represents any quantitative, or quantitative-qualitative, symbols characterizing the number *Z* with its basis. The symbols can be before, after, above, and under the basis. The basis is a *core* and the superstructure is an *envelope* of the number.

The main symbols of superstructure are "+", "–", exponents, indexes, *log, ln*, ...

We express the superstructure $\{S\}$ of number *Z* with basis *B* by the following equality,

$$\{S\} = ad_B(Z) \qquad \text{or} \qquad \{S\} = \sup{}_B(Z)\,. \qquad (12)$$

If adbasis $\{S\}$ is an exponent *m* of number *Z* with basis *B*, *i.e.*, $Z = B^m$, then the number *Z* is an exponential structure with basis *B* and superstructure *m*:

$$Z = \exp_B(m)\,, \qquad m = ad_B(Z)\,, \qquad \text{or} \qquad m = \log_B Z\,. \qquad (13)$$

In the simplest case, the basis of number *Z* is a measure *Yes* or *No*. Multiplicative algebra of such basis is expressed in dialectics by the following qualitative equalities:

$$Yes \cdot Yes = Yes\,, \quad No \cdot No = Yes\,, \quad Yes \cdot No = No\,, \quad No \cdot Yes = No\,. \tag{14}$$

Multiplicative algebra of the signs of superstructure, “+” and “–“:

$$(\pm)\cdot(\pm) = +\,, \qquad (\pm)\cdot(\mp) = -\,, \tag{15}$$

is the *algebra of affirmation*. Therefore, such signs “+” and “–“ are the signs of the affirmative feature, or briefly *Yes*.

According to dialectical logic, if algebra of the signs of superstructure *Yes* (15) exists, then the algebra of signs of superstructure *No* (the *algebra of negation*), symmetrical and opposite to the algebra (15), must be as well:

$$(\mp)\cdot(\mp) = -\,, \qquad (\mp)\cdot(\pm) = +\,. \tag{16}$$

The algebra of signs of *affirmation* is inherent in *electric interactions*: the interaction of charges of the same sign defines repulsion and the interaction of charges of the opposite signs defines their attraction.

On the contrary, the algebra of signs of *negation* describes *magnetic interactions of currents*: the interaction of currents of the same sign (direction) defines attraction and the opposite currents their repulsion. Of course, a choice of the signs of results of interaction is relative, to some extent, but the polar opposition of the algebras, which describe interactions of charges and currents, is absolute.

4. Periods-quanta of the wave numerical field

Euler’s formula $e^{i\varphi} = \cos\varphi + i\sin\varphi$ is valid for numbers of the $\hat{\boldsymbol{D}}$-field. Therefore, a number of affirmation-negation with *any* basis *B* (including the basis *e* of the natural logarithm): *binary*, *octal*, *decimal*, *etc*. is presented in the following general form,

$$\hat{Z} = r\exp_B(i\varphi) \tag{17}$$

or

$$\hat{Z} = rB^{i\varphi} = re^{\ln B\cdot i\varphi} = r(\cos(\ln B\cdot\varphi) + i\sin(\ln B\cdot\varphi))\,. \tag{18}$$

The condition of periodicity, $\ln B\cdot\varphi = 2\pi m$, where m is an integer unequal to zero, defines the fundamental period-quantum of a number with basis *B*:

$$\Delta = 2\pi\log_B e\,. \tag{19}$$

Under the condition $\varphi = \frac{t}{e_t}$, where e_t is the unit of a variable parameter t, the number (18) becomes a local number-wave. Introducing the designation $\omega = \frac{1}{e_t}$, we can present the wave in the following way:

$$\hat{Z} = rB^{i\omega t} = re^{\ln B \cdot i\omega t} = r(\cos(\ln B \cdot \omega t) + i\sin(\ln B \cdot \omega t)) . \qquad (20)$$

Local numbers-waves with the basis B are characterized by the relative Δ and absolute Δ_t periods-quanta:

$$\Delta = \frac{\Delta_t}{e_t} = 2\pi \log_B(e) , \qquad \Delta_t = 2\pi \log_B(e) \cdot e_t . \qquad (21)$$

A nonlocal (travelling) wave-beam with the basis B has the following structure

$$\hat{Z} = rB^{i(\omega t - ks)} = r(\cos(\ln B \cdot (\omega t - ks)) + i\sin(\ln B \cdot (\omega t - ks))) \qquad (22)$$

or

$$\hat{Z} = re^{\ln B \cdot i(\omega t - ks)} = \hat{r}(\cos(\ln B \cdot \omega t) + i\sin(\ln B \cdot \omega t)) , \qquad (23)$$

where $k = \frac{2\pi}{\lambda} = \frac{1}{ƛ}$ is the wave number along the beam s in some space $\hat{P}$, and $\hat{r} = re^{-i\ln B \cdot ks}$ is the modulus of number-wave.

Obviously, in $\hat{P}$-space along the beam s, the following relative and absolute, s_Δ and $s_{ƛ}$, spatial periods-quanta characterize the wave-beam s:

$$s_\Delta = 2\pi \log_B e = \Delta , \qquad s_{ƛ} = \Delta \cdot ƛ . \qquad (24)$$

The *periods-quanta* (24) of the wave numerical field $\hat{\boldsymbol{D}}$ are inseparably linked with the qualitative reference units of: the *gram*, the *centimetre*, and the *second*. We will consider them in the next Lecture. The periods-quanta and the triad of reference measures represent by themselves the two facets of a single process in the Universe.

5. The Law of the Decimal Base

Dialectics regards the World as the Material-Ideal Formation. Ideal processes occur in the informational material-ideal dialectical fields submitting to the quantitative-qualitative Code of the Universe.

A material facet of the Universe is described on the basis of physical laws, which we term the *first kind laws*. The laws reflecting an ideal side of the Universe, related to the non-physical laws, should be called the *second kind laws*.

There are the arguments to assume that the numerical wave field of affirmation-negation, with some *fundamental basis B* and *period* $2\pi\log_B e$, is one of the elementary levels of the informational field of the ideal facet of the Universe, expressed by the second kind laws.

The structure of human hands prompts the choice of the *fundamental basis B*, which was accepted by man to be *equal to ten*. The *fundamental periods-quanta* of fields of decimal basis, relative and absolute, will be equal, correspondingly, to

$$\Delta = 2\pi \lg e, \qquad\qquad \Delta = 2\pi \lg e \cdot e_t. \tag{25}$$

Here, e_t is the unit of a physical quantity, defined on the basis of the decimal base, $e_t = 10^{\pm n} \cdot e_M$, where *n* is a natural number and e_M is the basic unit measure of the physical quantity, built on the basis of reference units.

The fundamental quantum (25) defines the quantum-period of half-wave (the wave half-period – half-quantum)

$$\frac{1}{2}\Delta = \pi \lg e \cdot e_t \approx 1.3644 \cdot e_t. \tag{26}$$

The reference measures are closely related with the perception of the World by man, which follows the *Decimal Base Law*. This law and its fundamental period relate to the second kind laws.

If an interval of possible random scattering of a measure is taken and divided into *sixteen* equal intervals (*metameasures*), then nature most often selects the left or right tenth metameasure. Let us call the left tenth metameasure, the *subdominant*, and the right one, the *dominant*. When the interval is divided into eight metameasures, then the third metameasure represents the subdominant and the fifth metameasure – the dominant.

The choice of dominants and subdominants occurs unconsciously. This phenomenon was noticed long ago. In art, a similar selection of measures was called the *Golden Section Law*, which is formally (conventionally) regarded as an irrational ratio. In fact, under the name of the golden section law is hidden the *Law of Decimal Base*. At that, when the dominant selects the fundamental half-period, a length of the interval quite often is equal to $1.6\pi \lg e$. This exhibits itself, for example, in the appearance of books. The size (by height) of most Russian book covers is equal to the great span with the canonical measure,

$$L = \frac{8}{5}\pi \lg e\ dm \approx 21.83\ cm. \tag{27}$$

Usually, the fifth metameasure distinguishes book titles.

We will look further how the fundamental measures of matter, space and time have been formed. Continuation of our consideration we will begin in the next Lecture from the measures of mass.

6. Conclusion

Logical and philosophical aspects of a system of physical measures were considered here. The main peculiarity of any system, *i.e.*, any object of thought, is its binary structure. We mean the general feature of any investigated object, including a physical quantity, to have two naturally inherent facets: the *basis* and the *superstructure*. The basis is the foundation on which the superstructure rests upon.

Thus, a physical quantity is a system of its *basis* and *superstructure*. The *basis* of a physical quantity is its *quantitative-qualitative* measure*; the superstructure is a system* of its *signs of quality*.

Physical quantities are usually presented in *abstract-abstract*, *abstract-concrete*, and *concrete-concrete* forms. Moreover, all measures are divided into two classes: the class of *kinematic* measures and the class of *dynamic* measures.

Every physical quantity, expressing some physical quality, is defined by the measure on the basis of *reference measures* with the dimensionality inherent only to this quality. All measures of the same dimensionality define the class of qualitatively similar physical quantities, related to one many-sided physical property of the same nature.

According to dialectical physics, an ideal side of the Universe follows the *Laws of the Second Kind*. The numerical wave field of affirmation-negation, with some *fundamental basis B* and the *period* $2\pi\log_B e$, is one of the elementary levels of the informational field related to the *ideal* facet of the Universe.

The periods-quanta of the wave numerical field $\hat{\boldsymbol{D}}$ are inseparably linked with the qualitative reference units of matter, space, and time. In the case of the *decimal base*, the reference units are the *gram*, the *centimetre*, and the *second*. Why do such values? We will show this further. The periods and the triad of reference measures represent by themselves the two facets of a single process in the Universe.

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Lecture 2

A Triad of Basic Reference Measures

1. Introduction

The World is a complicated contradictory system-totality with an infinite series of mutually intersected material-ideal levels of *matter*, *space*, and *time* (matter-space-time for brevity). Life and Reason on Earth are the manifestation of one of the World's material-ideal levels with its own history, a part of which occurs on Earth.

The wave *triad of matter-space-time,* as a qualitative system, led to the formation of the *triad of reference qualitative measures*, which are represented by the *gram* (*g*), the *centimetre* (*cm*), and the *second* (*s*).

It would seem that one can accept in the capacity of the *reference triad* any units of *mass, length,* and *time*. Formally yes, we can, but as we will show below, just the above mentioned *unit measures* (*g*, *cm*, *s*) and their decimal multiples were accepted. They have the fundamental "magic" feature being the *ideal quanta* of the Universe [1-3]. Submitting to the Decimal Code of the Universe*, i.e.*, to the Universal harmony, these *three basic reference measures* (periods-quanta) penetrated in our lives everywhere intuitively independently of consciousness of the people. Let us show this.

2. The gram (*g*)

A formation of folk measures of *mass* and *volume* rests on comparison of masses and volumes of liquid and free-flowing substances. Nature compelled people to compare the mass and volume of water with other substances. In the epoch of initial land cultivation, water (wine as well as beer) and grain were the main factors determining ancient natural measures.

Water generated the formula, which relates mass and volume,

$$M = \varepsilon_0 V_0 = \varepsilon_0 \varepsilon V \,, \qquad (1)$$

where M is the mass of water equal to the mass of a substance; V_0 is the volume of the water; V is the volume of the substance; $\varepsilon_0\varepsilon$ is the volumetric density of the substance, ε_0 is the absolute volumetric density of water and $\varepsilon = \frac{V_0}{V}$ is the relative volumetric density of substance.

A comparison of water and other substances, in mass and volume, generated the relative volumetric density ε *and permeability* $\mu = \frac{1}{\varepsilon}$ ***independent of the concrete choice of units of mass and volume***. Consequently, most people on Earth, comparing the liquid and grain, have ***created, independently of each other, the equal (rational) multiple measures***.

The research of cereals allow asserting: mean values of the volumetric relative permeability μ of grain were approximately equal to the fundamental half-period $\frac{1}{2}\Delta$:

$$\mu = \pi \lg e = 1.364376354 \approx 1.3644 . \tag{2}$$

Accordingly, the relative volumetric density was

$$\varepsilon = \frac{1}{\mu} = 0.732935599 \approx 0.73 . \tag{3}$$

Hence, the relations between the mass of grain M and its volume V are as follows:

$$V = 1.3644\mu_0 M , \qquad M = 0.7329\varepsilon_0 V . \tag{4}$$

If we will assume that $\varepsilon_0 = 1\, g \times cm^{-3}$, then

$$V = 1.3644\, cm^3 g^{-1} M , \qquad M = 0.7329\, gcm^{-3} V . \tag{5}$$

From this point of view, let us analyze some of the Old English measures, taking into account that the volumetric density of cereals in England was within $\varepsilon_0\varepsilon \approx 0.73 - 0.79\; kg \times l^{-1}$. With the volumetric density equal to $0.75\, kg \times l^{-1}$, the Old English *bushel of free-flowing substances*, defined the *unit of mass of one bushel*, was equal to $1\, bu_m \approx 27.28\, kg \approx 10^4 \Delta\, g$. A tenth part of this unit is equal to the fundamental measure, which was at the base of Oriental measures.

Through liquids (water, wine, and beer), the bushel of mass formed an equal (in value) *bushel* with a volume of 27.28 *l*. Three *pecks* were virtually equal to this bushel. Further, like the *pounds* of volume 0.373242 *l* with the volumetric density defined by the formula (4), British apothecaries' and monetary pounds gave rise to the *pounds* with the mass 0.273 *kg*. One hundred of these pounds composed a bushel of mass. Five bushels of mass generated a *barrel* 136.4 *kg*. A Japanese *koku of grain* of 136.88 *kg*, a British *tierce of meat* of 137.89 *kg*, an Australian *bale of wool* of 136 *kg*, and numerous barrels of petroleum products are related to the same spectrum of measures.

Other examples: in Iran, a *barrel* is equal to 136.4 *kg*, in Brazil, 136.7 *kg*, on Bahrain Islands, 136.3 *kg*, in Kuwait, 137.8 *kg*, *etc*. Resting on the USA *wine barrel* 119.24 *l* and the British *barrel of bulky materials* (grain) 163.65467 *l*, we find the average relative density of cereals in the folk British metrological system:

$$\varepsilon = \frac{119.24}{163.65467} \approx 0.73. \qquad (6)$$

This value is very close to the canonical measure (3). Therefore, throughout very long history of material and spiritual British culture, measures similar to most ancient Oriental measures must be have developed. The East does not seem to pay a decisive role here, otherwise the *Ancient Roman ounce*, virtually equal to the fundamental period of 2.7288 *dg*, should have been at the basis of British measures.

In ancient Babylon, *minas of mass*, proportional to Roman ounces, were widely spread:

$$1\ mina = 15\ ounces = 409.3129\ g$$
$$1\ mina = 18\ ounces = 491.1755\ g$$
$$1\ mina = 20\ ounces = 545.7505\ g.$$

In ancient Egypt, a *kedet* was the main unit of mass:

$$1\ kedet = \frac{1}{3}\ ounce = 9.09584\ g \approx 9.096\ g.$$

In ancient Rome, a *libra* of mass was equal to the twelve ounces:

$$1\ libra = 12\ ounces = 327.4503\ g.$$

Different *pounds* were also used there:

$$1\ pound = 10\ ounces = 272.8753\ g,$$
$$1\ pound = 30\ ounces = 818.6258\ g,$$
$$1\ pound = 35\ ounces = 955.0634\ g,$$
$$1\ pound = 60\ ounces = 1637.2516\ g.$$

In ancient Greece, a *metret* (a unit of volume) was equal to 1000 ounces, or to the volume:

$$1\ metret = 27.2878\ l,$$
$$1\ metret = 100\ kotylas\ (cups).$$

Kotylas gave rise to an *amphora*:

1 *amphora* = 72 *kotylas* = 16 *pecks* = 36 *mugs* = I9.647 *l*.

An amphora of mass was a unit of monetary weight:

1 *talent* = 60 *minas* = 19.647 *kg*,

1 *mina* = 100 *drams* = 600 *obols* = 327.4503 *g*.

In ancient Attic, a *talent* of a larger mass was used:

1 *talent* = 80 *minas* = 26.196 *kg*.

In the Middle Ages, a *pound* with the mass of 233.769 *g* was used in Europe. As a unit of volume, it determined the *golden section* of the fundamental pound 272.88 *g*:

$$233.769\, cm^3 \cdot 0.73\, g \cdot cm^{-3} = 170.651\, g = \frac{5}{8} \cdot 272.88\, g\,.$$

The Russian metrological spectrum of mass is closely related with the *wheat grain*, which in Russia was called *pirog*. This word has been originated from the Old Russian name of wheat, *pyro*. According to historical and archaeological data, the Russian metrological spectrum of mass has been represented by the series:

1 *pirog* (pie) (a wheat corn)		= 42.625 *mg*
1 *polupochka* (a half-bud)	= 2 *pirogs*	= 85.25 *mg*
1 *pochka* (a bud)	= 4 *pirogs*	= 0.l705 *g*
2 *pochkas*	= 8 *pirogs*	= 0.3411 *g*
4 *pochkas*	= 16 *pirogs*	= 0.6822 *g*
8 *pochkas*	= 32 *pirogs*	= 1.3644 *g*
12 *pochkas*	= 48 *pirogs*	= 2.0466 *g*
16 *pochkas*	= 64 *pirogs*	= 2.7288 *g*
20 *pochkas*	= 80 *pirogs*	= 3.4110 *g*
24 *pochkas*	= 96 *pirogs*	= 4.0932 *g*

The Chinese *lan of mass*, 37.35 *g*, corresponds to the *lan of volume* of 0.03735 *l*, defining the fundamental period of mass, 27.3 *g*, with the relative volumetric density 0.73. The average relative volumetric density of Chinese rice, equal to the ratio of a *dan* of liquid capacity to a *dan of grain capacity*,

$$\varepsilon = \frac{103.546\, l}{122.535\, l} = 0.845\,, \tag{7}$$

gave rise to another series of measures based on rice. We can see that in China as well, which is located far from Great Britain, the dialectics of measures is similar to that of European and Oriental measures.

3. The centimeter (*cm*)

Perception of space and its fundamental length of one centimeter by man are closely related with the fundamental period Δ that is an effect of the Decimal Code of the Universe (Fig. 1).

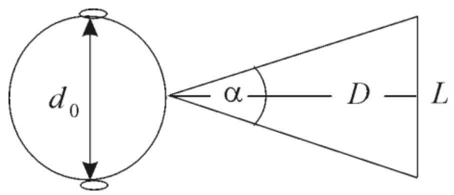

Fig. 1. A geometrical scheme of eyesight parameters; d_0 is a diameter of human skull with the characteristic average value $d_0 \approx 137$ *mm* (based on anthropological data); *D* is the average distance of the best eyesight, $D \approx 250$ *mm*; *L* is the average distance of the effective field of eyesight, $L \approx 137$ *mm*; α is the angular size of the field of visual perception, $\alpha \approx 30^0$.

As known, keenness of eyesight of man – the least distance between two points $s_{\min}$, which is able to distinguish man, – is about one angle minute, *i.e.*,

$$s_{\min} \approx \frac{\pi}{180 \cdot 60} D \approx 7.3 \times 10^{-3} cm \tag{8}$$

or

$$1\, cm \approx 137 s_{\min} \,, \tag{9}$$

where $D = 25\, cm$ is the average distance of the best eyesight (Fig. 1).

Thus, it is possible to suppose that for most people a tendency towards the ideal equality takes place:

$$1\, cm = 50 \cdot 2\pi \lg e \cdot s_{\min} \tag{10}$$

Thus, the measures of length on the basis of centimeter follow the fundamental period-quantum of the Decimal Code of the Universe.

$$1\, mm = 5 \cdot 2\pi \lg e \cdot s_{\min} \,,$$

$$1\,dm = 5 \cdot 2\pi \lg e \cdot 10^2 s_{\min}\,, \qquad (11)$$

$$1m = 5 \cdot 2\pi \lg e \cdot 10^3 s_{\min}\,.$$

In this sense, the measures (11) are the “magic” units.

In turn, millimeters, centimeters, decimeters, and meters determine the fundamental physical parameters, which are also closely related with the fundamental period Δ. They are the basis of folk metrology.

As an example, let us consider the Old Russian system of measures whose spectrum should mainly be described by the following formula:

$$M = 2^k 3^l 5^m 7^n \Delta\,. \qquad (12)$$

The numbers 2, 3, 5 and less frequently 7 are ordinal units of count, and $k, l, m, n \in Z$. This spectrum has the universal character and is peculiar to ancient measures of many nations.

The first natural units of the simplest measures of length were fingers and their joints, palms, spans, feet, elbows and other parts of human body. In the Old Russian metrology, a *foot* of about 2.73 *dm* and a *finger* of 2.73 *cm*, equal to a tenth of the foot, were the constitutive measures. And all remaining measures were built on the basis of these fundamental measures.

The measure equal to the *one foot* is the typical size of bricks, books, icons and architecture details in XI-XII centuries. A *vershock* of two *fingers* has defined a width of bricks; a *foot* of 12 *fingers* (32.8 *cm*) was also the characteristic format of bricks at that time. There were also a *palm* of three *vershocks* and a foot of three palms (30.8 *cm*), etc.

The main derivative units of the *foot* were:

1) A *vershock-osmushka* (VII-IX centuries) of 3.42 *cm*, equal to *one eighth of a foot*. The scales of Old Ladoga with marked points at the distances of this vershok were well known. 2) A *stopa* of two feet. This measure was found in measuring rulers of Ancient Novgorod. 3) A *lokots* (elbow) = 3 feet = 81.9 *cm*.

4) A series of measures with the same name the *sazhen*, multiple to the different number of *feet* (for example, a *sazhen* of 4, 5, 6, 7, 8, 9, … *feet*) and the fractional parts of them.

The *sazhen* = 5 *feet* = 3 *elbows* = 137 *cm* was the most widely used unit of length. Yaakov’s harquebus as cast in 1492 had the length of a *firearm barrel* equal to 1.37 *m*. The distance between rowlocks in most of boats had often the length 1.37 *m*. The measure of 1.37 *m* was the typical length of oars in XIV century.

The *sazhen* = 10 *feet* = 2.73 *m* was known as a *grand* (*slanting*) *sazhen*. It has been defined in the following way. A lace with the length of a grand sazhen has been folded in two and its middle point pressed by a hand to the shoulder, and then ends of the lace have to touch a floor. Note, according to anthropology data a shoulder is on average at the height of 1.37 *m*.

Every *sazhen* defined its own numerous multiple measures, as for example, a thousand of *sazhens* of four *feet* constituted a *verst* of 1.093 *km* and a thousand of *sazhens* of eight *feet* formed a *verst* of 2.185 *km*, *etc*.

Let us now go to the other extremity of the Eurasian continent and dwell upon the *Chinese metrology*. Chinese measures of length are closely related to rice. The first information about the cultivation of rice appeared in 2800 BC. The transverse dimension of a rice corn varies within d = 1.2 – 3.5 *mm*. The subdominant and dominant of this range are 2.06 *mm* and 2.64 *mm*, respectively. Apparently, ten subdominants gave rise to an *inch* of 2.06 *cm*. Chinese *feet* were formed certainly on the basis of this measure, that is confirmed by the following estimations:

1 *foot* = l2 *inches* = 24.72 *cm*,

1 *foot* = 16 *inches* = 32.96 *cm*,

1 *foot* = 18 *inches* = 37.08 *cm*.

These *feet* are in accordance with the ancient Chinese feet. In particular, a long Chinese *foot* is equal to 37.5 *cm*. A foot of 16 inches is close to a building foot of 32.28 *cm*. A foot of 12 dominant inches (31.68 *cm*) coincides actually with a landmark or the engineering foot of 31.97 *cm*. A mean Chinese foot is about 32.8 *cm*. If we divide it into 16, we will obtain one of the *ancient Chinese inches*. And in a case, when the foot is divided into 12, we arrive at the *inch* close to the fundamental measure of 2.73 *cm*.

4. The second (*s*) and canonical measures of *cm* and *s*

For the sake of the standard representation of numerical values of measures, let us agree that all physical constants should be presented by eight or more signs after a decimal point, because most of them were defined just with such a precision.

In the year 2000, a *star day* T was equal to $23^{h}56^{m}04^{s}.10056$. An angular speed of Earth's revolution, corresponding to this day, $\omega_Z = 7.29211501\times10^{-5}\,s^{-1}$, hence, a *daily radius* T_R is

$$T_R = \frac{1}{\omega_Z} = \frac{T}{2\pi} = 1.37134425\times10^{4}\ s\,. \tag{13}$$

Thus, the *daily radius* is in the vicinity of the fundamental half-period $\frac{1}{2}\Delta = 1.364376354...$, and if the new *canonical second* $\underline{s}$ is introduced, according to the equality,

$$1\underline{s} = 1.00510702s\,, \qquad (14)$$

then a duration of the period will be exactly equal to the fundamental quantity

$$T_R = \frac{T}{2\pi} = 2^{-1}\Delta\times 10^4\,\underline{s} = 1.36437635\times 10^4\,\underline{s}\,, \qquad (15)$$

and the *angular speed* of Earth's revolution will also be the fundamental one,

$$\omega_Z = \frac{1}{T_R} = 2\frac{1}{\Delta}\times 10^{-4}\,\underline{s}^{-1}\;. \qquad (16)$$

In accordance with the DM, the gravitational field is characterized by the *fundamental gravitational frequency* ω_g, coupled with the gravitational constant G by the equality,

$$\omega_g = \sqrt{4\pi\varepsilon_0 G} = 9.15697761\times 10^{-4}\,s^{-1}, \qquad (17)$$

where $G = 6.672590\times 10^{-8}\,cm^3\times g^{-1}\times s^{-2}$ and $\varepsilon_0 = 1\,g\times cm^{-3}$, and the corresponding *gravitational period*,

$$T_g = \frac{2\pi}{\omega_g} = 0.68616366\times 10^4\,s\,. \qquad (18)$$

The gravitational period defines the *gravitational wave radius* of the cylindrical gravitational field,

$$\lambda\!\!\!^{-}_g = \frac{c}{\omega_g} = 3.273923676\times 10^{13}\,cm\,. \qquad (19)$$

The wave radius divides the solar gravitational field into the nearest and distant wave zones, between which there is a ring of small natural satellites called asteroids.

The gravitational wave radius is in the vicinity of $\frac{6}{5}\Delta = 2\times 3\times 5^{-1}\Delta$ that is the characteristic value of ancient measures. If we introduce the *canonical centimeter* $c\overline{m}$, according to the equality

$$1c\overline{m} = 0.999823004\;cm\,, \qquad (20)$$

the *gravitational wave radius* will take the fundamental value,

$$\lambda\!\!\!^{-}_g = \frac{c}{\omega_g} = 2\times 3\times 5^{-1}\Delta\times 10^{13}\,c\overline{m} = 3.27450325\times 10^{13}\,c\overline{m}\,. \qquad (21)$$

On the other hand, the gravitational period is in the vicinity of a quarter of the fundamental period Δ, and if one introduces the *canonical second*,

$$1\underline{\underline{s}} = 1.00582754\,s\,, \tag{22}$$

we will arrive at the fundamental measure of the *gravitational period*,

$$T_g = \frac{2\pi}{\omega_g} = 2^{-2}\Delta\times 10^4\underline{\underline{s}} = 0.68218818\times 10^4\,\underline{\underline{s}}\,, \tag{23}$$

and the *fundamental gravitational frequency*,

$$\omega_g = \frac{8\pi}{\Delta}\times 10^{-4}\underline{\underline{s}}^{-1} = \frac{4}{\lg e}\times 10^{-4}\underline{\underline{s}}^{-1} = 9.210340372\times 10^{-4}\underline{\underline{s}}^{-1}, \tag{24}$$

which determines the fundamental value of the *gravitational constant*,

$$G = \frac{\omega_g^2}{4\pi\varepsilon_0} = \frac{4\pi}{(0.5\Delta)^2\varepsilon_0}10^{-8}\ \underline{\underline{s}}^{-2} = 6.75058634\times 10^{-8}\ cm^3\times g^{-1}\times\underline{\underline{s}}^{-2}\,. \tag{25}$$

The canonical second (22) and the centimeter (20) define the canonical measure of the speed of light,

$$c = \tilde{\lambda}_g\omega_g = 96\pi\times 10^8\ c\overline{m}\times\underline{\underline{s}}^{-1} = 3.015928947\times 10^{10}\ c\overline{m}\times\underline{\underline{s}}^{-1}\,. \tag{26}$$

Since $1\underline{\underline{s}} \approx 1\underline{s}$, equalities

$$T_R = 2T_g \qquad \text{and} \qquad T = 2\pi T_R = 4\pi T_g \tag{27}$$

point to the relation of Earth's time circumference (day) and its radius with the gravitational constant and the quarter of the fundamental period.

5. Conclusion

The *fundamental quantum of measures*, originated from the Law of Decimal Base, exists independently of the people consciousness. It is equal to the fundamental period-quantum Δ of the dialectical binumerical wave field (see L. 5, Vol. 1). The spectrum of measures, M, dependent on Δ is subordinated to the following formula:

$$M = 2^k 3^l 5^m 7^n\,\Delta\,.$$

Since ancient times, most people on Earth, comparing the water and cereals, in mass and volume, have created, *independently of each other*, the equal (rational) multiple measures. In particular, a comparison of two aforementioned substances generated, *independently of the concrete choice of units of mass and volume*, the *volumetric relative permeability* μ and the *relative volumetric density* ε of grain, which turned out to be multiple to Δ:

$\mu = \frac{1}{2}\Delta = \pi \lg e = 1.364376354... \approx 1.3644$ and $\varepsilon = \frac{1}{\mu} = 0.732935599 \approx 0.73$. A series of the Ancient measures presented above, as examples, convincingly demonstrated their multiplicity to fundamental quantum of measures, Δ.

The objective measures of *matter*, *space*, and *time*: measures of mass *M*, length *L*, and time *T*, are the *main (basic) measures*, reflecting the fundamental sides of the Universe. The corresponding units are the *gram g*, the *centimetre cm*, and the *second s*. These fiducial units in a definite extent, as it has been demonstrated above, are, the "*magic*" units predetermined by the course of historical process. They reflect harmony of material and ideal fields-spaces, to which everything in the Universe obeys; and for this reason these units were independently and intuitively selected by the collective experience of humanity.

References

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Lecture 3

Dialectics of the Systems of Units

1. Introduction

At the modern stage of the development of physics, one cannot solve arising problems without dialectical philosophy and its logic and, in particular, without taking into account the dialectical laws related to an ideal side of the material-ideal Universe – the second kind laws.

An idea of existence of the first and second kind laws naturally originates from the fundamentals of dialectical philosophy. These laws allow describing the World, comprising two polar opposite sides, material and ideal, more completely. The second kind laws demonstrated themselves, in particular, in the metrology of Earth's nations. We considered this issue in previous Lecture.

Without taking into account the laws of the first and second kinds it is impossible to build a reliable foundation of physics, in which a significant place is given to the system of standard (reference) measures. More adequately reflecting reality, the dialectical approach demands essential changes in the existing theoretical metrology of modern physics, which is inadequate to reality. The latter is based upon *seven basic units* among which there is a unit of current, *ampere*, mistakenly entered thither. Such a unit unfoundedly accepted as "basic" has actually a strange (erroneous) dimensionality, tacitly hidden under the name *ampere*.

Compared with modern physics, dialectical physics recognizes the reference system of units on the basis of only *three objective measures* of *matter*, *space* and *time*: the *gram* (*g*), the *centimeter* (*c*), and the *second* (*s*). The rest of the units of physical quantities are the derivatives of this triad. It should be stressed that dimensionalities of all derivative units of dialectical physics *do not contain the fractional powers* of the aforementioned basic units. We call the system of units, fully formed and used in dialectical physics, the *gram-centimeter-second* system (abbreviated *GCS*).

In this Lecture, we will try to reveal the main features of the dialectical concept as applied to the formation of objective metrology in physics, which led to an appearance of the *GCS* system [1, 2]. The given system, as the objective system resting on the triad of basic units of matter-space and time, can be regarded, in all appearances, as an alternative to the existent currently system of the SI units.

2. An objective system of units, *GCS*

We should regard the *physical quantities* and *physical parameters* not only as *synonyms*, but also as the *notions* with a different sense.

Every *qualitative definition* of some physical notion *A*, based on a series of its characteristic properties *x*, *y*, *z*, …, is supplemented with the *quantitative formula*, representing a short mathematical expression (definition) of the notion:

$$A = Def\,(x, y, z, ...)\,. \tag{1}$$

The left part of the formula is the *nomination* (name) of this physical notion, the right part is its *abstract physical quantity* (or its abstract measure), which is characterized by the definite *numerical value*. In a series of the cases, it makes sense (for the sake of severity of logical expressions) an abstract physical quantity to call the *physical parameter*, or briefly, the *parameter*, and a concrete physical measure of the parameter to call the *physical quantity*, or simply, the *value of the parameter*.

In the *GCS* system of dialectical physics, the *dimensionality of any physical quantity N is defined by only the integer powers of reference units*:

$$\dim N = g^k \cdot cm^l \cdot s^m\,. \tag{2}$$

Thus, the powers $k, l, m \in Z$. The reference units: *g*, *cm*, and *s* are the *metrological basis*, in which it is possible to create any triad of *base qualitative units*.

Quantitative measures of the *GCS* system are related with the fundamental World periods-quanta, reflecting the Decimal Code of representation of quantitative measures in the Universe:

$$\Delta = 2\pi \lg e \qquad (\textit{Yes}\text{-measure}), \tag{3}$$

$$i\Delta = i2\pi \lg e \qquad (\textit{No}\text{-measure}). \tag{4}$$

The p*eriods-quanta of the field of affirmation* (*Yes*-subfield) *and negation* (*No*-subfield) *of the Decimal Code of the Universe* (4) *form the basis of the quantitative part of the GCS system of units*, supplementing the qualitative parts of the system. We have denoted sometimes (for distinguishing) this quantitative part of the system by the letters *Qu* (from the Latin, *Quantum*) [1]. The quantitative part of the *GCS* system is the foundation of metrology of Earth's nations (see L. 2).

The combination of quantitative and qualitative parts of the *GCS* system results in the complete quantitative-qualitative system of objective units, *GCS*. This system describes all informational material of contemporary physics on the basis of only three basic units: *g*, *cm*, and *s*.

The modern system *SI* contains seven basic units. The four of them are *kg, m, s* and *A* (*ampere*). We will analyze in detail only the unit of electric current, *ampere* (*A*). The remaining three quantitative measures: the units of thermodynamic temperature, *kelvin* (*K*), amount of substance, *mole* (*mol*), and luminous intensity, *candela* (*cd*), were introduced in a series of base units also erroneously, like the ampere. We will not consider them.

The dimensionality of other important units in *SI* is represented by half-integer powers of three basic units, which are hidden under the *nominative dimensionality* of *phenomenological measures*. Their dimensionalities are defined by the units of mass *M*, length *L*, time *T*, and electric current *I*:

$$\dim A = M^{k} \cdot L^{l} \cdot T^{m} \cdot I^{n}, \tag{5}$$

where $k, l, m, n \in Z$. Here, the *unit of current I*, regarded as the basic unit, *is actually the derivative* (dependent) unit, because it is the function of the first three basic units:

$$I = I(M, L, T) = M^{1/2} \cdot L^{3/2} \cdot T^{-1}. \tag{6}$$

The function (6) is phenomenological, because objects and processes with such measures as $M^{1/2}$ and $L^{3/2}$ ($kg^{1/2}$ and $m^{3/2}$) do not exist in nature. Such a structure of the units in SI is the effect of lack of understanding of the nature of charges and, hence, electric current. Thus, the unfounded “rationalization” of the system of units has covered (hidden) unsolved problems with fractional powers in dimensionalities of basic units.

During the last decades, it became normal to disregard the function (6). Thus, the solution of the problem with the fractional powers of the reference units has been pushed to the side. The latter does not promote the normal development of science. Thus, an appearance in SI of the fourth “basic” unit (the *ampere*) among the three really basic units of mass, length, and time (*kg*, *m*, *s*) is the acknowledgement of ideological bankruptcy of the phenomenological approach in physics.

We refer the physical measures and their units to the class of the *phenomenological units* if they were formed, explicitly or implicitly, with the participation of the unit of current the *ampere* (whose dimensionality contains *half-integer powers* of reference units of the gram and the centimeter). The units, formed on the basis of dimensionalities (2) of *GCS* system (which contain *integer powers* of reference units), we refer to the class of the theoretical *objective units*.

Of course, there is not a clear boundary between the *phenomenological quantities* with the integer powers of reference units, but which were formed on the basis of phenomenological measures with the half-integer powers of reference units, and the corresponding theoretical *objective quantities*. However, phenomenological measures with integer powers of reference units can differ from their theoretical objective measures in value of the numerical factor. Such difference will express the definite quantitative error of a phenomenological physical quantity, in question.

The theoretical units with integer powers of reference units are the effect of the basic law of cognition – the *law of comparison*. The comparison generates integer powers of theoretical (*correct* or *objective*) units. The latter are the *objective units*, because they are formed on the basis of real comparison, but not on the basis of formal irrational operations, which are based on a free game of notions. Any freedom is restricted by the requirements of objectivity, *i.e.*, freedom is realized necessity. This is true because freedom is not subjected to the objective nature of phenomena and, therefore, is able to generate the phenomenology of the kind (6).

Of course, the *objective measures*, as any measures in dialectics, by virtue of an approximate character of the description of nature, reflect the nature with the different extent of accuracy.

We will also present the formula of dimensionality of parameters (2) by the symbolic *vector of dimensionality D* in a set of reference measures:

$$D(k,l,m) = g^k \cdot cm^l \cdot s^m \,, \tag{7}$$

where *k*, *l*, *m* are integers. The *qualitative* vector $D(k,l,m)$ defines the structure of the nomination of a physical unit.

The *quantitative* measure of a physical quantity Q_u can be presented in the following way

$$Q_u = r \cdot \Delta \cdot 10^n \,, \tag{8}$$

where 10^n is the decimal scale and *n* is an integer number; *r* is (in a general case) any number.

If *r* is a rational number, the measure Q_u defines characteristic values of a quantitative spectrum of the parameter, repeating the ancient measures, which are multiple to the fundamental period.

For the complete representation of the structure of a parameter, we will introduce the fourth and fifth *quantitative* coordinates in the *vector of dimensionality*, separating them from the *qualitative* coordinates by a semicolon:

$$D(k,l,m; r\cdot\Delta, n) = Q_u \; g^k \cdot cm^l \cdot s^m \,, \tag{9}$$

where Δ is the quantitative measure of a parameter

$$\Delta = \pm 2\pi \lg e, \qquad \pm 2\pi \lg e \cdot i\,. \tag{10}$$

All parameters with the equal qualitative coordinates, *i.e.*, with the same qualitative dimensionalities, belong to the one class. In this sense, the qualitative vector of dimensionality $D(k, l, m)$ is the determinant of a class. Each class is presented by a group of qualitatively related quantities, having some differences.

Physical parameters of different classes reflect the qualitatively different properties of processes and objects of study. Therefore, the same property of an object cannot be presented by means of measures of different classes. If this happens, then it means that the theory, describing such a quality of a process or an object, is still in a stage of development and its basis contains errors.

The definite correlation takes place between measures of physical parameters, expressed in phenomenological and theoretical objective units. If some objective factor of an arbitrary process is described on the basis of *phenomenological units* by a parameter A_{ph} , then its measure has the form

$$A_{ph} = Q_{ph} \cdot M_{ph}, \tag{11}$$

where M_{ph} is the subjective phenomenological unit with *fractional* powers of the reference units, *g*, *cm*, and *s*; Q_{ph} is the quantitative value of the parameter in a system of the phenomenological units.

The theoretical measure of the same parameter, expressed in *objective units*, is characterized by the objective measure A_o:

$$A_o = Q_o \cdot M_o, \tag{12}$$

where M_o is the objective theoretical unit with *integer* powers of the reference units, *g*, *cm*, and *s*; Q_o is the quantitative value of the parameter in a system of the theoretical (objective) units.

If phenomenological and theoretical measures and units are proportional each other, then the *ratio of phenomenological and theoretical measures*, A_{ph} and A_o, to their units, M_{ph} and M_o, will be an *invariant* magnitude:

$$\frac{A_{ph}}{M_{ph}} = \frac{A_o}{M_o} == invariant\,; \tag{13}$$

consequently, their numerical values will be equal:

$$Q_o = Q_{ph}\,. \tag{14}$$

The system *GCS* is able adequately to describe notions of any longitudinal and transversal subfields, which form the complicated longitudinal-transversal fields of matter-space-time. We will show this on examples in the following two Lectures.

3. The notion of "electromagnetic"

As was already noted, the subatomic longitudinal-transversal field of exchange is called in physics the "*electromagnetic field*". From the point of view of semantics, the name the "electromagnetic" field is deprived of a sense. Following one version, it literally means the "*amber-magical*" field. This is, roughly speaking, the "alias" or the pseudonym. We should refrain from the pseudonym, because the last initially generates the erroneous concepts and directions of research. Moreover, on the basis of the pseudonym, cognition of the nature of "electromagnetic phenomena" becomes impossible.

The "electromagnetic field" is the *longitudinal-transversal wave field of the subatomic level* of exchange and, at the same time, it is the field-space of the triad of matter-space-time.

It would be more correctly to call the "electromagnetic" field the longitudinal-transversal "electric" field, whose intensity of rest-motion should be described by the velocity vector of exchange $\hat{\mathbf{E}}$ (the "strength" vector) of the following logical structure *Yes-No*:

$$\hat{\mathbf{E}} = \hat{\mathbf{E}}_l + \hat{\mathbf{E}}_\tau, \tag{15}$$

where $\hat{\mathbf{E}}_l$ is the vector of the longitudinal "electric" subfield and $\hat{\mathbf{E}}_\tau$ is the vector of the transversal "electric" subfield.

To the equal degree, the "electromagnetic" field can be called the longitudinal-transversal "magnetic" field with the corresponding vectors of the longitudinal $\hat{\mathbf{B}}_l$ and transversal $\hat{\mathbf{B}}_\tau$ "magnetic" subfields:

$$\hat{\mathbf{B}} = \hat{\mathbf{B}}_l + \hat{\mathbf{B}}_\tau. \tag{16}$$

Through this approach, the central charge of exchange of an electron is, in the first nomination (15), the "electric" charge-monopole; in the second nomination (16), the "magnetic" charge-monopole of the *central* part of the longitudinal-transversal field.

By virtue of this, the elementary *central exchange* can be presented in the language of electric or magnetic charges, respectively, as

$$F = \frac{q_E Q_E}{4\pi\varepsilon_0 r^2} \qquad \text{or} \qquad F = \frac{q_M Q_M}{4\pi\varepsilon_0 r^2}. \tag{17}$$

It is natural that here we have

$$q_E = q_M \,, \qquad (18)$$

because we deal with the same charges having the different names.

The charge, actually, is the longitudinal-transversal (“electric” or “magnetic”) charge of the field of the subatomic level. The transversal charges in a general case differ from the central (“electric” or “magnetic”) charges.

For the more complete description of the fields (15) or (16), it is necessary to take into account also the axial subfields $\hat{\mathbf{E}}_z$ or $\hat{\mathbf{B}}_z$:

$$\hat{\mathbf{E}} = \hat{\mathbf{E}}_l + \hat{\mathbf{E}}_\tau + \hat{\mathbf{E}}_z \,, \qquad \hat{\mathbf{B}} = \hat{\mathbf{B}}_l + \hat{\mathbf{B}}_\tau + \hat{\mathbf{B}}_z \,. \qquad (19)$$

All these subfields have the *potential-kinetic* character and only with some degree of simplification the “electric” field can be referred to the potential field and the “magnetic” field – to the kinetic field.

The physicist studies the longitudinal-transversal field of exchange of the *subatomic microlevel* “from above” (because he *towers over* this field in laboratory conditions); therefore, he clearly sees its longitudinal and transversal sides. But at the same time, he is *inside the cosmic longitudinal-transversal field*. Being on the Earth, he feels only the longitudinal side of the field, but does not perceive its transversal component, which is represented by the shells of the gravitational field of the Sun and its planets.

In such a situation, when “complexes of sensations” do not help, it is necessary to turn to reason and dialectics. Only they will lead the researcher to the understanding of the fact that the *gravitational field is also the longitudinal-transversal field*, analogous to the longitudinal-transversal field of the subatomic level.

When we speak about dialectics, we mean the best achievements of the Greek, Chinese, Indian, European, and German (in the person of Hegel) philosophy. It is possible to say that dialectics is the quintessence of world human thought, the theoretical experience of mankind, which should not be substituted for all kinds of temporal fashionable trends. Another matter if these new concepts (trends) enrich the world experience.

4. CGSE, CGSM and the circulational Γ-system of units

The longitudinal-transversal character of the “electric” field (or, that is the same, the “magnetic” or “electromagnetic” field) has induced the following three systems of units:

1. *Yes*-system (*CGSE*) for the description of the longitudinal subfield (“electric field”);
2. *No*-system (*CGSM*) for the description of the transversal subfield (“magnetic field”);

3. *Yes-No*-system. The formal logic was unable to understand this system on the basis of its notions.

We will call the last system, for brevity, the "*circulational system*". It was impossible to comprehend the circulational system *Yes-No* on the basis of a naïve formal-logical rule of the excluded third. Therefore, physics referred (and refer) all notions of electromagnetism to either *Yes*-system (*CGSE*) or *No*-system (*CGSM*). Thus, physics, in principle, is unable to form deliberately the notions of the type *Yes-No*. The *circulational* system *Yes-No* is based on *CGS* units. Hence, conditionally, it can be called *CGS*-system, although this is not quite correctly, because *CGS*-system was built for the description, above all, mechanical, but not electromagnetic phenomena.

The *circulational system Yes-No*, through the equality for the cylindrical field,

$$\Gamma = \frac{1}{c} I \,, \tag{20}$$

united in a single whole both (*CGSE* and *CGSM*) systems (Fig. 1). Here Γ is the *circulation* of the vector $H = \varepsilon_0 \varepsilon_r B = \dfrac{B}{\mu_0 \mu_r}$ – the parameter of the *transversal* subfield (see L. 8, Vol. 3); whereas I is the parameter of the *longitudinal* subfield.

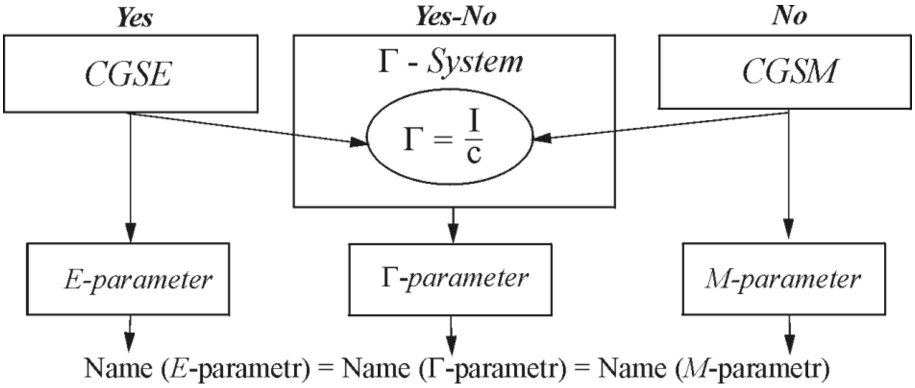

Fig. 1. A graph of the formation of the following systems of units: *Yes*, *No*, and *Yes-No*.

Parameters of the circulational system, formed on the basis of the formal analogy with the parameters of *Yes* (*CGSE*) or *No* (*CGSM*) systems, were called the parameters in the "magnetic system" with corresponding names of the systems, *Yes* and *No*. As a result, the confusion with notions and their ambiguity have appeared. This is extremely inconvenient and undesirable.

The development of notions of the conjugated subfields, *Yes* and *No*, was not proceeded quite symmetrical. As a result, the relevant parameters for the description of both, the longitudinal and transversal subfields, have obtained the same names, although in essence they are very different. This further complicated the logical situation in the field theory.

Since the circulation Γ is inseparable from the current I, it can be conditionally called the current circulation, *i.e.*, the circulation related to the given current. Just *this inseparable relation of the circulation and current led to the erroneous name*. The circulation was termed the "*current in the magnetic system*" and denoted by the symbol I_m or simply by the same symbol of current I. This confusion remains in electrodynamics so far.

In reality, the circulation Γ is the parameter, which connects in a single whole the electric and magnetic features. It belongs equally to both, the *CGSE* and *CGSM* systems; therefore, it cannot be called the current in the "magnetic system". Let us rewrite (20) as

$$\Gamma = \frac{dq}{cdt}. \tag{21}$$

The differential of the basis length $dz = cdt$, along the axis of the cylindrical field, defines the linear density of charge q_z, representing by itself the circulation Γ:

$$\Gamma = \frac{dq}{dz} = q_z. \tag{22}$$

Joining together (20) and (22), we have

$$I = c\Gamma = cq_z. \tag{23}$$

In the longitudinal-transversal field, in the equilibrium process, the transversal (tangential) and longitudinal (axial) exchanges are equal. The equality of masses and charges of the longitudinal and transversal subfields expresses this:

$$M_l = M_\tau = M, \qquad\qquad q_l = q_\tau = q. \tag{24}$$

Thus, the linear density of charge q_z is related to the equal degree to both the transversal charge and the longitudinal charge.

Although the circulation Γ was called the current in the magnetic system of units, some physicists of the 19th and the first half of the 20th centuries have understood the inaccuracy of the similar identifying. At present, the form of the *law of total current*, in *SI*, demonstrates these errors:

$$\oint(\mathbf{H}d\mathbf{l}) = I. \tag{25}$$

Such form has not a single-valued sense.

If the right part of the formula (25) contains the current in the "magnetic system", I_m, then we must write that

$$\oint(\mathbf{H}d\mathbf{l}) = I_m \qquad \text{or} \qquad \oint(\mathbf{H}d\mathbf{l}) = \frac{1}{c}I\,. \tag{26}$$

It is usual to call the last equality the law of total current in *Gaussian units*. It is the correct form of the presentation of this law; although here the circulation is not called explicitly by its name and has no its own designation. In metrology, this equality is written as

$$\oint(\mathbf{H}_m d\mathbf{l}) = \frac{1}{c}I\,, \tag{27}$$

where the index *m* shows that the strength *H* is the strength "in the magnetic system".

The vector of phenomenological strength H_m is, strictly speaking, the vector of "induction or displacement" of the magnetic field, because it describes the analogous qualities of the field, inherent for the vector of "induction or displacement" of the electric field *D*.

The linguistic, nominative, error creates the definite confusion and incomprehension of the role and meaning of the vector *H* in the phenomenological theory of electromagnetism. Folk wisdom says that things must be called by their own names. In science, this must take place so much the more.

For the sake of definiteness, we will denote the vector of *phenomenological strength* H_m by the symbol H_e. It will allow avoiding the definite ambiguity of electromagnetic notions. Further, we will denote by the index *e* the other *phenomenological* parameters as well.

In such a case, we have

$$\oint(\mathbf{H}_e d\mathbf{l}) = \frac{1}{c}I\,. \tag{28}$$

We introduce the vector of "*circulational strength*" $\mathbf{H}_\gamma$ in accordance with the equality

$$\mathbf{H}_\gamma = c\mathbf{H}_e\,. \tag{29}$$

An analogous equality for the vector $\mathbf{B}_\gamma$ is

$$\mathbf{B}_\gamma = c\mathbf{B}_e\,. \tag{30}$$

The physical parameters, generated by the circulation and denoted by the index γ, are not equal to the vectors (with the same name) of electric and magnetic systems. They are the circulational parameters of the field and their essence will be considered below.

Following the formula (29), the *law of total current* must take the form

$$\oint(\mathbf{H}_\gamma d\mathbf{l}) = I\,. \tag{31}$$

In the course of development of phenomenology, relating to the electromagnetic phenomena, the two laws of total current have appeared, which are equal in form, but different in content:

$$\oint(\mathbf{H}d\mathbf{l}) = I_m\,, \qquad \oint(\mathbf{H}_\gamma d\mathbf{l}) = I\,. \tag{32}$$

Both laws were/are misapprehended as one law, but expressed in the different systems. This is a great fallacy. Such a formal description (remaining up to now) was/is the cause of the mess in thoughts of physicists.

On the basis of the relation between current and circulation (20), it is possible to introduce the "*circulational charge*" q_γ, which occasionally is called erroneously the magnetic charge:

$$q_\gamma = \frac{1}{c}q\,, \tag{33}$$

where

$$q_\gamma = \int I_\gamma dt = \int \Gamma dt\,. \tag{34}$$

By virtue of *mixture of the notions, circulation and current*, the two classes of conjugated units, on the basis of *CGSE* and *CGSM* systems, were formed. Being different in essence, they have the same nomination. It is necessary to refer the most of these units to the circulational Γ-system (Fig. 1).

Let us denote the phenomenological quantities of the systems, *CGSE* and *CGSM*, by the general symbols, A_e and A_m. The corresponding circulational quantities (which are called erroneously as the quantities of the magnetic system *CGSM*) will be denoted by the symbol A_γ. Then, the correlation between the aforementioned different quantities, in a general case, takes the form

$$A_\gamma = c^n A_e \qquad \text{or} \qquad A_e = c^{-n} A_\gamma\,, \tag{35}$$

where c is the base wave speed and $n = \pm 1, \pm 2$.

5. Conversion of measures of *CGSE* system into *GCS*

The identification of conjugated phenomenological parameters (whose dimensionalities are represented by half-integer powers of reference units) is the fundamental error, leading to the incognizability of atomic phenomena and, accordingly, fundamentals of the World in the large.

According to the equation $F = \frac{dM}{dt}E = \frac{Q^2}{4\pi\varepsilon_0\varepsilon_r r^2}$ (see (18) in L. 4, Vol. 2), it is natural to accept in the capacity of the measure of exchange (of a particle with the field of matter-space-time at the field level ($\varepsilon_r = 1$)) the following expression,

$$W = \int_r^\infty F dr = \int_r^\infty \frac{Q^2}{4\pi\varepsilon_0 r^2} dr = \frac{Q^2}{4\pi\varepsilon_0 r} = Q\varphi\,, \tag{36}$$

where φ is the potential, defined by the equality $\varphi = \frac{Q}{4\pi\varepsilon_0 r}$ (see (14) in L. 4, Vol. 2), and $\varepsilon_0 = 1 g \times cm^{-3}$.

The energy of exchange (36) corresponds, in *CGSE* (*CGSM*) system, to the energy W_e (W_M) of a theory of the electrostatic (or magnetostatic) field:

$$W_e = \frac{q_e^2}{r} \qquad (W_M = \frac{q_M^2}{r}), \tag{37}$$

where q_e is the electric (Coulomb) charge.

Assuming that $W = W_e$, we arrive at the following correspondence of the exchange charge Q and the Coulomb charge q_e:

$$Q = \sqrt{4\pi\varepsilon_0} \cdot q_e\,, \qquad q_e = \frac{Q}{\sqrt{4\pi\varepsilon_0}}\,. \tag{38}$$

The analogous relation takes place for the current

$$I = \sqrt{4\pi\varepsilon_0} \cdot I_e\,, \qquad I_e = \frac{I}{\sqrt{4\pi\varepsilon_0}}\,. \tag{39}$$

On the basis of (36) and (38), we obtain the relations between the energy of exchange W and electric potentials:

$$W = Q\varphi = q_e\left(\sqrt{4\pi\varepsilon_0}\,\varphi\right) = q_e\varphi_e \tag{40}$$

and, hence,

$$\varphi_e = \sqrt{4\pi\varepsilon_0}\,\varphi\,, \qquad \varphi = \frac{\varphi_e}{\sqrt{4\pi\varepsilon_0}}\,, \tag{41}$$

$$U_e = \sqrt{4\pi\varepsilon_0}\,U\,, \qquad U = \frac{U_e}{\sqrt{4\pi\varepsilon_0}}\,, \tag{42}$$

where U is the electric voltage.

The correlation between the *electric strength vector* E_e and the *physical vector of exchange* E, defined from the equality

$$F = QE = \sqrt{4\pi\varepsilon_0}\,q_e E = q_e E_e\,, \tag{43}$$

is

$$E_e = \sqrt{4\pi\varepsilon_0}\,E \qquad \text{or} \qquad E = \frac{E_e}{\sqrt{4\pi\varepsilon_0}}\,. \tag{44}$$

The analogous relations take place for the "*magnetic induction*" vector *B*:

$$B_e = \sqrt{4\pi\varepsilon_0}\,B \qquad \text{or} \qquad B = \frac{B_e}{\sqrt{4\pi\varepsilon_0}}\,. \tag{45}$$

B-Vector describes the properties of the magnetic field, analogous to the properties of the electric field presented by the electric strength vector *E*. By this reason it is necessary to call *B*-vector the *magnetic strength vector*. The nominative error produces the definite inconveniences and cannot be justified.

Thus, we have arrived at the following relation,

$$A_e = \sqrt{4\pi\varepsilon_0}\,A, \tag{46}$$

that was found between the *objective* parameter, *A*, originated from the DM, and the subjective *phenomenological* parameter of the *CGSE* system, A_e. It is the conversion formula. We will use it when considering (correcting), in value and dimensionality, of well-known physical parameters.

6. Conclusion

Dialectics is considered in science as the quintessence of world human thought, the theoretical experience of mankind. Being taken into account in natural science, its concepts led to corrections and changes of the fully formed tenets in all branches of physics and, in particular, in physical metrology with its systems of units.

Dialectical physics uses the system of units based on three basic units of *matter*, *space* and *time* (*g*, *cm*, *s*). We call it the *GCS* system. In such a system, the *dimensionality* of any physical quantity is defined by only *integer powers* of basic (reference) units. And the *quantitative* values of the *GCS* units are in agreement with the periods-quanta of the Decimal Code of the Universe. The periods-quanta are the basis of the *quantitative part* of the *GCS* system of units, supplementing the qualitative part of the system. The combination of quantitative and qualitative parts of the *GCS* system results in the complete quantitative-qualitative system of objective units, *GCS*. This system describes all informational material of contemporary physics on the basis of only three basic units: *g*, *cm*, and *s*.

The erroneous (because of *fractional powers* of basic units) dimensionalities inherent in the modern system of units have obtained its origin from the time of the discovery of "electric" and "magnetic" fields, called "electromagnetic" owing to their interrelation.

Nobody thought over the fact that the name "*electromagnetic*" does not reflect a key feature of the field. This whole word combination does not characterize the given field, its fundamental meaning, being just semantics fully formed historically. Literally, the word "electromagnetic" means the *amber-magical* field. Actually, according to the definition of dialectical physics, the "*electromagnetic"* field is the *longitudinal-transversal wave field of the subatomic level* of exchange and, at the same time, it is the field-space of the triad of matter-space-time.

The longitudinal-transversal character of the ""electromagnetic" field has caused an appearance of the two systems of units: *CGSE*, for the description of the longitudinal subfield ("electric field") and *CGSM*, for the description of the transversal subfield ("magnetic field"). A mixture of two different notions of *circulation* and *current* has led to two classes of conjugated units, in the framework of the two systems, *CGSE* and *CGSM*. Being different in essence, *circulation* and *current* have obtained the same nomination in contemporary physics, *curren*t, that turned out to be the great error.

Phenomenological measures with fractional powers of reference units led to a whole series of the corresponding phenomenological formulas. An analysis of experiments, based on these formulas, revealed the incorrect values of many fundamental parameters of the microworld.

The definite correlation takes place between measures of physical parameters expressed in subjective *phenomenological units* (existed presently in modern physics) and *objective GCS* units of dialectical physics. We believe that this point, as others, was argued here convincingly enough.

Originated from dialectical physics, the *formula of conversion* (46), $A_e = \sqrt{4\pi\varepsilon_0}\,A$, where $\varepsilon_0 = 1\, g \times cm^{-3}$, of the *phenomenological* parameters A_e of the *CGSE* system (with *fractional powers* of reference units) into the *objective* parameters *A* of the *GCS* system of dialectics (with *integer powers* of reference units), allow us to reconsider and correct completely all system of units in modern physical metrology.

We will proceed to discuss the correct presentation of the well-known units accepted in physics, in magnitude and dimensionality, in the subsequent two Lectures (4 and 5).

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References

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[2] G. P. Shpenkov, *Some Words about Fundamental Problems of Physics*, p. 88 (2011); http://shpenkov.com/pdf/Book-2011-Eng.pdf
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Lecture 4

The Units of Electromagnetism

1. Introduction

Phenomenological dimensionalities of physical quantities of *electromagnetism*, accepted in modern physics, are based on the *erroneous dimensionality of the electric charge* and, hence, on the *erroneous dimensionality of current*. They are expressed by *fractional powers* of basic units of *matter* (*g* or *kg*) and *space* (*cm* or *m*). For this reason, dimensionalities of all other physical quantities related with charge and current, in all areas of physics, are erroneous as well. We have touched on this issue in some extent in previous Lectures.

Phenomenological measures in fact are not yet measures. Strictly speaking, they are only approximation to them. Unfortunately, in modern physics there took precedence a trend to *hide* measures with *fractional powers* of base units by using the complex unit of current hidden under the name *ampere*. The unit of *ampere* was introduced in the International System of Units (SI) in the capacity of the *fourth base unit*. It was made in spite of the fact that this unit is expressed over *fractional powers* of the triad of truly base units of matter, space and time. Obviously, this is nothing more than a plain trick, *hiding the inability* of physicists to solve the problem on the nature of electric charge and, hence, their inability discovering it's true dimensionality.

At the base of the material-ideal Universe, apart from the *Universal Triad* of *matter, space* and *time*, there are no other *notions* of the *Universal meaning, i.e.,* of the same level of universality. Such a physical parameter like the *electric current*, incidentally, one of the many other specific physical parameters characterizing material processes in Nature, *is not universal* in the broadest sense.

Three base units, the units of *mass*, *length* and *time*, are the measures of three primary notions of the Universe (philosophical categories): *matter*, *space* and *time*. They are *undefinable through any other notions*. Whereas the unit of current – *ampere* – is in fact the *combination* of the aforementioned triad of the base units, and, furthermore, it is presented by these universal (base) units absurdly in *fractional powers* [1]:

$$1\,A = \frac{c_r}{10}\frac{1}{\sqrt{10^9}}\;kg^{1/2}cm^{3/2}s^{-2}\,.$$

Therefore, the unit of the electric current (*ampere*) should not be included in the above triad of the truly fundamental (base) units of matter-space-time in principle.

In this Lecture, we proceed to consider from the point of view of dialectical physics the units of the electric current, *ampere*, and the electric charge, *coulomb*, and some of the well-known *derivative units* related with charge and current. The derivative units which we intend to consider here are the units of *potential* (volt, *V*), *velocity-strengths vectors* (*E* and *B*), *B-vector flux*, *resistance* (*R*), *capacity* (C), and *inductance* (*L*). This consideration reveals faults of the contemporary *phenomenological systems* of units, including the International System SI, and demonstrates an advantage of the GCS system of units of dialectical physics, which is the *objective system* adequately reflecting reality based on *three truly base units*. Supplementary data on this issue one can find in [2, 3] and references to them.

2. The units of electric current; the ampere

Let us agree to denote the *unit of an arbitrary physical quantity X* by the symbol *E*(*X*). This is especially convenience, when the unit has no name.

The unit of current the *ampere* was accepted at the First International Congress of Electricians in Paris in 1881 (FICE'1881). The ampere (phenomenological, I_e) was defined as one tenth of the unit of "*current in the magnetic system of units* (*CGSM*)".

$$E(I_e) = \frac{E(I_\gamma)}{10}, \tag{1}$$

where $I_\gamma = \Gamma = \frac{I}{c}$.

Thus, actually, as follows from the above considered in previous Lectures, the talk at the Congress was about the circulation in *CGS* (*CGSE* and *CGSM*) system.

The following relation connects the circulation Γ with the current *I* (see (20) in L. 3 and (66) in L. 8 of Vol. 3),

$$\Gamma = \frac{I}{c} = \frac{1}{c}\frac{dQ}{dt} = \frac{1}{c}\frac{d^2M}{dt^2}\,. \tag{2}$$

Using the relation, $I = \sqrt{4\pi\varepsilon_0}\cdot I_e$ (see (39), L. 3), we arrive at the phenomenological equality similar in form to (2):

$$\Gamma_e = \frac{I_e}{c} = \frac{1}{c}\frac{dQ_e}{dt} = \frac{1}{c}\frac{d^2M_e}{dt^2}\,, \tag{3}$$

where

$$\Gamma = \sqrt{4\pi\varepsilon_0}\cdot\Gamma_e \qquad \text{and} \qquad I_e = \frac{dQ_e}{dt} = \frac{d^2 M_e}{dt^2}\,. \tag{4}$$

The mass M_e, entering in these equalities, is connected with the physical mass by the relations:

$$M = M_e\sqrt{4\pi\varepsilon_0} \qquad \text{and} \qquad M_e = \frac{M}{\sqrt{4\pi\varepsilon_0}}\,, \tag{5}$$

where the dimensionality of the *phenomenological mass* is

$$\dim M_e = g^{1/2} cm^{3/2}\,. \tag{6}$$

We see, thus, that the unconditionally senseless unit of mass, $1g^{1/2}cm^{3/2}$, lies (in a latent form) in the basis of electromagnetic theory. Of course, an understanding of physics of the microworld on the basis of such a unit is impossible.

Let us call the unit of the phenomenological mass M_e the "*electric*" *gram* and denote it by the symbol g_e, *i.e.*,

$$1g_e = 1g^{1/2}cm^{3/2}\,. \tag{7}$$

The "*electric*" (phenomenological) *gram* defines the phenomenological unit of "*electric*" *charge*,

$$1e_e = 1\frac{g_e}{s} = 1g^{1/2}cm^{3/2}s^{-1}. \tag{8}$$

Because the electric (Coulomb) and magnetic laws have the same form, the phenomenological, "electric" and "magnetic", grams are equal. Therefore, the unit magnetic charge is characterized by the same measure (8):

$$1e_m = 1\frac{g_m}{s} = 1g^{1/2}cm^{3/2}s^{-1}. \tag{9}$$

The charges, (8) and (9), define the *units of currents*, electric (longitudinal) and magnetic (transversal):

$$1\,i_e = 1\,\frac{e_e}{s} = 1\,\frac{g_e}{s^2} = 1g^{1/2}cm^{3/2}s^{-2}\,, \tag{10}$$

$$1\,i_m = 1\frac{e_m}{s} = 1\,\frac{g_m}{s^2} = 1g^{1/2}cm^{3/2}s^{-2}\,. \tag{11}$$

Hence, the units of "electric" and "magnetic" currents (as well as of charges) are equal.

Thus, the following four reference units constitute the basis of modern systems of units:

1) the ***gram***, *g*
2) the ***centimetre***, *cm*
3) the ***second***, *s* (12)
4) the "***electric***" ***gram***, $1g_e = 1g^{1/2}cm^{3/2}$

(or the ***electric charge***, $e_e = \dfrac{g_e}{s}$; or the ***electric current***, $i_e = \dfrac{g_e}{s^2}$).

The reference units (12) form the four base units of *SI*:

1) the ***kilogram***, *kg*
2) the ***meter***, *m* (13)
3) the ***second***, *s*
4) the "***electric***" ***kilogram***, 1 kg_e = 1000 g_e

The electric gram defines the electric *unit of current* I_e,

$$E(I_e) = 1\,\dim(c\Gamma_e) = 1\,\dim\left(\frac{d^2M_e}{dt^2}\right) = 1g^{1/2}cm^{3/2}s^{-2} = 1\,g_e\cdot s^{-2}\,, \tag{14}$$

and the *unit of circulation*, corresponding to the unit of current (14),

$$E(\Gamma_e) = \frac{E(I_e)}{c} = 1\dim\left(\frac{d^2M_e}{cdt^2}\right) = 1g^{1/2}cm^{1/2}s^{-1} = 1g_e\cdot cm^{-1}\cdot s^{-1}\,, \tag{15}$$

which forms the unit of electric current the *ampere*:

$$1A_e = \frac{c_r}{10}g^{1/2}\cdot cm^{3/2}\cdot s^{-2} = 2.99792458\cdot 10^9\,g_e\cdot s^{-2} \approx 3\cdot 10^9\,g_e\cdot s^{-2}. \tag{16}$$

where $c_r = \dfrac{c}{cm\cdot s^{-1}}$ is the numerical (relative) value of the basic wave speed at the atomic and subatomic levels (equal in magnitude to the speed of light) [1].

The *phenomenological* basis (12) can be presented by the equivalent basis with use of the *phenomenological* unit of current the *ampere*:

1) the ***kilogram***, *kg*
2) the ***meter***, *m* (17)
3) the ***second***, *s*
4) the ***ampere***, $1A_e = 2.99792458\cdot 10^6\ kg_e\cdot s^{-2}$. (18)

The above-enumerated measures constitute the official basis of *SI* system, which contains the objective kilogram, *kg*, and the *fictitious absurd kilogram*, kg_e, *hidden in the* *ampere*. Such erroneous basis converts scientists into a community of the blind, because it makes impossible seeing the real nature of phenomena. This is why we must abandon this basis immediately. It became a significant brake for the development of modern high technologies and resulted in the huge (invisible for uninitiated) additional economical costs.

An *objective* physical measure and *phenomenological* are related by the equality $I = \sqrt{4\pi\varepsilon_0} \cdot I_e$, where $\varepsilon_0 = 1g \cdot cm^{-3}$. Hence, taking into account (16), we find the *objective* physical measure of current in 1 *ampere*:

$$1A = \sqrt{4\pi\varepsilon_0} \cdot \frac{c_r}{10} 1g^{1/2} \cdot cm^{3/2} \cdot s^{-2} = \sqrt{4\pi} \cdot \frac{c_r}{10} g \cdot s^{-2} \tag{19}$$

or

$$1A = \sqrt{4\pi} \cdot 2.99792458 \cdot 10^9 \; g \cdot s^{-2}. \tag{20}$$

Considering (7), $1g_e = 1g^{1/2} cm^{3/2}$, and denoting the factor $\sqrt{4\pi}$ by the symbol η_0,

$$\eta_0 = \sqrt{4\pi}\,, \tag{21}$$

the phenomenological and objective *ampere* can be presented in the following forms:

$$1A_e = \frac{c_r}{10} g_e \cdot s^{-2}, \tag{22}$$

$$1A = \frac{c_r \eta_0}{10} g \cdot s^{-2}. \tag{23}$$

Thus, the *objective ampere* and its *metric measure* are equal, respectively, to

$$1A = 1.062736593 \cdot 10^{10} g \cdot s^{-2},$$

$$1_m A = 1 \cdot 10^{10} g \cdot s^{-2}. \tag{24}$$

The *metrical measure*, denoted conditionally, by the index *m*, is defined by rounding to an integer the corresponding theoretical objective measure (unit). Please note that the unit (24) is a very big magnitude.

The following phenomenological *ampere* (in *Si* units) (16) corresponds to the objective *ampere* (24):

$$1A_e = \frac{1A}{\sqrt{4\pi\varepsilon_0}} = \frac{c_r}{10} g^{1/2} \cdot cm^{3/2} \cdot s^{-2} = 2.99792458 \cdot 10^9 \; g_e \cdot s^{-2}. \tag{25}$$

Because of (8), $1e_e = 1 \dfrac{g_e}{s} = 1g^{1/2} cm^{3/2} s^{-1}$, we can write

$$1A_e = \frac{c_r}{10} e_e \cdot s^{-1}. \qquad (26)$$

Using the equality $\Gamma_e = \frac{I_e}{c}$, we determine the *phenomenological* "*circulational*" *ampere*, which was erroneously called the "magnetic" *ampere*:

$$1A_{ph,\gamma} = 1A_e \frac{1}{c} = \frac{c_r}{10} e_e \cdot s^{-1} \times \frac{1}{c} cm^{-1} \cdot s = \frac{1}{10} e_e \cdot cm^{-1} \qquad (27)$$

From this we find the *objective* "*circulational*" *ampere* A_γ and its metric measure ${}_mA_\gamma$:

$$1A_\gamma = \frac{1}{c} 1A = \frac{\eta_0}{10} g \cdot cm^{-1} \cdot s^{-1}, \qquad (28)$$

$$1_m A_\gamma = 1\, g \cdot cm^{-1} \cdot s^{-1}. \qquad (29)$$

The *circulational ampere* (28) is the *unit of circulation* Γ, called the *bio*. The circulational metric *ampere* ${}_mA_\gamma$ and the metric *bio* ${}_mBi$ are the same units:

$$1_m Bi = 1_m A_\gamma = 1 g \cdot cm^{-1} \cdot s^{-1}. \qquad (30)$$

3. The units of electric charge; the coulomb

The *coulomb*, phenomenological (C_e) and objective (C), is defined on the basis of the *ampere*:

$$1C_e = 1A_e \cdot s = \frac{c_r}{10} g^{1/2} \cdot cm^{3/2} \cdot s^{-1} = 2.99792458 \cdot 10^9 g_e \cdot s^{-1}, \qquad (31)$$

$$1C = 1A \cdot s = \frac{c_0 \eta_0}{10} g \cdot s^{-1} = 1.062736593 \cdot 10^{10} g \cdot s^{-1}. \qquad (32)$$

The *metric measure* of the objective *coulomb* is

$$1\,{}_mC = 1 \cdot 10^7 kg \cdot s^{-1} = 1 \cdot 10^{10} g \cdot s^{-1}. \qquad (33)$$

Besides, we can conditionally speak about (as it took place in the first half of the 20th century) the "*circulational*" ("magnetic") *coulomb*. The "*circulational*" *coulomb* is the *unit of linear density of the associated mass*. Because $q_\gamma = \frac{1}{c} q$ (see (33), L. 3), the phenomenological "circulational" *coulomb* is

$$1C_{e\gamma} = 1C_e \frac{1}{c} = \frac{1}{10} g_e \cdot cm^{-1}. \qquad (34)$$

The objective and metric measures of the "circulational" *coulomb* are, respectively,

$$1C_\gamma = 1C \frac{1}{c} = \frac{\eta_0}{10}\ g \cdot cm^{-1} = 3.544907701 \cdot 10^{-1} g \cdot cm^{-1}, \qquad (35)$$

$$1_m C_\gamma = 1\ g \cdot cm^{-1}. \qquad (36)$$

4. The units of potential; the volt

The phenomenological unit of potential the *volt* was accepted (at the First International Congress of Electricians in Paris in 1881) as 10^8 units of "potential in *CGSM* system". As follows from above, this definition is incorrect because the *volt* is actually the unit of "circulational" potential.

Let as clarify the correlation between the *potential of exchange* and the circulation (pseudo)potential on the basis of the expression for energy ((36), L. 3):

$$W = Q\varphi = q_e\left(\sqrt{4\pi\varepsilon_0}\,\varphi\right) = q_e\varphi_e = \frac{q_e}{c} \cdot (c\varphi_e) = q_\gamma\varphi_\gamma, \qquad (37)$$

where

$$\varphi_e = \frac{\varphi_\gamma}{c}, \qquad \varphi = \frac{\varphi_e}{\sqrt{4\pi\varepsilon_0}}. \qquad (38)$$

The potential φ_γ represents some characteristic *value of current in the spherical field* of exchange; therefore, it has the dimensionality of the *phenomenological unit of electric current*:

$$E(\varphi_\gamma) = 1\dim\left(\frac{cW}{q_e}\right) = 1 g^{1/2} \cdot cm^{3/2} \cdot s^{-2} = 1 g_e \cdot s^{-2}. \qquad (39)$$

Taking into account the equalities, (38) and (39), and following the definition of the *volt*, we have

$$1V_e = \frac{10^8 E(\varphi_\gamma)}{c} = \frac{1}{299.792458}\, g^{1/2} \cdot cm^{1/2} \cdot s^{-1} \approx \frac{1}{300} E(\varphi_e). \qquad (40)$$

Considering (7) and (10), $1g_e = 1g^{1/2}cm^{3/2}$ and $1\,i_e = 1\,\frac{g_e}{s^2} = 1g^{1/2}cm^{3/2}s^{-2}$, we arrive at the presentation of the unit of volt in the following forms:

$$1V_e = \frac{10^8 E(\varphi_\gamma)}{c} = \frac{10^8}{c_r} g_e \cdot cm^{-1} \cdot s^{-1} = \frac{10^8}{c_r} e_e \cdot cm^{-1} = \frac{10^8}{c_r} i_e \cdot cm^{-1} \cdot s\,, \tag{41}$$

or

$$1V_e = \frac{10^8 E(\varphi_\gamma)}{c} = \frac{1}{299.792458} g_e \cdot cm^{-1} \cdot s^{-1} = \frac{1}{299.792458} i_e \cdot cm^{-1} \cdot s\,. \tag{42}$$

In the literature on metrology, it is common to present the *volt* by the approximate equality. By this way, the relation of the volt with the base speed c is hidden. The *volt objective* is related with phenomenological by the equality, $1V\sqrt{4\pi\varepsilon_0} = 1V_e$, hence, we have

$$1V = \frac{10^8 E(\varphi_\gamma)}{\sqrt{4\pi\varepsilon_0} \cdot c} = 9.4096901 \cdot 10^{-4}\, cm^2 \cdot s^{-1}\,. \tag{43}$$

In a shortened form, the expressions for the *objective* and *metric volt* are

$$1V = \frac{10^8}{\eta_0 c_r} cm^2 \cdot s^{-1}\,, \tag{44}$$

$$1\,{}_mV = 1 \cdot 10^{-3} cm^2 \cdot s^{-1}\,. \tag{45}$$

5. The units of the *E*-vector

The *objective unit* of the speed-strength vector E (or electric vector, or briefly E-vector) is $E(E) = 1\, cm \cdot s^{-1}$.

According to the formula $E_e = \sqrt{4\pi\varepsilon_0} E$ ((44), L. 3), where $\varepsilon_0 = 1\, g \cdot cm^{-3}$, the *phenomenological unit* of the electric vector E is

$$E(E_e) = \sqrt{4\pi\varepsilon_0} \cdot E(E) = 1\, g^{1/2} \cdot cm^{-1/2} \cdot s^{-1}\,. \tag{46}$$

Or, because $1 g_e = 1 g^{1/2} cm^{3/2}$ (7) and $1\, i_e = 1\, \frac{g_e}{s^2} = 1 g^{1/2} cm^{3/2} s^{-2}$ (10), we have

$$E(E_e) = 1 g_e \cdot s^{-1} \cdot cm^{-2} = 1\, e_e \cdot cm^{-2}\,, \tag{47}$$

The analogous *phenomenological* unit of the *magnetic strength vector B* (known as the magnetic induction) was called the *gauss* (*G*). Logically, it must be called the *magnetic gauss* and the unit of *E*-vector (46), the *electric gauss*. However, because these phenomenological units refer to the one class of *phenomenological units* and reflect the similar properties of the field, we will simply call them the *gauss*. Thus, taking into consideration the above stated, the formula of the phenomenological *gauss* can be written as:

$$1G_e = 1g^{1/2} \cdot cm^{-1/2} \cdot s^{-1} = 1\, e_e \cdot cm^{-2}. \tag{48}$$

Now, the *objective electric gauss* will be presented as

$$1G = \frac{E(E_e)}{\sqrt{4\pi\varepsilon_0}} = \frac{1g^{1/2} \cdot cm^{-1/2} \cdot s^{-1}}{\sqrt{4\pi\varepsilon_0}} = \frac{1}{\eta_0}\, cm \cdot s^{-1}, \tag{49}$$

and its metric measure is

$$1_m G = 1\, cm \cdot s^{-1}. \tag{50}$$

The *phenomenological units of strength* (or of the *rate of electric exchange*) – $volt \cdot m^{-1}$ and $volt \cdot cm^{-1}$ – are very small parts of the *gauss*:

$$1V_e \cdot m^{-1} = \frac{10^8 E(\varphi_\gamma)}{c \cdot 100\, cm} = \frac{1}{29979.2458}\, g^{1/2} \cdot cm^{-1/2} \cdot s^{-1} \approx \frac{1}{30000}\, e_e \cdot cm^{-2}, \tag{51}$$

$$1V_e \cdot cm^{-1} = \frac{10^8 E(\varphi_\gamma)}{c \cdot cm} = \frac{1}{299.79458}\, g^{1/2} \cdot cm^{-1/2} \cdot s^{-1} \approx \frac{1}{300}\, e_e \cdot cm^{-2}. \tag{52}$$

For example, the *objective measure* of the vector of velocity of exchange in the "electric" field at the discharge in air with the strength of $50\, kV \cdot cm^{-1}$ is

$$E = 50 \cdot 10^3 \cdot \frac{1}{300} \cdot \frac{1}{\sqrt{4\pi}}\, cm \cdot s^{-1} \approx 47\, cm \cdot s^{-1}. \tag{53}$$

6. The units of the *B*-vector

The two units determine the velocity-strength B (known as the magnetic field induction): the *gauss* and the *tesla*.

Because B-vector is the *vector of the rate of exchange in the magnetic field*, its objective unit is $E(B) = 1 cm \cdot s^{-1}$. Using this, we obtain the phenomenological magnetic *gauss*,

$$1G_e = E(B_e) = 1\dim\left(\sqrt{4\pi\varepsilon_0} \cdot B\right) = 1\, g^{1/2} \cdot cm^{-1/2} \cdot s^{-1} = 1\, e_e \cdot cm^{-2} \tag{54}$$

and the objective measure of the magnetic *gauss* with the metric measure:

$$1G = \frac{E(B_e)}{\sqrt{4\pi\varepsilon_0}} = \frac{1}{\eta_0}\, cm \cdot s^{-1} = 2.820947918 \cdot 10^{-1}\, cm \cdot s^{-1}, \tag{55}$$

$$1_m G = 1\, cm \cdot s^{-1}. \tag{56}$$

By definition, the phenomenological magnetic *tesla* is equal to 10^4 *gauss*:

$$1T_e = 1\cdot 10^4 G_e = 1\cdot 10^4\ e_e \cdot cm^{-2}. \quad (57)$$

The following objective *tesla* with the metric measure corresponds to the phenomenological unit T_e:

$$1T = 1\cdot 10^4 G = \frac{10^4}{\eta_0}\, cm\cdot s^{-1} = 2.820947918\cdot 10^3\ cm\cdot s^{-1}, \quad (58)$$

$$1\,{}_mT = 1\cdot 10^4\,{}_mG = 1\cdot 10^4\ cm\cdot s^{-1}. \quad (59)$$

According to the equation ((28), L. 3), the *gauss* and the *tesla* define the corresponding “circulational” *gauss* and *tesla*:

$$1G_\gamma = c\cdot G_e, \qquad 1T_\gamma = c\cdot T_e = c\cdot 10^4\ e_e\cdot cm^{-2}. \quad (60)$$

7. The units of the *B*-vector flux

Following the definition of the flux, $d\Phi = B\cdot dS\cdot\cos\alpha$, its *phenomenological* unit, called the *maxwell* (Mx_e), is

$$1Mx_e = 1Gs_e\cdot cm^2 = 1\,e_e. \quad (61)$$

The following *objective* units of the flux correspond to this phenomenological unit:

$$`1\,Mx = 1Gs\cdot 1m^2 = 2.820947918\cdot 10^{-1}\ cm^3\cdot s^{-1}, \quad (62)$$

$$1\,{}_mMx = 1\,cm^3\cdot s^{-1}. \quad (63)$$

The *phenomenological* unit of the flux, the *weber* electric (*Wb*), is equal, by definition, to the product $tesla\times m^2$:

$$1Wb_e = 1T_e\cdot 1m^2 = 1\cdot 10^8 Mx_e. \quad (64)$$

The phenomenological *weber* defines the following, *objective* and *metric*, measures:

$$1Wb = 1T\cdot 1m^2 = 2.820947918\cdot 10^7 cm^3\cdot s^{-1} = 1\cdot 10^8\,{}_0Mx, \quad (65)$$

$$1\,{}_mWb = 1\,{}_mT\cdot 1m^2 = 100\ m^3\cdot s^{-1} = 1\cdot 10^8\,{}_0Mx. \quad (66)$$

The “circulational” units of the flux (taking into account (28), L. 3) are represented by the following equalities:

$$1Mx_\gamma = cMx_e, \qquad 1Wb_\gamma = cWb_e. \quad (67)$$

8. The units of resistance, *R*

On the basis of Ohm's law, $R = \frac{U}{I}$, and the formulae, (26) and (42), we find the phenomenological unit of resistance, the *ohm*:

$$1\Omega_e = \frac{1V_e}{1A_e} = \left(\frac{10^8}{c_r} e_e \cdot cm^{-1}\right) / \left(\frac{c_r}{10} e_e \cdot s^{-1}\right) = \frac{10^9}{c_r^2} cm^{-1} \cdot s \qquad (68)$$

or

$$1\Omega_e = \frac{10^9}{c_r^2} cm^{-1} \cdot s = 1.112650056 \cdot 10^{-12}\ cm^{-1} \cdot s\,. \qquad (69)$$

At the First International Congress of Electricians (1881), the *ohm* was defined as 10^9 *units of resistance* in the *magnetic system* (*CGSM*). This definition is incorrect because it rests on Ohm's law in the magnetic system, *i.e.*, on Ohm's law *for circulation*. Unfortunately, invalidation of such a definition is still not understood in metrology. Thus, we deal with

$$\Gamma = \frac{U_\gamma}{R_\gamma}\,. \qquad (70)$$

From this law, we define the following correlation between the "*circulational*" R_γ and *electric* R_e resistances:

$$R_\gamma = \frac{U_\gamma}{\Gamma} = \frac{cU_e}{I_e / c} = c^2 \frac{U_e}{I_e} = c^2 R_e \qquad \text{and} \qquad R_e = \frac{R_\gamma}{c^2}\,. \qquad (71)$$

Hence, the unit of "*circulational*" resistance is

$$E(R_\gamma) = 1\dim(c^2 R_e) = 1\,cm \cdot s^{-1}\,. \qquad (72)$$

Following the recommendations of the aforementioned Congress, we find the circulational *ohm*,

$$1\Omega_\gamma = 10^9\ cm \cdot s^{-1} \qquad (73)$$

and the phenomenological measure of the *electric ohm*, defined on the basis of the electric Ohm's law,

$$1\Omega_e = \frac{10^9 E(R_\gamma)}{c^2} = \frac{10^9}{c_r^2} cm^{-1} \cdot s\,. \qquad (74)$$

Using formulas of the objective units, *volt* (44), $1V = \frac{10^8}{\eta_0 c_r} cm^2 \cdot s^{-1}$, and *ampere* (23), $1A = \frac{c_r \eta_0}{10} g \cdot s^{-2}$, we arrive at the formula of the *objective ohm*:

$$1\Omega = \frac{1V}{1A} = \left(\frac{10^8}{\eta_r c_r} cm^2 \cdot s^{-1}\right) / \left(\frac{c_r \eta_0}{10} g \cdot s^{-2}\right) = \frac{10^9}{\eta_r^2 c_r^2} g^{-1} \cdot cm^2 \cdot s \tag{75}$$

or

$$1\Omega = \frac{10^9}{\eta_0^2 c_r^2 \varepsilon_0} cm^{-1} \cdot s\,, \tag{76}$$

where $\varepsilon_0 = 1\, g \cdot cm^{-3}$. Thus, we have

$$1\Omega = \frac{10^9}{\eta_0^2 c_r^2 \varepsilon_0} cm^{-1} \cdot s = 8.854187817 \cdot 10^{-14} \mu_0 \;\; cm^{-1} \cdot s\,, \tag{77}$$

where $\mu_0 = \dfrac{1}{\varepsilon_0} = 1\, g^{-1} \cdot cm^3$.

The *objective ohm* defines the *metric ohm,*

$$1\Omega = 1 \cdot 10^{-14} \mu_0 \;\; cm^{-1} \cdot s\,. \tag{78}$$

9. The units of capacity, C

We will present the electric capacity through the symbol C (note that the symbol for the coulomb is *C*). On the basis of the ratio $\mathsf{C} = \dfrac{Q}{U}$, we find the *phenomenological* unit of the *electric capacity,*

$$1\mathsf{C}_e = \frac{Q_e}{U_e} = \frac{e_e}{e_e \cdot cm^{-1}} = 1\, cm\,. \tag{79}$$

As the practical measure, the FICE ‘1881 accepted the *farad*; its formula is

$$1F_e = \frac{1C_e}{1V_e} = \left(\frac{c_r}{10} e_e\right) / \left(\frac{10^8}{c_r} e_e \cdot cm^{-1}\right) = \frac{c_r^2}{10^9} cm \tag{80}$$

or

$$1F_e = \frac{c_r^2}{10^9} cm = 8.987551787 \cdot 10^{11} cm\,. \tag{81}$$

The phenomenological *farad* has been defined as 10^{-9} units of capacity in the “magnetic” system. Of course, this definition is related to the “circulational” *farad, i.e.*, to the physical quantity of another nature. The *circulational capacity* is related to the electric capacity as

$$\mathsf{C}_{\gamma} = \frac{Q_{\gamma}}{U_{\gamma}} = \frac{Q_e / c}{cU_e} = \frac{\mathsf{C}_e}{c^2} \qquad \text{and} \qquad \mathsf{C}_e = c^2 \mathsf{C}_{\gamma}\,. \tag{82}$$

Hence, the *unit of the circulational capacity* has the dimensionality different of the dimensionality of the electric capacity,

$$E(\mathsf{C}_{\gamma}) = \frac{E(\mathsf{C}_e)}{\dim(c^2)} = 1\frac{cm}{(cm/s)^2}\,. \tag{83}$$

Following the aforementioned definition, the *farad*, defined on the basis of the "circulational" *farad,* is

$$1F_e = c^2 10^{-9} E(\mathsf{C}_{\gamma}) = \frac{c_r^2}{10^9}\,cm\,. \tag{84}$$

This value corresponds to the formula (80).

The *objective farad* and its *metric measure* are:

$$1F = \frac{1C}{1V} = \left(\frac{c_r \eta_0}{10}\, g \cdot s^{-1}\right) \Big/ \left(\frac{10^8}{\eta_0 c_r}\, cm^2 \cdot s^{-1}\right) = \frac{c_r^2 \eta_0^2}{10^9}\varepsilon_0 \;\; cm \tag{85}$$

or

$$1F = \frac{c_r^2 \eta_0^2}{10^9}\varepsilon_0 \; cm = 4\pi F_e = 1.129409067 \cdot 10^{13} g \cdot cm^{-2}\,, \tag{86}$$

$$1\,{}_mF = 1 \cdot 10^{13} g \cdot cm^{-2}\,. \tag{87}$$

10. The units of inductance, *L*

Using the expression of the inductive voltage,

$$U_e = L_e \frac{dI_e}{dt}\,, \tag{88}$$

we find

$$L_e = \frac{U_e}{\dfrac{dI_e}{dt}}\,. \tag{89}$$

From this we define the *unit of the phenomenological inductance*,

$$E(L_e) = \frac{E(U_e)}{E\left(\dfrac{dI_e}{dt}\right)} = \frac{e_e \cdot cm^{-1}}{e_e \cdot s^{-2}} = 1\,s^2 \cdot cm^{-1}\,. \tag{90}$$

On the basis of circulation, the expression, conjugated to the inductive voltage U_e (88), is

$$U_\gamma = L_\gamma \frac{d\Gamma}{dt}. \tag{91}$$

Hence,

$$L_\gamma = \frac{U_\gamma}{\frac{d\Gamma}{dt}} = \frac{cU_e}{\frac{d(I_e/c)}{dt}} = c^2 L_e \qquad \text{and} \qquad L_e = \frac{L_\gamma}{c^2}. \tag{92}$$

Thus, the unit of the “magnetic inductance” (more precisely, the *circulational inductance*) is

$$E(L_\gamma) = 1(cm \cdot s^{-1})^2 \cdot s^2 \cdot cm^{-1} = 1\,cm. \tag{93}$$

The *unit of inductance*, the *quadrant*, called afterward the *henry*, was defined at the FICE ‘1881 as 10^9 units of inductance in the “magnetic system”:

$$1H_\gamma = 10^9\,cm. \tag{94}$$

This is the *henry* circulational. On the basis of (92), we arrive at the formula of the electric *henry*:

$$1H_e = \frac{10^9 E(L_\gamma)}{c^2} = \frac{10^9}{c_r^2}\,cm^{-1} \cdot s^2 \tag{95}$$

or

$$1H_e = 1.112650056 \cdot 10^{-12} cm^{-1} \cdot s^2. \tag{96}$$

Taking into consideration the relation of objective and phenomenological measures of current and voltage (defined by the formulas, (39) and (42), L. 3), we present the expression (88) in the objective form,

$$U_e = L_e \frac{dI_e}{dt} \quad \Rightarrow \quad \sqrt{4\pi\varepsilon_0} \cdot U = L_e \frac{d\left(I/\sqrt{4\pi\varepsilon_0}\right)}{dt} \quad \Rightarrow$$

$$\Rightarrow \quad U = \frac{L_e}{4\pi\varepsilon_0}\frac{dI}{dt} \quad \Rightarrow \quad U = L\frac{dI}{dt}.$$

These transformations give us the correlation between the theoretical and phenomenological inductance,

$$L = \frac{L_e}{4\pi\varepsilon_0}. \tag{97}$$

This equality defines the *objective henry*:

$$1H_e = \frac{10^9}{4\pi\varepsilon_0 c_r^2}\, cm^{-1}\cdot s^2 = \frac{10^9}{4\pi c_r^2}\mu_0\ cm^{-1}\cdot s^2\,, \qquad (98)$$

or

$$1H = 8.854187816\cdot 10^{-14}\ \frac{cm^2}{g\cdot s^{-2}}\,, \qquad (99)$$

and the *henry* metric,

$$1\,{}_mH = 1\cdot 10^{-13}\ \frac{cm^2}{g\cdot s^{-2}}\,. \qquad (100)$$

11. Conclusion

Thus, we have analysed the units of measurements accepted in modern physics, revealed the reason of their shortcomings and have shown how these units must be presented correctly. With this, we rely on undoubted recognition that the concepts of dialectical physics, concerning physical metric, are true ones.

The measures existing currently in physics are *phenomenological*. Their flaws have its origin due to *lack of knowledge* on the nature of the electric charge and *mixing* of *different notions* related to electric and magnetic units classified in corresponding subsystems (CGSE and CGSM) of the CGS system, in particular, due to giving to some of the principal notions the same name.

As follows from the comprehensive analysis conducted in the framework of dialectical physics, the *phenomenological* measures of modern physics are divided, actually, on *electric* and *circulational*, depending on what current, *electric* or so-called "*magnetic"* (which is in fact the *circulation*, Γ), I_e or $I_m = \Gamma = \frac{I_e}{c}$, has been taken in their basis.

Therefore, a special attention in this Lecture has been turned to the presentation of the units of the electric charge, *coulomb*, and the electric current, *ampere,* in different systems of units. The matter is that just *ignorance* of the true nature of the electric charge, have resulted in the appearance of the erroneous dimensionalities, which were ascribed subjectively to the unit of charge and, hence, to the unit of current. This fact has led to the appearance of corresponding erroneous values and dimensionalities of a whole series of the units of electromagnetism in modern physics.

The main derivative units, related with the units of charge and current that we had the opportunity to consider here are the units of *potential*, *velocity-strengths vectors*, *B-vector flux*, *resistance*, *capacity*, and *inductance*.

For all these units, apart from an analysis of invalidity of their *phenomenological values,* we have shown the way for the conversion of them into the corresponding adequate *objective values* of the GCS system, which are true ones both in magnitude and dimensionality.

We will continue the given subject in the next Lectures.

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Lecture 5

The Unit of Magnetic Moment

1. Introduction

This Lecture is completely devoted to analysis of the DM concepts on the *moment of current* and the *circulation* (magnetic) *moment* in *cylindrical spaces* and on the origin of the unit called the Bohr magneton (μ_B). The latter was accepted in physics for expressing the so-called *magnetic dipole moment of electron*, an existence of which is questioned in the last two decades. The matter is that an introduction of this notion turned out to be a sad consequence of a great mistake made by physicists of that time [1-3]. Nevertheless, presently, the unit μ_B is considered in modern physics as a *physical constant* and as the "*natural" unit* of the magnetic moment.

Erroneousness of the introduction in physics of this unit, *of the accepted numerical value* (according to "2010 CODATA *recommended values*", $\mu_B = 9.27400968 \cdot 10^{-24} \quad J \cdot T^{-1}$), has been shown convincingly enough in previous Lectures (4, 5 and 6 of Vol. 3). Some important aspects concerning this notion, which have not been discussed earlier, are revealed here to complete the understanding of its specific peculiarities, including those related to the definition.

Our consideration takes into account the *longitudinal-transversal structure* of the fields, called in physics as electromagnetic, and peculiarities of their exchange interaction. Analyzing the aforesaid moments (of *current* and *circulation*) from different sides, we demonstrate the dialectical approach inherent in the DM with respect to revealing the veritable physical meaning of investigated physical parameters.

The substantial difference between such two pairs of fundamental notions, characterizing exchange in cylindrical fields of the *circular* current, as *current* and *circulation* and, respectively, as the *moment of current* and the *moment of circulation*, has not been taken into account in physics so far. In result, this circumstance has influenced on all systems of units in physics, including CGS and SI.

The unit of the magnetic moment μ_B analyzed here is one of the *derivative units* of modern physics; it is used at the description of magnetic properties. Recall that the reason of an appearance of μ_B is due to an undisguised adjustment of the mismatching (in two times!) of the erroneously calculated theoretical value of the electron orbital magnetic moment with the experimental value obtained, initially, in the Einstein-De Haas and Barnett experiments [1-3].

Therefore, and taking into account the fact that the *numerical value* for this unit was introduced without a comprehensive analysis, hastily and subjectively, under influence of the invented hypothesis on the electron spin of $\frac{1}{2}\hbar$ in value, we should analyze all aspect related with its origin and features.

It is necessary to understand the physical meaning of the given *derivative unit*, according to the definition, and know the proper mathematical form of its presentation, including in *objective* and *metric* values, with true dimensionality expressed by three *base units* of matter, space, and time (*g*, *cm*, and *s*). This is the subject of the present Lecture.

2. Moments of current and circulation in cylindrical space

Let us suppose that an exchange process occurs in a *cylindrical space* of a round cross-section, for example, of a copper conductor. If we estimate this process using the value of the *current of exchange I*, then the *wave field of current of exchange*, with the azimuthal symmetry, can be presented in the form,

$$\hat{I} = I_0(k_r r)e^{-ikz}e^{-i\omega t} \,. \tag{1}$$

The following elementary relations take place between the *axial gradient*, $\hat{I}_\lambda$, the *rate of change of current*, $\frac{d\hat{I}}{dt}$, and the *current itself*, $\hat{I}$:

$$\hat{I}_\lambda = \frac{d\hat{I}}{dz} = -ik\hat{I} = -i\omega\frac{\hat{I}}{c} = -i\omega\hat{\Gamma}\,, \qquad \frac{d\hat{I}}{dt} = -i\omega\hat{I}\,, \tag{2}$$

where the parameter

$$\hat{\Gamma} = \frac{\hat{I}}{c} \tag{3}$$

should be regarded as the *axial* (*longitudinal*) *circulation*, equal to the *transversal circulation*, because the transversal circulation is related to current by the same equality.

Obviously, an *elementary quantum of circulation* has the form,

$$\hat{\Gamma} = \frac{\hat{I}}{c} = \frac{i\omega\hat{e}}{c} = ik\hat{e}\,. \tag{4}$$

The *transversal current*, related to the deeper level of matter-space-time, always surrounds the longitudinal (axial) current. Because the longitudinal and transversal masses of exchange are equal, the longitudinal and transversal currents are equal as well.

If the *axial current* is closed and a circuit of the current is a *circular* one, then the *moments of current* $\hat{P}_i$ *and circulation* $\hat{P}_\gamma$ will be determined by the following formulas:

$$\hat{P}_i = \hat{I} \cdot S = \hat{I} \cdot \pi a^2\,, \tag{5}$$

$$\hat{P}_\gamma = \hat{\Gamma} \cdot S = \hat{\Gamma} \cdot \pi a^2\,. \tag{6}$$

Evidently,

$$\hat{P}_\gamma = \frac{\hat{I}}{c} \cdot S = \frac{\hat{P}_i}{c}\,. \tag{7}$$

It is seen from Eqs. (4) − (7), the following correlation exists between the *circulational* (*magnetic*) *moment* P_γ and the *electric moment* (*moment of electron charge*, $P_e = ea$):

$$P_\gamma = \frac{\upsilon}{c} P_e\,, \tag{8}$$

where $\upsilon = \omega a$. The correlation between the amplitude a of the wave at the level of *superstructure* and the wave radius $ƛ$ has the form,

$$a = \frac{\upsilon}{c} ƛ\,. \tag{9}$$

Comparing (8) and (9), we arrive at the conclusion that the ***circulational*** *moment* P_γ is the ***charge*** *moment of superstructure* of the wave, and the charge moment P_e is the *moment of basis* of the wave. With that, the “electric” moment is the limiting circulational moment, when $\upsilon \to c$.

The *power of exchange* (or the rate of exchange, or “force” in the language of modern physics) of an electron, as an “electric” monopole, with the surrounding field-space at the basis level, has the form,

$$F_c = eE\,. \tag{10}$$

Let us recall in this connection that the term the *power of exchange* means, in a broad sense, the *rate* (intensity) of vector and scalar exchange (see L. 4, Vol. 1). As was stressed in [4], the word "force" is the unsuccessful name for the vector rate of exchange of momentum, because the notion of *force* is connected with the physiological perception of exchange.

At the level of superstructure, the power of exchange has the name the Lorentz force and is defined, in accordance with the relation of superstructure and basis (9), by the formula,

$$F_\upsilon = \frac{\upsilon}{c} ie \cdot iE \qquad \text{or} \qquad F_\upsilon = \frac{\upsilon}{c} ie \cdot iB\,, \tag{11}$$

where $B = E$.

The vectors, *E* and *B*, are different forms of the presentation of the same field, which (as was noted above) can be called either the electric field or the magnetic field. Comparing the two forms of the power of exchange at the motion of an electron in the longitudinal-transversal field (Fig. 1), we have

$$\frac{\upsilon}{c} eB = m_e \frac{\upsilon^2}{a}\,.$$

From this, considering that $\upsilon = \omega a$ and $q = m\omega$, we obtain the value of the *kinematic charge* of an electron q_e in the longitudinal-transversal field:

$$q_e = m_e \omega = \frac{B}{c} e\,. \tag{12}$$

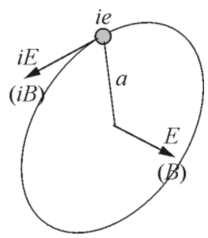

Fig. 1. A graph of motion of an electron in the longitudinal-transversal electric (magnetic) field.

It is clearly seen that at $B = E \to c$, the *kinematic charge* of an electron q_e strives (in magnitude) towards the *exchange charge* of the electron $e = m_e \omega_e$, where ω_e is the fundamental frequency of exchange at the atomic and subatomic levels.

If we present the relation (12) in the form

$$\frac{q_e}{e} = \frac{B}{c} \tag{13}$$

and compare it with the fundamental wave relation,

$$\frac{a}{\lambda} = \frac{\upsilon}{c}, \tag{14}$$

then we can say that the charge *e* is the *wave power of exchange* of the electron at the level of basis (where the basis speed of exchange is equal to *c*).

Since $q_e = m_e\omega$ and $e = m_e\omega_e$, the equality (13) can be presented in the form of the ratio of the frequencies:

$$\frac{\omega}{\omega_e} = \frac{B}{c}, \tag{15}$$

where ω_e is the fundamental frequency of exchange (see L. 4, Vol. 2) of an electron with the surrounding field of matter-space-time. This is the frequency of exchange at the level of basis or the basis frequency of exchange. So that the relation (15) shows that at $B \to c$ the frequency of superstructure (of the circular motion of an electron) ω moves, in magnitude, towards the basis frequency ω_e. In this sense, the *basis frequency* is the *limiting frequency of superstructure*.

On this basis, we can assert that the exchange moment of an electron P_e is the parameter of the basis of the wave, whereas the circulational moment of the electron is the wave superstructure at the orbit. Hence, the "*electric*" *moment* P_e is the *limiting value of the circulational moment*.

Let us now consider the essence of the *current moment*. According to the formula of the relation of *active* and *reactive* charges (see (28) and (29), L. 3, Vol. 2), $q_a = qkr$, or the formula of the relation of *active mass* of dispersion at exchange m_a and *reactive* (associated) masses *m*, $m_a = \frac{q_a}{\omega} = mkr$, the *circular current moment* $P_i = I \cdot S$ (see (5)) can be presented as

$$P_i = \upsilon er = m_e\upsilon\omega_e r = m_e k_e r\upsilon c = m_a \upsilon c\,. \tag{16}$$

Thus, here, $m_a = m_e k_e r$ is the *active mass* of an electron and m_e is its *associated* (*reactive*) *mass*, $k_e = \frac{\omega_e}{c}$, *c* is the *basis* speed, υ is the oscillatory speed of *superstructure*. From the expression (16) it follows that the *moment of current* is the *energy of exchange of basis-superstructure* or the *energy of the wave mass exchange* (see (3), L. 9, Vol. 2).

Thus, the comparison of moments of current and circulation shows that it is incorrectly to call them the "magnetic moments". *The moment of current is the energy and the moment of* *circulation is the charge moment of superstructure*. Strictly speaking, only the last should be called the magnetic moment.

3. The Bohr magneton

Let us define the *phenomenological* values of the orbital moments in the hydrogen atom, taking into account that the radius of the first Bohr orbit r_0, the speed on the orbit υ_0, and the phenomenological charge of an electron *e* are equal, correspondingly, to

$$r_0 = 5.2917721092 \cdot 10^{-11}\, m, \qquad \upsilon_0 = 2.187691263 \cdot 10^{6}\, m \cdot s^{-1},$$
$$e_e = 1.602176565 \cdot 10^{-19}\, C_e.$$

Remember, the *subscript* "*e*" means that we deal with the *phenomenological units* and the unit of the electric charge in *phenomenological coulombs*, C_e (see (31) in L. 4), is equal to

$$1C_e = \frac{c_r}{10} g^{1/2} \cdot cm^{3/2} \cdot s^{-1} = 2.99792458 \cdot 10^{9}\, g^{1/2} \cdot cm^{3/2} \cdot s^{-1}.$$

Consequently, the phenomenological *circulational moment* (7), $P_\gamma = \dfrac{P_i}{c}$, at the first Bohr orbit has the following value,

$$P_{e\gamma} = \frac{\upsilon_0}{c} e_e r_0 = \frac{e_e}{m_e c}\hbar = 6.186953293 \cdot 10^{-32}\, C_e \cdot m, \tag{17}$$

m_e is the electron mass, $\hbar = m_e \upsilon_0 r_0$ is the orbital moment of momentum of the electron on the first Bohr orbit (called the reduced Planck constant or Dirac constant).

If we present this measure in the *phenomenological* "*circulational*" ("*magnetic*") *coulombs*, $C_{e\gamma}$ (see (34), L. 4), then, taking into account that $1C_{e\gamma} = 1C_e \dfrac{1}{c} = \dfrac{1}{10}\, g^{1/2} \cdot cm^{3/2} \cdot s^{-1}$, we obtain

$$P_{e\gamma} = \frac{\upsilon_0}{c} e_e r_0 = \frac{e_e}{m_e c}\hbar = 1.854801935 \cdot 10^{-23}\, C_{e\gamma} \cdot m. \tag{18}$$

The *moment of current*, P_i (16), representing the physical quantity of a quite other nature then P_γ, is defined by the following *phenomenological* measure,

$$P_{ei} = \upsilon_0 e_e r = \frac{e_e}{m_e}\hbar = 1.854801935 \cdot 10^{-23}\, A_e \cdot m^2, \tag{19}$$

where $1A_e = \frac{c_r}{10} g^{1/2} \cdot cm^{3/2} \cdot s^{-2}$ ((22), L. 4).

In accordance with the formulas, ((26) and (57), L. 4), $1A_e = \frac{c_r}{10} e_e \cdot s^{-1}$ and $1T_e = 10^4\ e_e \cdot cm^{-2}$, we have

$$1A_e \cdot T_e \cdot m^2 = \frac{c_r}{10} e_e \cdot s^{-1} \cdot 10^4\ e_e \cdot cm^{-2} \cdot 10^4 cm^2 = c \cdot 10^7 erg = c \cdot 1J\ . \tag{20}$$

Using this equality, the measure of the phenomenological *moment* of *current* can be presented as

$$P_{ei} = \upsilon_0 e_e r_0 = \frac{e_e}{m_e}\hbar = 1.854801935 \cdot 10^{-23} c\quad J \cdot T_e^{-1}\ . \tag{21}$$

If we will divide (21) by the speed *c*, we will obtain the *moment of circulation*, *i.e.*, the "*magnetic*" *orbital moment*, $P_{e\gamma} = \frac{P_{ei}}{c} = \mu_{orb}$:

$$\mu_{orb} = \frac{\upsilon_0}{c} e_e r_0 = \frac{e_e}{m_e c}\hbar = 1.854801935 \cdot 10^{-23}\quad J \cdot T_e^{-1} \tag{22}$$

Phenomenology ascribes to the Bohr orbit, erroneously and unfoundedly, only the *half value* of the "*magnetic*" *orbital moment* (22) and the second missing part of the later attributes, subjectively, to the *electron spin moment*, in accordance with the *spin hypothesis*. In reality, the electron does not have the proper moment of such a value. We have already discussed this matter in detail (see Lectures 4, 5 and 6 of Vol. 3). Accordingly, it should be stressed again, *the spin hypothesis is incorrect*.

The *half value of the orbital moment* (22), $\frac{1}{2}P_{e\gamma} = \frac{1}{2}\mu_{orb}$, has obtained the name the *Bohr magneton* and designated as μ_B. Thus, the phenomenological value of the Bohr magneton is

$$\mu_{eB} = \frac{1}{2}\mu_{orb} = \frac{1}{2}\frac{\upsilon_0}{c} e_e r_0 = \frac{e_e}{2m_e c}\hbar = 9.274009676 \cdot 10^{-24}\quad J \cdot T_e^{-1}\ . \tag{23}$$

The following half of the *current orbital moment* (21), $\frac{1}{2}P_{ei}$, corresponds to this half of the *circulational* (*magnetic*) *moment*:

$$\frac{1}{2}P_{ei} = \frac{1}{2}\upsilon_0 e_e r_0 = \frac{e_e}{2m_e}\hbar = 9.274009676 \cdot 10^{-24} c\quad J \cdot T_e^{-1}. \tag{24}$$

Physicists of the first half of the 20th century have rested on the measure (23), which is the value of the initial Bohr magneton. Unfortunately, in the scientific literature, the basis speed of the wave *c* (the speed of light) quite often is omitted in the formula (23), which is presented as

$$\mu_{eB} = \frac{1}{2}\upsilon_0 e_e r_0 = \frac{e_e}{2m_e}\hbar = 9.274009676\cdot 10^{-24} \quad J\cdot T_e^{-1}, \tag{25}$$

that is incorrect, because

$$\mu_{eB} = \frac{e_e}{2m_e}\hbar \neq 9.274009676\cdot 10^{-24} \quad J\cdot T_e^{-1}. \tag{26}$$

It is necessary to not use the incorrect equalities of the type (25).

4. The objective orbital magnetic moment of the electron

The magnetic field, *i.e*., the transversal electric field appearing around a conductor with current, is the field of stellar systems of the microworld (microgalaxies), whose cores are represented by electrons, as their centers. As a whole, this is the wave process, which is described by the wave of current (4) and the circular orbital moment (22).

To an equal extent, the central magnetic (electric) field is the field with discrete structures of the one level, where there are also electrons. And the transversal magnetic field is the field with discrete structures of the lower level, represented by the satellites of electrons and other elementary microobjects.

All above considered moments were presented by the *phenomenological* measures, which have the same numerical values as objective theoretical measures. For example, the theoretical *circulational* (magnetic) *moment of the electron orbit*, in *objective measures* of *joule* and *tesla*, is

$$\mu_{orb} = P_\gamma = \frac{\upsilon_0}{c} e r_0 = \frac{e}{m_e c}\hbar = 1.854801935\cdot 10^{-23} \quad J\cdot T^{-1}. \tag{27}$$

Recall that, in view of the discovery of its nature, the electron charge has the following objective value and dimensionality,

$$e = 1.702691665\cdot 10^{-9}\, g\cdot s^{-1}$$

The objective *tesla*, according to ((58), L. 4), is defined through the base units by the measure,

$$1T = \frac{10^4}{\sqrt{4\pi}}\ cm\cdot s^{-1} = 2.820947918\cdot 10^3\ \ cm\cdot s^{-1}. \tag{28}$$

Hence, taking into consideration that $1J = 10^7 erg$ and $1T = 10^4 G$, we have

$$\mu_{orb} = \frac{\upsilon_0}{c} er_0 = \frac{e}{m_e c}\hbar = 6.575101667\cdot 10^{-20}\ erg\cdot G^{-1}, \tag{29}$$

or, because $erg\cdot G^{-1} = g\cdot cm\cdot s^{-1}$,

$$\mu_{orb} = 6.575101667\cdot 10^{-20}\ \ g\cdot cm\cdot s^{-1} \tag{29a}$$

As we see, the *objective circulational* (magnetic) *moment* of the electron orbit (of the transversal field of exchange) is determined through the *three basic units* of matter, space and time (*g*, *cm* and *s*).

If we will use the *metric objective tesla*, $1\,{}_mT = 10^4\ cm\cdot s^{-1}$, and the metric unit of energy, the *joule*, then, although the circulational moment will be characterized by the new metric measure, $J\cdot{}_mT^{-1}$, the numerical value is the same, as (29a) (considering that $J\cdot{}_mT^{-1} = 10^3\,g\cdot cm\cdot s^{-1}$):

$$\mu_{orb} = \frac{\upsilon_0}{c} er_0 = \frac{e}{m_e c}\hbar = 6.575101667\cdot 10^{-23}\ \ J\cdot{}_mT^{-1}. \tag{30}$$

Thus, the numerical value of *objective measures is not changed* under transition from the measure, expressed in reference units, to the new metric measure. This is a very important feature of metric measures of the *GCS* system. The metric units of *GCS* system give the objective values of microparameters, whereas the measure (27) distorts the object measure of the circulational moment. This is stipulated by the fact that the objective *tesla* contains the factor $\sqrt{4\pi}$, having no relation to the moment, but reflecting the errors of the past.

Moreover, practically, all *phenomenological* measures contain the speed of light *c*. This fact once more stresses their artificial character. This is why, we should refuse such measures.

Finally, let us consider the relation of the *circulation of basis and superstructure*.

The relation between *circulation* and *current* is defined by the formula (3), $\hat{\Gamma} = \frac{\hat{I}}{c}$. We can present this equality in the following form:

$$\hat{\Gamma} = \frac{\hat{I}}{c} = \frac{\upsilon}{c}\frac{\hat{I}}{\upsilon} = \frac{\upsilon}{c}\hat{\Gamma}_c, \tag{31}$$

where

$$\hat{\Gamma}_c = \frac{\hat{I}}{\upsilon} \tag{32}$$

is the *circulation of basis*, because $\hat{\Gamma} = \frac{\hat{I}}{c}$ is the *circulation of superstructure*.

The equality (32) defines the correlation between the *density* of circulation of basis γ_c and the *density* of current of basis J_c:

$$\gamma_c = \frac{J_c}{\upsilon}. \tag{33}$$

Since the *density* of current of basis is equal to $J_c = ne\upsilon$, the *density of circulation* will be defined by the expression,

$$\gamma_c = ne. \tag{34}$$

Thus, the density of circulation γ_c will be defined by the *density of power of exchange* (the *density of charge*) at the level of basis. Because the density γ_c is determined by the electron charge *e*, this charge, representing by itself an elementary quantum of power of exchange, relates to the wave basis level. And in this sense, the *electron charge* is one of the limiting quanta of this level.

5. Conclusion

Moments of current and circulation in *cylindrical spaces* and characteristic features of the unit the Bohr magneton (μ_B), considered in modern physics as a *physical constant* and as the "*natural" unit* of the magnetic moment, were discussed here.

The *longitudinal-transversal structure* of the fields, called in physics as *electromagnetic*, and peculiarities of their exchange interaction were taken into account at the consideration.

It was shown that the *moment of current is*, in essence, *the energy of exchange of basis-superstructure* or the *energy of the wave mass exchange*, and the *moment of circulation is the charge moment of superstructure* of the wave. The *moment of circulation*, strictly speaking, is that we call the *magnetic moment*. With that, the "electric" moment can be regarded as the limit circulational moment, when $\upsilon \to c$.

The *moment of circulation*, *i.e.*, the *orbital* "*magnetic*" *moment* (22), in the *phenomenological measures* with the dimensionality in *joule* and *tesla*, is equal to

$$\mu_{orb} = \frac{e_e}{m_e c}\hbar = 1.854801935 \cdot 10^{-23} \quad J \cdot T_e^{-1}. \tag{35}$$

Recall that the above value of μ_{orb} does not take into account insignificant additional terms (see (6) in L. 4 of Vol. 3) conditioned by perturbation effects due to the wave structure and wave behavior of such a wave dynamic system which is the hydrogen atom (details are in L. 4, 5 and 6 of Vol. 3). The peculiarity of the *wave behavior*, caused by the *wave origin* and, hence, the *wave structure*, is reflected in the fine structure of optical spectra, including the phenomenon known as the Lamb shift.

Thus, according to the definition, μ_{orb} is presented in the following three equivalent forms:

$$\mu_{orb} = \frac{I}{c} S, \qquad \mu_{orb} = \frac{\upsilon_0}{c} e r_0, \qquad \text{and} \qquad \mu_{orb} = \frac{e}{m_e c}\hbar, \tag{36}$$

where S is the area of the circuit (orbit) and $\hbar = m_e \upsilon_0 r_0$. For the first Bohr orbit, $S = \pi r_0^2$ and $\upsilon_0 = \omega r_0 = \frac{2\pi}{T_{orb}} r_0$ (T_0 is the period of electron revolution along the orbit). Hence, equalities (36) can be presented also in the following form:

$$\mu_{orb} = \frac{1}{c}\frac{2e}{T_{orb}} \pi r_0^2. \tag{37}$$

From this it follows that an *average value of the circular current* generated by the orbiting electron in the hydrogen atom is equal to

$$I = \frac{2e}{T_{orb}}. \tag{38}$$

The strict calculations leads to the same value of the circular current (see Part 2 "*Electron spin*" in [5] and Lectures 4 – 6 of Vol. 3).

As we have discussed earlier and noticed also here, the *half value of the orbital moment* (35) was ascribed subjectively to the *electron spin magnetic moment*. This half has been called the *Bohr magneton* (μ_B). In phenomenological units tagged with corresponding designations (the subscript *e*) accepted here, it is written as

$$\mu_{eB} = \frac{1}{2}\mu_{orb} = \frac{e_e}{2 m_e c}\hbar = 9.274009676 \cdot 10^{-24} \quad J \cdot T_e^{-1}. \tag{39}$$

An introduction of such a physical constant, accepted as "fundamental", was made by theorists at that time in order to correct a *great theoretical error* (which they, unfortunately, have not noticed) made during calculation of a *circular current* generated by the orbiting electron in the hydrogen atom. The value of the circular current that they have obtained, $I = \frac{e}{T_{orb}}$, is two times less of the real value (38).

To present time there are quite enough evidences, including the data presented in the Lectures, in order to state once more that, really, *the spin hypothesis* (an introduction of which is based on the aforesaid elementary error) *is fallacious* [5]. Nevertheless, in spite of the disclosed inconsistency with reality, the official physics does not want to notice this, and the spin concept as before is widely used for explanation of different phenomena, in the creation of different hypotheses and theories.

We have discussed in the Lectures the difference between *current* and *circulation*. Confusion with these notions (along with ignorance of the nature and, hence, the true dimensionality of the electric charge) has had an influence on present systems of units accepted in physics. In this Lecture, we have considered the analogous difference, respectively, between the *moment of current* and the *moment of circulation*.

Naturally, the aforesaid negative circumstance (confusion) has influenced also on the unit of the magnetic moment, the Bohr magneton. In particular, the muddle observed sometimes in scientific literature with its mathematical presentation (formula of μ_B with or without the factor c) leads to inconsistency of the value, originated from the formula written in the given incorrect form, to the indicated dimensionality and to the accepted (standard, reference) numerical value of μ_B.

The Bohr magneton in the adequate units, *objective* and *metric*, inherent in the GCS system used in the DM, has been presented here at the end of the discussion. Generally, as follows from the comprehensive analysis conducted in the DM, the *metric* units of *GCS* system give the objective values of microparameters. As an example, an advantage of metric units of the GCS system has been demonstrated here on the *metric measure* of the unit the Bohr magneton.

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Lecture 6

The Units, ε_0 and μ_0, and Vectors, ε_0E and ε_0B, of the DM

1. Introduction

The "physical" constants under consideration here: *electric constant* ε_0 and *magnetic constant* μ_0, are well-known not only to all physicists but still from a school bench to every educated peoples as well. They are also known as *permittivity* (epsilon-naught) and *permeability* (mu-naught) of free space. Here are accepted numerical values and dimensionalities of the constants, respectively, recommended (in 2012) officially for using in physics [1]:

$$\varepsilon_0 = (\mu_0 c^2)^{-1} = 8.854187817... \times 10^{-12}\, F \cdot m^{-1}, \tag{1}$$

$$\mu_0 = 4\pi \times 10^{-7}\, N \cdot A^{-2} = 12.566370614... \times 10^{-7}\, N \cdot A^{-2}. \tag{2}$$

Originally, the dimensionality of μ_0 (with the same numerical value $4\pi \times 10^{-7}$) was accepted as $H \cdot m^{-1}$, so that, along with (2), physicists simultaneously still use the following "constant",

$$\mu_0 = 4\pi \times 10^{-7}\, H \cdot m^{-1} = 12.566370614... \times 10^{-7}\, H \cdot m^{-1}. \tag{2a}$$

We have considered already some of their features, caused by the confusing origin of these values, in L. 9 entitled "*Elementary Laws of Transversal Exchange*" of Vol. 3. There we have shown absurdity of an introduction in physics such, to put it mildly, strange "constants", judging by their farfetched values and dimensionalities, and, hence, invalidity (groundlessness) of placing them in a series of the "*fundamental physical constants of physics and chemistry*".

These so-called "*constants*" are artificially constructed factors, introduced first (we mean ε_0) in Coulomb's law for presentation its in SI units. They do not have the physical meaning ascribed to them because they, (1) and (2a), actually, are *dimensionless prime numbers* multiple to π; and (2) having, in fact, the dimensionality $cm^{-2}\times s^{2}$ is not in conformity with (2), *etc*. We will show this here. Such a conclusion, to which we have come, is very significant for physics from all points of view. First of all, understanding of this fact must stimulate the revival of the neglected attention to the problem on the nature of charges, ignorance of which was the main reason of an appearance of such fictitious "constants".

In this connection, we sure that the solution of the charge problem, which was found two decades ago thanks to the DM theory formed to that time (this solution was considered in our previous Lectures), sooner or later nevertheless will be analyzed and accepted by physicists. And aforesaid imaginary "constants" will be removed from physics and replaced with the proper parameters, about which we will talk here. Undoubtedly, these steps will promote exiting from the dead-end in which the present state of physics turned out to be. Therefore, in this Lecture, we go back again for continuation of the begun earlier consideration concerning the given notions, elucidating this times some of their little-known aspects.

A comprehensive analysis conducted in the framework of the DM theory has disclosed the true values (in magnitude and dimensionality) of the so-called "*fundamental constants*" and showed that the presented above "constants", (1) and (2a), are in fact equal to the prime dimensionless numbers multiple to π [2, 3], namely,

$$\varepsilon_0=\frac{1}{4\pi} \qquad \text{and} \qquad \mu_0=4\pi. \tag{3}$$

The clear (sharp) difference between the presentation of the values, (1, 2, 2a) and (3), for the *same notions* ("constants" ε_0 and μ_0) naturally calls many various questions. Therefore, we decided to discuss again this issue in this Lecture presenting this time an additional material, extending the aforesaid consideration initiated earlier in L. 9 of Vol. 3.

The second part of the Lecture is devoted to analysis of the physical meaning and dimensionality of the vectors **D** (*electric displacement field* or *electric flux density*) and **H** (*magnetic field strength*), according to the definition accepted in modern physics, which are related with the vectors **E** (*electric field strength*) and **B** (*magnetic induction* or *magnetic flux density*) by the aforementioned phenomenological "*physical*" constants ε_0 and μ_0, (1) and (2): $\mathbf{D}=\varepsilon_0\mathbf{E}$ and $\mathbf{B}=\mu_0\mathbf{H}$.

According to the DM [4], the *longitudinal-transversal* field of exchange is characterized by the vector of *velocity-strength* **E** and by the *vector of density of momentum* (of associated field mass of longitudinal exchange) **D:** $\mathbf{D}=\varepsilon_0\mathbf{E}$ or $\mathbf{E}=\mu_0\mathbf{D}$.

The **B** vector is, respectively, the vector of *transversal velocity-strength* and **H** is the *vector of density of the transversal momentum*. They are related as: $\mathbf{H}=\varepsilon_0\mathbf{B}$ or $\mathbf{B}=\mu_0\mathbf{H}$. In these cases (in view of the DM), the factors ε_0 and μ_0 are the *derived physical units* having the following meaning:

$$\varepsilon_0 = 1g \cdot cm^{-3} \tag{4}$$

is the *absolute unit density*, and

$$\mu_0 = \frac{1}{\boldsymbol{\varepsilon_0}} g^{-1} \cdot cm^3 \tag{5}$$

is its inverse value (the unit absolute *volume density*).

To distinguish the *units* ε_0 and μ_0 of the DM ((4) and (5)) from the aforementioned *phenomenological* “physical constants” of modern physics ((1), (2), (2a), and (3)), having the same designations, we will *designate* the latter (*phenomenologica*l “*constants*”) with the subscript “*e*0*”* and present them as: ε_{e0} and μ_{e0}.

2. Phenomenological constants, $\boldsymbol{\varepsilon_{e0}}$ and $\boldsymbol{\mu_{e0}}$

Let us compare the right form of the Law of Central Exchange of the DM (see (19), L. 4 of Vol. 2),

$$F = \frac{qQ}{4\pi\varepsilon_0 r^2}\ , \tag{6}$$

where $\varepsilon_0 = 1g \cdot cm^{-3}$ (4) and q and Q are *exchange charges* expressed in $g \cdot s^{-1}$, with a particular case of this law – Coulomb’s law in the form as it was presented at the beginning in phenomenological CGS units:

$$F = \frac{q_e Q_e}{r^2}\ . \tag{7}$$

In this expression the dimensionality of the point *electric charges* is expressed in $g^{1/2} \cdot cm^{3/2} \cdot s^{-1}$.

As is evident, the difference between (6) and (7) is essential, both in form and contents; about this we have already had a corresponding talk. Please pay attention to the absence of the factor 4π in the denominator of the law (7). The presentation of Coulomb’s law of interaction of electric charges, having the spherical form, along the direct line in the form (7) is, obviously, incorrect. As one of the first, Heaviside Oliver (1850-1925), the British electronic engineer and physicist, has noted that. This was understood also by some other well-known physicists of that time. It was necessary to take into account the spherical character of the charges pervasive throughout the spherical angle of 4π steradian and their interaction along the line in one direction. Heaviside has attempted to remove the indicated fault and correct the mathematical form of the law (7). However, contemporaries did not want to hear his argued opinion.

And only afterwards (at the so-called "rationalization") the missing factor 4π was introduced, at last, in the denominator of the formula (7). But unfortunately, this has been made incorrectly. Namely, simultaneously, the inverse factor $\frac{1}{4\pi}$, which was denominated as ε_0 (ε_{e0} in our designations), was added there for all that, for compensation:

$$F = \frac{q_e Q_e}{r^2} \qquad \Rightarrow \qquad F = \frac{q_e Q_e}{4\pi\left(\frac{1}{4\pi}\right)\cdot r^2} \qquad \Rightarrow \qquad F = \frac{q_e Q_e}{4\pi\varepsilon_{e0} r^2}\,. \tag{8}$$

By this way, in fact, it was introduced the "*electric constant*" of the following value,

$$\varepsilon_{e0} = \frac{1}{4\pi}\,. \tag{9}$$

Accordingly, since $\mu_{e0} = \frac{1}{\varepsilon_{e0}}$, the so-called "*magnetic constant*" has the value,

$$\mu_{e0} = 4\pi\,. \tag{10}$$

Considering the above values ((9) and (10)) as *physical* constants, there was a need to attribute to them the corresponding dimensionalities, as it is inherent in all physical quantities. But what dimensionalities they must have?

Let us consider first the transformation of the "magnetic constant" (10) into (2a), which then was transformed volitionally into (2) (and was recommended finally in physics). The change $H\cdot m^{-1}$ to another strange dimensionality $N\cdot A^{-2}$ led to the essentially different new numerical value for μ_{e0}, in comparison with (10).

Remember that the *circulational henry*, determined according to ((94), L. 4) by the measure equal approximately to a quarter of Earth's meridian, is equal to

$$1H_\gamma = 10^9\,cm = 10^7\,m\,. \tag{11}$$

If we product this measure by its inverse value, $10^{-7}\,m^{-1}$, we obtain, naturally, the numerical unit:

$$10^7\,m \times 10^{-7}\,m^{-1} = 1\,. \tag{12}$$

Thus, the *numerical unit* can be presented in the form of the following "*dimension*" *quantity*:

$$1 = 10^{-7} H_{\gamma} \cdot m^{-1} . \qquad (13)$$

Obviously, it is a plain manipulation, which has no sense and, therefore, is absurd.

By this way it was created a new "physical constant", the so-called "magnetic constant", which was presented in physics in the *SI* units in the following form:

$$\mu_{e0} = 4\pi \times 1 = 4\pi \times 10^{-7} H_{\gamma} \cdot m^{-1} . \qquad (14)$$

In Eq. (2a), $H=H_{\gamma}$. As follows from the "*CODATA Recommended Values of the Fundamental Physical Constants*: *2010*" [1], the "magnetic constant" in the last time has acquired arbitrarily the new dimensionality in $N \cdot A^{-2}$ at the same numerical value as (14), so that it is recommended now for using officially in the form,

$$\mu_{e0} = 4\pi \times 10^{-7} \ N \cdot A^{-2} . \qquad (15)$$

However, because $N \times A^{-2} = \dfrac{10^7}{c^2} cm^{-2} \cdot s^2$ and $H_{\gamma} \times m^{-1} = 10^7$, (14) does not equal to (15):

$$4\pi \times 10^{-7} H_{\gamma} \cdot m^{-1} \neq 4\pi \times 10^{-7} \ N \cdot A^{-2} . \qquad (16)$$

If we take into account the values of the SI units, newton (*N*) and ampere (*A*), expressed in base units of matter (*g*), space (*cm*) and time (*s*) (see L. 4 of this volume), we arrive at the following true *value* of the "magnetic constant" corresponding to (15),

$$\mu_{e0} = \frac{1}{c^2} 4\pi \ cm^{-2} \times s^2 . \qquad (17)$$

Thus, in modern physics (in the same system of units, SI), in fact, there are used two different (dimensionless and dimensional) "magnetic constants", (14) and (15), or:

$$\mu_{e0} = 4\pi \qquad \text{and} \qquad \mu_{e0} = \frac{1}{c^2} 4\pi \ cm^{-2} \times s^2 \qquad (18)$$

We have analyzed this duality (in L. 9 of Vol. 3) and, therefore, will not repeat the analysis here. However, it should be noted that μ_{e0} is expressed in scientific literature also in other dimensionalities not mentioned here, but absurd in the same degree.

A majority of constants in physics was composed in such a spirit, unfortunately. Whether it is possible to treat this as a scientific approach? Undoubtedly, it has nothing to do with science. Those who have done such a "rationalization" (underlying of the creation of the international system of units, SI) have actually regarded nature as the subjective reality. They have operated with the unlimited freedom as if they have dealt with an abstract mathematical game. Such transformations remind us the circus juggles.

It should be noted that modern physics continues, as before, its destructive work, creating an appearance of solutions, being unable to solve them. A chain of the formal transformations, like (8), clearly demonstrates this. Obviously, this is rightful and desirable in a circus, but it is undesirable and inadmissible in science.

The following steps in transformations (8) were devoted to the expression of Coulomb's law in the SI units keeping the *fractional powers* of reference units for measures of electromagnetism: the force F in *newtons* (N), the distance r in *meters* (m), and charges, q_e and Q_e, in *phenomenological coulombs* (C_e).

Here are these three historical steps:

1. $$F=\frac{q_e Q_e}{4\pi\varepsilon_{e0} r^2} \quad \Rightarrow \quad F=10^{-5} N\cdot dyn^{-1}\cdot\frac{q_e Q_e}{4\pi\varepsilon_{e0} r^2} \quad \Rightarrow$$

2. $$F=\frac{10^{-5} N\cdot dyn^{-1}}{\left(\dfrac{100\,cm}{m}\right)^2}\cdot\frac{q_e Q_e}{4\pi\varepsilon_{e0}\left(r\dfrac{m}{100\,cm}\right)^2} \quad \Rightarrow$$

3. $$F=\frac{10^{-5} N\cdot dyn^{-1}}{10^4 cm^2\cdot m^{-2}}\cdot\frac{q_e Q_e\left(\dfrac{c_r}{10}e_e/C_e\right)^2}{4\pi\varepsilon_{e0} R^2\left(\dfrac{c_r}{10}e_e/C_e\right)^2} \quad (19) \quad \Rightarrow \quad F=\frac{q_C Q_C}{4\pi\varepsilon_{e0} R^2}\,, \quad (20)$$

where $R=\left(r\dfrac{m}{100\,cm}\right)$ is the distance in *meters*; $q_C=q_e\dfrac{C_e}{\dfrac{c_r}{10}e_e}$ is the charge in *coulombs* (see (31), L. 4); $1C_e=\dfrac{c_r}{10}e_e$; $1e_e=1g^{1/2}cm^{3/2}s^{-1}$ (see (8), L. 4); ε_{e0} is the "electric constant" (in (19), in the CGS system; in (20) – in SI units).

The *new numerical value* of ε_{e0} (presented in (20)) and its resulting *pseudo dimensionality* were defined from *comparison* of (19) and (20). Namely, after substituting phenomenological (CGS) charges, q_e and Q_e, with the phenomenological (SI) charges, q_c and Q_c, Eq. (19) took the form:

$$F=\frac{q_C Q_C}{4\pi R^2}\left[\left(\frac{10^{-5} N\cdot dyn^{-1}}{10^4 cm^2\cdot m^{-2}}\right)\frac{1}{\dfrac{1}{4\pi}}\left(\frac{c_r}{10}e_e/C_e\right)^2\right] \quad (21)$$

which was presented further in the final form (16) of Coulomb's law in SI units. In equation (21), the factor $\frac{1}{4\pi}$ in the denominator is the *value* of the "electric constant" ε_{e0} in Coulomb's law (8) presented in the CGS system of units and remained in (19).

Thus, an expression in square brackets in (21) presents the factor $\frac{1}{\varepsilon_{e0}}$ in Coulomb's law (20) presented in SI units after the above conversion ("rationalization").

Taking into account that $\frac{dyn\cdot cm^2}{e_e^2}=1$ and $\frac{C_e^2}{N\cdot m^2}=\frac{F_e}{m}$ (where $1F_e=\frac{c_r^2}{10^9}\,cm$, see (80), L. 4), from (20) and (21) it follows that ε_{e0} has the following value in SI units:

$$\varepsilon_{e0}=\frac{1}{4\pi}10^9\,\frac{dyn\cdot cm^2}{N\cdot m^2}\cdot\frac{100}{c_r^2}\frac{C_e^2}{e_e^2}=\frac{10^{11}}{4\pi c_r^2}\cdot\frac{C_e^2}{N\cdot m^2}=\frac{10^{11}}{4\pi c_r^2}\,F_e\cdot m^{-1}. \tag{22}$$

Thus, we have demonstrated how physicists artificially created the so-called "*electric constant*" of the value,

$$\varepsilon_{e0}=\frac{10^{11}}{4\pi c_r^2}\,F_e\cdot m^{-1}=8.854187818\cdot 10^{-12}\,F_e\cdot m^{-1}, \tag{23}$$

which become considered since then as one of the fundamental constants of physics.

Although, for the first glance, all of this appears sound and rational, however, in essence, the above disclosed manipulation, which led to the new "physical constant" ε_{e0}, is an obvious nonsense. Thus, those who were unable to solve the problem on the metrology of electromagnetic phenomena have endeavored to hide it in the formal pseudo-scientific constructions. Since the latter still exist in physics, we must recognize that they succeeded in their endeavors.

Taking into account that the *farad*, according to the formula ((80), L. 4), has the measure

$$1F_e=\frac{c_0^2}{10^9}\,cm=\frac{c_0^2}{10^{11}}\,m, \tag{24}$$

from (23) we find that the real value of the "*electric constant of vacuum*" is equal to (9), *i.e.*, to the number $\frac{1}{4\pi}$, actually:

$$\varepsilon_{e0}=\frac{10^{11}}{4\pi {c_0}^2}\frac{F}{m}=\frac{10^{11}}{4\pi {c_0}^2}\frac{{c_0}^2}{10^{11}}\frac{m}{m}=\frac{1}{4\pi}. \tag{25}$$

Obviously, the factor in the equation (8), $4\pi\varepsilon_{e0}=1$, expresses nothing reasonable. In this way, only an imitation of the reform in metrology of electromagnetic processes, but not the reform itself (that led to the SI units), was carried out.

Nothing hindered, at that time, to compare the two forms of Coulomb' law,

$$F=\frac{qQ}{4\pi r^2} \qquad \text{and} \qquad F=\frac{q_e Q_e}{r^2}, \tag{26}$$

and to obtain, at least, the correct *numerical values* of the charges:

$$F=\frac{q_e Q_e}{r^2} \qquad \Rightarrow \qquad F=\frac{(\sqrt{4\pi}\cdot q_e)(\sqrt{4\pi}\cdot Q_e)}{4\pi r^2} \qquad \Rightarrow \qquad F=\frac{qQ}{4\pi r^2}. \tag{27}$$

Thus,

$$Q=\sqrt{4\pi}q_e. \tag{28}$$

It was very simple to perform such an operation, but why it was not done is understandable.

A simple reform of (27) – (28), if only it would be realized, the explicit error could be removed in the description of the spherical field of exchange. Of course, the incorrect dimensionality of the electric charge, as before, would be incorrect, because the coefficient ε_0 in (27) and (28) is equal to the numerical (dimensionless) unit. As we know from the present Lectures, this problem has been solved as soon as the new theory (DM) has appeared [4]. This theory turned out to be adequate to reality. About this we can judge by the unique results at the level of scientific discoveries obtained in its frameworks and considered in these Lectures.

As we see, the worth of scientific truth turned out to be lower than the ambitions of the legislators in science at that time. As a result, instead of the aforementioned extremely simple reform (27) – (28), science has toiled with the fictitious "rationalization" for decades, leaving unsolved the important problems of metrology of electromagnetic processes.

If we write Coulomb's law for "magnetic" charges,

$$F=\frac{q_m M_m}{r^2}, \tag{29}$$

we will arrive at the system of measures on the basis of the given charges. Measures of magnetic charges are equal to the measures of electric charges. Therefore, all above-presented parameters and their measures in the equal degree are valid for the magnetic field. However, here as well their own "circulational" measures, incorrectly called the "magnetic" ones, appear.

3. The D and H vectors

The longitudinal-transversal field of exchange is characterized (according to the DM theory) by the vector of *velocity-strength* **E** and by the vector of *density of momentum* (of associated field mass of longitudinal exchange) **D**,

$$\mathbf{D} = \varepsilon_0 \mathbf{E} \qquad \text{or} \qquad \mathbf{E} = \mu_0 \mathbf{D}, \tag{30}$$

where $\varepsilon_0 = 1 g \cdot cm^{-3}$ and $\mu_0 = \frac{1}{\boldsymbol{\varepsilon_0}} g^{-1} \cdot cm^3$.

The *density of energy* of the longitudinal exchange has the same form for all mass processes:

$$w = \frac{1}{2}\varepsilon_0 \varepsilon_r \upsilon^2. \tag{31}$$

If $\varepsilon_r = 1$, then the simplest expression for the *density of energy* is

$$w = \frac{1}{2}\varepsilon_0 \upsilon^2. \tag{32}$$

It is natural to call this density of energy the *density of the energy of physical space*, because the unit density $\varepsilon_0 = 1 g \cdot cm^{-3}$ is actually the coefficient of identity of measures of matter and space.

The expression (32) is valid not only at the field level of the quantitative identity of matter and space, but also under the condition, when $\varepsilon_r \neq 1$.

In such a field-space of matter, the expression (32) has the meaning of the *density of energy of space itself*. If we now denote the *velocity of mass exchange* by the symbol **E**, we will obtain the expression for the *density of longitudinal energy* in the following form:

$$w = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2} ED = \frac{1}{2}\mu_0 D^2. \tag{33}$$

Evidently, the *density of transversal energy* will be presented by the analogous equality

$$w = \frac{1}{2}\varepsilon_0 B^2 = \frac{1}{2} BH = \frac{1}{2}\mu_0 H^2, \tag{34}$$

where **B** is the vector of *transversal velocity-strength* and **H** is the vector of *density of the transversal momentum*:

$$\mathbf{H} = \varepsilon_0 \mathbf{B} \qquad \text{or} \qquad \mathbf{B} = \mu_0 \mathbf{H}. \tag{35}$$

The formula of the density of longitudinal energy on the basis of the *phenomenological* vector $\mathbf{E}_e$ has the form

$$w = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0\left(\frac{E_e}{\sqrt{4\pi\varepsilon_0}}\right)^2 = \frac{1}{2}\varepsilon_{e0}E_e^2 = \frac{1}{2}E_e D_e = \frac{1}{2}\mu_{e0}D_e^2\,, \qquad (36)$$

where $\varepsilon_{e0} = \frac{1}{4\pi}$ is the *phenomenological* "electric constant", $\mu_{e0} = 4\pi$ is the *phenomenological* "magnetic constant", and D_e is the *phenomenological* vector of the "*electric displacement*"

$$\mathbf{D}_e = \varepsilon_{e0}\mathbf{E}_e = \frac{\mathbf{E}_e}{4\pi} \qquad \text{or} \qquad \mathbf{E}_e = \mu_{e0}\mathbf{D}_e. \qquad (37)$$

Thus, the vectors of *strength* and *electric displacement* (in the electric phenomenology) relate to the same class of phenomenological parameters, because they differ only *quantitatively*.

Analogously, we will transform the formula (34):

$$w = \frac{1}{2}\varepsilon_0 B^2 = \frac{1}{2}\varepsilon_0\left(\frac{B_e}{\sqrt{4\pi\varepsilon_0}}\right)^2 = \frac{1}{2}\varepsilon_{e0}B_e^2 = \frac{1}{2}B_e H_e = \frac{1}{2}\mu_{e0}H^2\,. \qquad (38)$$

If one follows Coulomb's law for magnetic charges and the formula of the density (35), then

$$\mathbf{H}_e = \varepsilon_{e0}\mathbf{B}_e = \frac{\mathbf{B}_e}{4\pi} \qquad \text{or} \qquad \mathbf{B}_e = \mu_{e0}\mathbf{H}_e\,. \qquad (39)$$

Further, we will consider the vectors on the basis of *circulational* expressions. They generate the *circulational vectors*: $\mathbf{E}_\gamma$, $\mathbf{D}_\gamma$, $\mathbf{B}_\gamma$, $\mathbf{H}_\gamma$. Because

$$F = q_e E_e = \frac{q_e}{c}\cdot cE_e = q_\gamma E_\gamma\,, \qquad (40)$$

hence, the "*circulational*" *strength* and the *velocity-strength* are related by the equality

$$\mathbf{E}_\gamma = c\mathbf{E}_e\,. \qquad (41)$$

The analogous relation takes place also for the vector $\mathbf{B}_e$:

$$\mathbf{B}_\gamma = c\mathbf{B}_e\,. \qquad (42)$$

Let us now carry out the following transformations with the formula (33):

$$w=\frac{1}{2}\frac{\varepsilon_{e0}}{c^2}\left(cE_e\right)^2=\frac{1}{2}\varepsilon_{\gamma0}E_\gamma^2=\frac{1}{2}E_\gamma D_\gamma=\frac{1}{2}\mu_{\gamma0}D_\gamma^2 . \qquad (43)$$

Hence, we obtain the expressions for the circulational parameters, $\varepsilon_{\gamma0}$ and $\mathbf{D}_\gamma$:

$$\varepsilon_{\gamma0}=\frac{\varepsilon_{e0}}{c^2} , \qquad D_{e\gamma}=\varepsilon_{\gamma0}E_\gamma=\frac{\varepsilon_{e0}}{c^2}\cdot cE_e=\frac{D_e}{c} . \qquad (44)$$

The analogous relations take place for $\mathbf{H}_\gamma$ vector:

$$\mu_{\gamma0}=c^2\mu_{e0} , \qquad H_{e\gamma}=\varepsilon_{\gamma0}B_\gamma=\frac{\varepsilon_{e0}}{c^2}\cdot cB_e=\frac{H_e}{c} . \qquad (45)$$

4. Conclusion

Thus, we have considered the *electric constant* ε_0 *and magnetic constant* μ_0, (1) and (2), which are recommended officially for using in physics [1], and have shown again that these so-called "*fundamental constants*" are not some "fundamental" in the true sense of the word. They are subjective fictional quantities confusedly introduced in physics. A reason for their appearance (first in Coulomb's law) was stipulated by ignorance of the nature of electric charges and, hence, due to an incorrect dimensionality ascribed to the charges. As follows from the comprehensive analysis conducted in the DM, the "constants", (1) and (2a), are, actually, the *prime dimensionless numbers* multiple to π, namely, $\varepsilon_{e0}=\frac{1}{4\pi}$ and $\mu_{e0}=4\pi$. At the same time, the "magnetic constant" μ_{e0}, according to (2), is actually the *dimensional* quantity equal to $\mu_{e0}=\frac{1}{c^2}4\pi\ cm^{-2}\times s^2$.

On the whole, all the *systems of measures of electromagnetism* based on the erroneous dimensionality of electric charges (and, hence, of electric current) are *subjective*, phenomenological. For this reason, as inadequate to reality, their usage hampers (along with other faults inherent in the SM) the proper development of physics.

In the DM theory, there are *no artificial subjective notions*, like the mentioned about *"electric* and *magnetic constants"* of modern physics, where these values are regarded, by misunderstandings, absurdly as "*fundamental* physical constants".

As compared with the "*constants*", (1) and (2), used in physics, the *derived units* of the DM, designated by the same letters, ε_0 and μ_0, have the real physical meaning and, accordingly, different numerical values and dimensionalities. Their clear logically conditioned physical meaning is due to that they have an *objective origin* (not fictitious, not imaginary). They are *derived physical units* which represent, respectively, the *absolute unit* *density* $\varepsilon_0 = 1 g \cdot cm^{-3}$ (see "*Basic definitions*" in L. 1, Vol. 2) and its *inverse value*, $\mu_0 = \frac{1}{\boldsymbol{\varepsilon_0}} g^{-1} \cdot cm^3$.

Just these *derived units* enter in the corresponding formulas describing the *longitudinal-transversal* ("electromagnetic") structure of fields-spaces and an exchange (interaction) of exchange charges (electric, magnetic and gravitational) in accordance with the Law of Central Exchange, which is one of the fundamental laws of Nature discovered in the framework of the DM theory as well (see L. 4, Vol. 2).

The aforementioned *derived unit* of the DM, the *absolute unit density* $\varepsilon_0 = 1 g \cdot cm^{-3}$ (4), connects the vector of *velocity-strength* **E** with the *vector of density of momentum* (of associated field mass of longitudinal exchange) **D:** $\mathbf{D} = \varepsilon_0 \mathbf{E}$. The same role plays the *inverse unit* $\mu_0 = \frac{1}{\boldsymbol{\varepsilon_0}} g^{-1} \cdot cm^3$ (5): $\mathbf{E} = \mu_0 \mathbf{D}$. The **E** and **D** vectors of the DM are vectors characterizing the *longitudinal* part of the *longitudinal-transversal* field of exchange ("electromagnetic" field).

Analogously, the unit of the DM, inverse to ε_0, $\mu_0 = \frac{1}{\boldsymbol{\varepsilon_0}}$ (5), connects the vector of *transversal velocity-strength* **B** with the vector of *density of the transversal momentum* **H:** $\mathbf{B} = \mu_0 \mathbf{H}$. The same role plays the unit ε_0 (4): $\mathbf{H} = \varepsilon_0 \mathbf{B}$. The **B** and **H** vectors of the DM are the vectors characterizing the *transversal* part of the *longitudinal-transversal* field of exchange.

For the modern physics, **E** is the vector of *electric field strength*, **D** is the vector of *electric displacement field* (or *electric flux density*), **H** is the vector of *magnetic field strength*, and **B** is the vector of *magnetic induction* (or *magnetic flux density*). These vectors, electric (**E** and **D**) and magnetic (**H** and **B**), are connected between themselves by the absurd, as was mentioned above (in value and dimensionality), "*electric* and *magnetic constants*", (1) and (2): $\varepsilon_0 = (\mu_0 c^2)^{-1} F \cdot m^{-1}$ and $\mu_0 = 4\pi \times 10^{-7} N \cdot A^{-2}$.

Thus, we are confronted with an essential difference in the *definitions of the vectors* of the DM, characterizing the *longitudinal-transversal* field of exchange, and in the definition of the vectors of modern physics, characterizing the same field, which is named as *electromagnetic* there. This confrontation relates also to the *different values of the factors* connecting the corresponding opposite vectors (longitudinal and transversal, "electric" and "magnetic").

What is the reason of such a principled difference at the description of the same real field? We believe that an answer to this question is understandable now for everyone who has read the present Lectures. Actually, all material that was considered and analyzed in these

Lectures (and contained in references to them) reveals, among other things, all the reasons of the indicated difference and leads to the proper answer.

Namely, for *modern physics*, based on the Standard Model (SM), electromagnetic field is regarded one-sidedly as the *transversal wave field*, and the *nature of charges*, including electric, is *terra incognita*. Just these facts are the main reason of the aforementioned distinction. In the DM, the so-called "*electromagnetic field*" of modern physics is defined as the *longitudinal-transversal potential-kinetic wave field* characterized by the corresponding vectors inherent in this field. They were discussed partially here and heretofore in L. 8, Vol. 3. All the details on this issue one can find in [4].

Concerning the *discovery* in the DM of the *nature of charges* (and the *origin of mass*), we should say that this revelation still remains unnoticed (or simply ignored without consideration) by major physicists and, hence, not yet accepted in modern physics; unfortunately, as we see, by subjective reasons only. Hence, the *subjective* notions and *artificial* (imaginary) constants are still the basis of the corresponding *phenomenological* theories in contemporary physics, developing already enough long period of time in the framework of the Standard Model (SM) for explanation of the data obtained experimentally. Opposite, in the DM theory, all notions and all physical parameters are *objective*, adequate to reality. This relates also to the parameters, characterizing the longitudinal-transversal ("electromagnetic") field, including the derived units, ε_0 and μ_0. These parameters have appeared as the consequence of the aforesaid key discovery of the nature of charges, which, as turned out, are the parameters characterizing the *rate of mass exchange*, that is expressed in their dimensionality, $[q] = g \times s^{-1}$. In turn, the latter discovery is one of the main results of the new theoretical concepts underlying the DM.

References

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Lecture 7

The Units of Electric Current and Circulation: Ampere and Bio

1. Introduction

The unit of electric current – the *ampere* was accepted in physics in connection with "rationalization" in physical metrology and introduction of the International System of Units (SI). It was a step, which allowed to get rid of (to cover up) the dimensionalities of electrical quantities expressed in the CGS system by fractional powers of *base units* of matter (*g*) and space (*cm*), conditioned by the dimensionality of electric charge $[CGSE_q] = g^{1/2} \cdot cm^{3/2} \cdot s^{-1}$ originated from Coulomb's law. From that time the *ampere* is considered in modern physics as one of the seven SI *base units*.

The comprehensive analysis (carried out by the DM) of the results of the aforesaid "rationalization", has revealed its flaws. We have considered already this matter. Now we turn again our attention to the unit of electric current the *ampere*. Under the *phenomenological* unit the *ampere*, if one expresses it in the CGS *base units* of matter, space, and time (*g*, *cm*, and *s*), the following value (see (16), L. 4) is hidden,

$$1A_e = \frac{c_r}{10} g^{1/2} \cdot cm^{3/2} \cdot s^{-2} = 2.99792458 \cdot 10^9 \, g^{1/2} \cdot cm^{3/2} \cdot s^{-2} \,. \tag{1}$$

Opposite to the *phenomenological* measure (1), the *objective* measure of the *ampere* (according to the DM, see (23), L. 4) is equal to

$$1A = \sqrt{4\pi}\,\frac{c_r}{10}\, g \cdot s^{-2} = 1.062736593 \cdot 10^{10}\, g \cdot s^{-2} \,. \tag{2}$$

The difference between the above expressions, (1) and (2), is essential. We have discussed in details in Lecture 4 the presented values related to this *derived unit* – the *ampere*. As was noted, the *ampere*, being the *derived unit*, was added unfoundedly (that is not in doubt in sane physicists) to a triad of truly *base units* of matter-space-time.

Now we will try to disclose the *physical meaning*, which is contained in the formal *definition* of this unit. As it is stressed in [1], one of the effects of the definition of the ampere is "to fix the "*magnetic constant*" μ_0 (permeability of vacuum) at exactly $4\times10^{-7}\ H\cdot m^{-1}$". The meaning of this "constant" was considered in previous Lecture. This time we intend to present the result of the comprehensive analysis in order to bring to light the principle blunders made by the creators of the given definition.

From the analysis conducted in the DM it follows that according to the definition accepted in physics the unit the *ampere* relates, in fact, to the *circulational ampere*, i.e. to the physical parameter $\frac{I}{c}$. Under the unit called the *ampere* is, actually, *the unit of linear density of the phenomenological magnetic charge*.

Thus, the definition of the "*ampere*" does not relate to the definition of the phenomenological unit of current *I*, but to the *phenomenological unit of circulation* Γ. Both above notions (current and circulation) are related between themselves as we know by the equality, $\Gamma=\frac{I}{c}$. The unit of *circulation* was termed in the DM theory the *bio*. The formal definition of the latter was done at this.

We intend to consider all these questions here, to the best of our capabilities.

2. On the definition of the ampere

As was shown earlier, the *interchange* of two cylindrical *transversal* spaces-fields in the simplest case ($\mu_r=1$), according to ((12) of L. 9, Vol. 3) [2], is expressed by the following formula of the *power of exchange*,

$$F=\frac{\mu_0\Gamma^2 l}{2\pi R}, \tag{3}$$

and the *transversal velocity-strength* has the form,

$$B=\frac{\mu_0\Gamma}{2\pi R} \qquad \text{or} \qquad H=\frac{\Gamma}{2\pi R}. \tag{4}$$

The *circulation* $\Gamma=\frac{I}{c}$ (having the dimensionality $g\cdot s^{-1}\cdot cm^{-1}$) defines the *linear density of transversal charge* (all details concerning the notion of *circulation* are considered in L. 8 and 9 of Vol. 3). Therefore, the total charge of a section of the cylindrical field of a length *l* will be equal to

$$Q_\tau=\Gamma l. \tag{5}$$

Therefore, the expression (3) for *power of exchange* can be presented simply as

$$F = Q_\tau B . \tag{6}$$

Through a similar way, we can present the *power of exchange* between the two cylindrical *longitudinal* fields-spaces and express the *velocity-strength* as

$$F = \frac{\tau^2 l}{2\pi\varepsilon_0 R}\ , \qquad E = \frac{\tau}{2\pi\varepsilon_0 R} \qquad \text{or} \qquad D = \frac{\tau}{2\pi R}\, , \tag{7}$$

where τ is the *linear density of charge*.

We have as well

$$Q_n = \tau l\, , \qquad F = Q_n E\, . \tag{8}$$

In the longitudinal field-space, the *linear density of the longitudinal charge* τ is the *longitudinal circulation*, which is usually called the *linear flux N*:

$$N = \tau\, . \tag{9}$$

Taking into consideration that $\Gamma = \sqrt{4\pi\varepsilon_0} \cdot \Gamma_e$ (see (4), L. 4), the *phenomenological* variant of the exchange formula (3) can be presented as

$$F = \frac{\mu_0 \Gamma^2 l}{2\pi R} = \frac{4\pi\varepsilon_0\mu_0\Gamma_e^2 l}{2\pi R} = \frac{2\Gamma_e^2 l}{R}\, . \tag{10}$$

Hence, the *linear power of exchange* of cylindrical fields takes the form

$$\frac{F}{l} = \frac{2\Gamma_e^2}{R}\, . \tag{11}$$

Identifying the circulation and current, i.e., assuming that $\Gamma_e = I_e$, that is, obviously, absolutely *incorrectly*, the relation (11) can be presented as

$$\frac{F}{l} = \frac{2I_e^2}{R}\, . \tag{12}$$

Just this *incorrect equality* defines the *phenomenological unit* of electric current the *ampere*:

> "The ***ampere*** *is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1meter apart in a vacuum, would produce between these conductors a force equal to* $2 \cdot 10^{-7}$ *newton per meter of length*." (13)

The base of such a definition is a phenomenological train of thought, which, however, does not enter explicitly in the definition: the *unit of electric current the **ampere** is equal to a tenth of the unit of current in the "magnetic system"* [3] (where, as we know, $1A_\gamma = 0.1e_e \cdot cm^{-1}$; remember that $e_e = 1g^{1/2} \cdot cm^{3/2} \cdot s^{-1}$). Actually, because $I_\gamma = \Gamma_e = \dfrac{I_e}{c}$ and taking into account that $1A_e = \dfrac{c_r}{10} e_e \cdot s^{-1}$ ((26), L. 4), hence, $1A_\gamma = 0.1e_e \cdot cm^{-1}$, and also that $\dfrac{dyn}{cm} = 10^{-3}\dfrac{N}{m}$, we arrive at the force indicated in the definition (13):

$$\frac{F}{l} = \frac{2\cdot(0.1e_e/cm)^2}{100\,cm} = \frac{2\cdot(0.1)^2}{100}\frac{dyn}{cm} = \frac{2\cdot(0.1)^2}{100}\cdot 10^{-3}\,N\cdot m^{-1} = 2\cdot 10^{-7}\,N\cdot m^{-1}. \qquad (14)$$

Thus, in fact, the aforementioned definition relates to the *circulational ampere*, which, in accordance with ((27), L. 4), is equal to

$$1A_\gamma = \frac{1}{10}(e_e\cdot s^{-1})/(cm\cdot s^{-1}) = \frac{1}{10}e_e\cdot cm^{-1}. \qquad (15)$$

It is *the unit of linear density of the phenomenological magnetic charge*.

Thus, the definition of the "*ampere*" (13) relates to the *phenomenological unit of circulation*. In the DM [3], this phenomenological unit $1e_e\cdot cm^{-1}$ has obtained the name the *bio* and is denoted by the symbol *bi*$_e$. The square of the *phenomenological unit of circulation* is equal to the *dyne*: $(1e_e\cdot cm^{-1})^2 = 1\,dyn$.

3. The unit of circulation the bio

The definition of the unit of circulation the *bio* ($1e_e\cdot cm^{-1}$) can be formulated as follows:

"*The one-tenth of the unit of circulation the **bio** is the circulation of the cylindrical field of rest-motion of matter-space-time at the subatomic level, whose power of interchange with the equal cylindrical field is* $2\cdot 10^{-7}\,N$ *per meter of length. The axial field of these transversal cylindrical fields are localized in the space of two straight parallel conductors of infinite length, of negligible circular cross section, and placed* 1 *meter apart*. (16)

The *circulation* Γ_e of $0.1bi_e$ defines also the unit of *magnetic current* of 1 *ampere*, on the basis of the relation $I_e = c\Gamma_e$, and the unit of *magnetic charge* of 1 *coulomb* = 1 *ampere*

× *second*. The magnetic current, as the current of the transversal electric (called magnetic) field, is represented by the cylindrical field. The value of the longitudinal current $I_{e\tau}$ is always equal to the value of the axial longitudinal current $I_{e\tau} = I_{e0} = I_e$ (Fig. 1); therefore, the *ampere* of the magnetic current is equal to the *ampere* of the electric current.

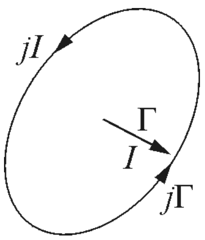

Fig. 1. A graph of the longitudinal-transversal field with objective measures of the longitudinal subfield of current *I* and circulation Γ and with measures of the transversal subfield of current *jI* and circulation $j\Gamma$, where *j* is the unit of negation of longitudinal parameters *I* and Γ.

The transversal magnetic fields-currents, but not the axial ones define the interchange between cylindrical fields.

Since the magnetic circulation $\Gamma_e = \frac{I_e}{c}$ represents the *linear density of the transversal magnetic charge* of cylindrical field, $\Gamma_e = q_Z$, the *bio* is simultaneously the *unit of linear density of the transversal magnetic charge*. The circulation of the magnetic current Γ_e defines also the axial longitudinal circulation $\Gamma_{e0} = \frac{I_{e0}}{c}$ of the electric axial field, because they are equal.

The circulation of $0.1 bi_e$ defines, at the part of length *z* of 10 *cm*, the *unit transversal magnetic charge*:

$$Q_\tau = q_Z \cdot z = 0.1\, bi_e \cdot 10\, cm = 1\, bi_e \cdot cm = 1\, e_e\,, \tag{17}$$

and at the part of length of $c_r cm$ (299792.458 *km*), the *magnetic charge* of 1 *coulomb*,

$$1\, C_e = 0.1\, bi_e \cdot c_r\ cm = \frac{c_r}{10}\ bi_e \cdot cm = \frac{c_r}{10}\ e_e = 2.99792458 \cdot 10^9\ e_e\,, \tag{18}$$

which, in turn, (in conformity with $I_e = c\Gamma_e$ as well) defines the unit of *magnetic* (transversal) *current* of 1 *ampere*:

$$1\,A_e = 1\,C_e \cdot s^{-1} = c \cdot 0.1 bi_e = 0.1\,bi_e \cdot c_r\,cm \cdot s^{-1} = \frac{c_r}{10}\,e_e \cdot s^{-1} = 2.99792458 \cdot 10^9\,e_e \cdot s^{-1}. \qquad (19)$$

Let us now present the phenomenological measures, defined by the above-described formulas, through the objective measures.

The *objective bio* (*bi*) defines the *linear density of magnetic charge*,

$$1\,bi = \sqrt{4\pi\varepsilon_0} \cdot 1\,bi_e = 3.544907702\ (g \cdot s^{-1}) \cdot cm^{-1} = 3.544907702\ e \cdot cm^{-1}, \qquad (20)$$

where $e = g \cdot s^{-1}$ is the *objective measure of charge*, i.e., the unit power of mass exchange.

The *phenomenological* measure (17) conceals the real (objective) magnitude of the magnetic charge:

$$Q_\tau = q_Z \cdot z = 0.1\,bi \cdot 10\,cm = 1\,bi \cdot cm = 3.544907702\ \ g \cdot s^{-1}. \qquad (21)$$

The relative value of the last, in the objective electron's charges, is defined by the measure

$$Q_\tau = q_Z \cdot z = 1\,bi \cdot cm = 2.081942420 \cdot 10^9 e, \qquad (22)$$

where $e = 1.60217733 \cdot 10^{-19}\,C$ is the objective measure of the electron charge in the units of the objective coulomb, $1C = 1.062736593 \cdot 10^{10}\ g \cdot s^{-1}$ (see ((32) in L. 4, and the relation $A_e = \sqrt{4\pi\varepsilon_0}\,A$ (46) in Vol. 3). In the CGSE units of electric charge (1 CGSE$_q$), the value of the electron charge is $e = 4.80320679 \cdot 10^{-10}\ g^{1/2} \cdot cm^{3/2} \cdot s^{-1}$.

The value (22) expresses the quantity of magnetic electron charges related with the particles, participating in formation of the transversal magnetic field. These particles are placed with the definite density along the axial line. The following *quantum of length* of the axial line accounts for every transversal electron charge in the case with one-centimeter axial length at the circulation of 1*bi*:

$$L_e = \frac{1\,cm}{Q_\tau / e} = 4.803206805 \cdot 10^{-10}\ cm\ \ \textit{per electron magnetic charge}. \qquad (23)$$

The above-enumerated units relate to the transversal magnetic field. The units of the same nomination, but defined on the basis of the two infinite, in length, charged conductors of negligible circular cross section, relate to the longitudinal field. It is usual to call them the electric units.

Because formulae of the longitudinal and transversal *cylindrical fields* are identical in form, the measures of units of the longitudinal field will coincide with the measures of units of the transversal field. Standards of the longitudinal field are difficult for realization and, therefore, in reality, all relevant measures used by contemporary physics relate to the measures of the transversal magnetic field.

Quantitatively, the conjugated measures of the transversal and longitudinal fields are equal, although both fields differ qualitatively. The fact is that the longitudinal field is represented by one sublevel of matter-space-time and the other more “disperse” sublevel represents the transversal field. As quality and quantity, the qualitative transversal and quantitative longitudinal subfields, being essentially different, together form the single qualitative-quantitative field.

Natural measures of the ***quantitative field*** should be called ***quanta***, whereas the conjugated measures of the ***qualitative field*** should be called ***quals***. The ***qual*** is the negation of the ***quantum***: $qual = i \cdot quantum.$

4. Conclusion

We have revealed that identifying the circulation and current made by the ideologists of the so-called “rationalization”, *i.e.* assuming that $\Gamma_e = I_e$ (that is absolutely incorrectly, because $\Gamma_e = \frac{I_e}{c}$), the unit of electric current the *ampere* was *formally* defined in SI units as the value equal to one-tenth of the unit of current in the “*magnetic system*” of units (CGSM), *i.e.*, equal to the value, $1A_\gamma = \frac{1}{10} e_e \cdot cm^{-1}$ (15). For this reason the unit of current the *ampere* has obtained the dimensionality of phenomenological *circulation* Γ_e, but not the current. Actually, the ratio of the corresponding dimensionalities shows this:

$$[\Gamma_e] = \frac{[I_e]}{[c]} = \frac{g^{1/2} \cdot cm^{3/2} \cdot s^{-2}}{cm \cdot s^{-1}} = e_e \cdot cm^{-1}.$$

We see that the *formal definition* of the ampere accepted in physics relates to the *circulational ampere*, whereas the *phenomenological ampere* (in CGS) is equal to $1A_e = \frac{c_r}{10} e_e \cdot s^{-1}$ ((16), L. 4). Thus, in fact, the formally defined unit the *ampere* is *the unit of linear density of the phenomenological magnetic charge*.

As a result of the conducted analysis, the *phenomenological* unit, $1 e_e \cdot cm^{-1}$ (entering in (15)), called in the DM the *bio* and denoted by the symbol bi_e [3], has been naturally termed as the *unit of circulation*. Taking into account the formula ((30), L. 3, Vol. 2), we find its *objective* measure, which in the GCS objective units of the DM has the following value:

$$1\,bi = \sqrt{4\pi\varepsilon_0} \cdot 1\,bi_e = 3.544907702\ e \cdot cm^{-1},$$

where $\varepsilon_0 = 1 g \cdot cm^{-3}$ is the absolute unit density, and $e = g \cdot s^{-1}$ is the *objective measure of charge*. The *objective bio* (*bi*) defines, thus, the *linear density of the charge*.

It should be reminded at the end of this discussion that in *practical* terms, the *ampere* is a measure of the amount of electric charge passing a point in an electric circuit per unit time, with $6.241150934 \times 10^{18}$ electrons (or one coulomb) per second. It is also the measure of electric current that is equivalent to the steady current produced by 1 volt applied across a resistance of 1 ohm.

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