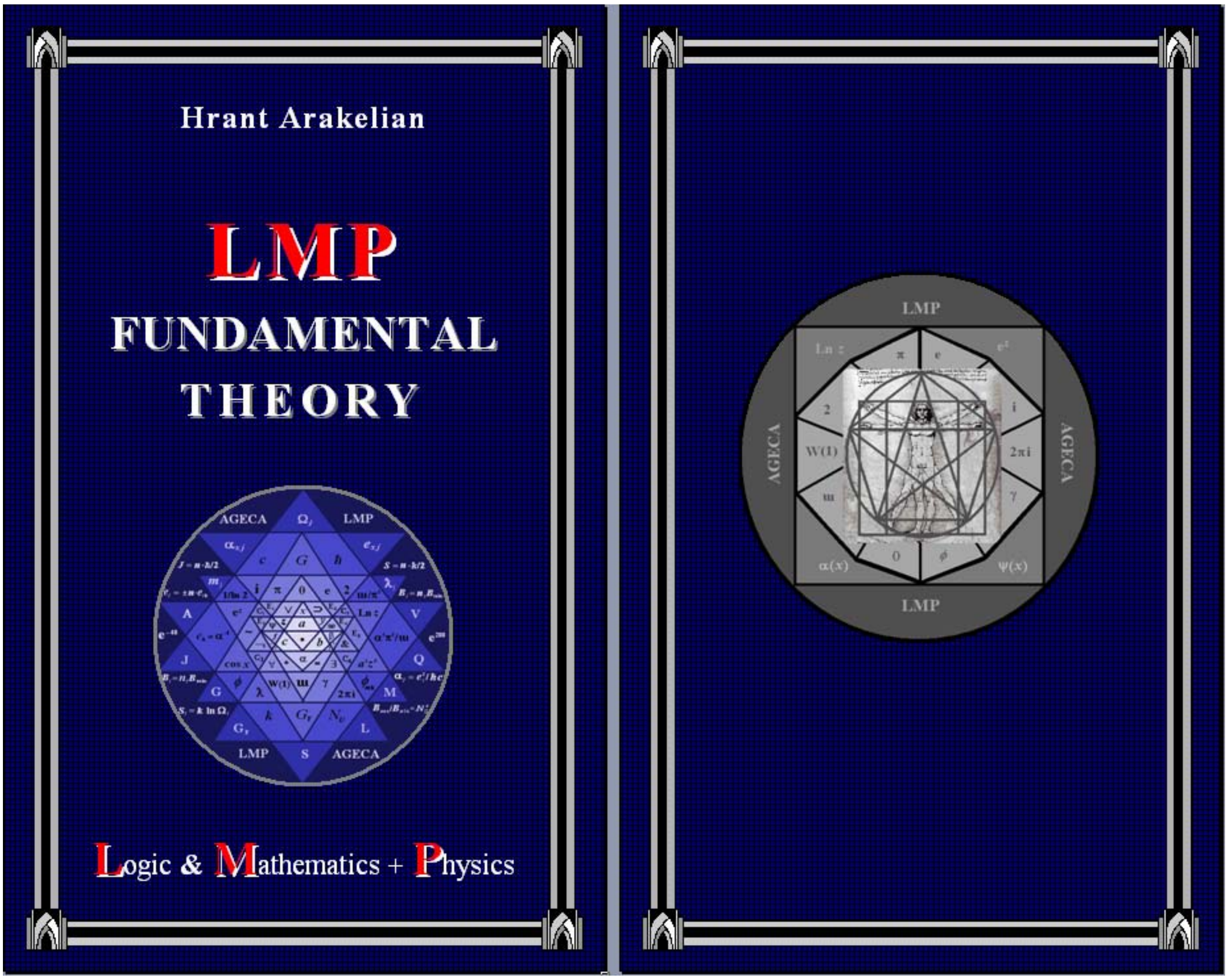
Abstract



Guestbook   Monograph   Book   The New FMC   Articles   Forum

LMP is a theory for the 21st century. It is a fundamental theory of the physical world grounded in the idea of unity of mathematical logic, formal mathematics and fundamental physics. It is presented in minute details in a voluminous monograph *LMP Fundamental Theory* (in Russian), which contains a substantive Abstract in English posted here.

Part I. **LMP Theory**

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On the attempts of creating FPT. The main reasons of the failure

The ***fundamental physical theory*** (FPT) is also called ***unified theory*** or ***theory of all***. It is common knowledge that after a number of great discoveries in the first thirty years of the last century the further development of physical theory ceased to be exclusively valuable for scientific cognition and philosophy of science. Thus far, all the numerous attempts of creating a fundamental (unified) theory, called to comprehend the whole physical world, were not successful. Far from being complete list of such attempts includes the "Fundamental theory" [Eddington], unified field theories [Einstein; Hilbert; Kaluza; Klein; Weyl], unified theory of nonlinear spinor field [Heisenberg], various versions of axiomatic quantum field theory [Боголюбов, Логунов, Тодоров], supergravitation, superstrings [Freedman, van Nieuwenhuisen, and Ferrara; Голдфанд, Лихтман; Deser and Zumino; Schwarz; Green and Gross]. Retrospectively, from the height of the contemporary physical knowledge, as well as from the viewpoint of LMP conception, it is possible to point out some reasons, which may be considered now as insurmountable barriers in the path of success.

- The creation of FPT is possible only on a certain stage of physical theory's and experiment's development, only if some opportunities are available
- To construct FPT new fresh ideas are required, a new understanding of physical theory's foundations is needed, a new methodology is necessary
- The mathematical apparatus, used in various attempts of building FPT, is not sufficient for solving the problem totally, as far as it has serious gaps

Definition of physics and physical theory.
The tree scheme of fundamental physical theory with its environment

All requirements and conditions, which are necessary and sufficient for building a fundamental theory, nowadays are present. The presentation of general ideas, used as the basis for LMP fundamental theory is reasonable to begin from definition of physics as a science. As it is shown in [Arakelian 1997], any statement on the physical reality is inevitably a statement about some *physical values*, any physical equation, formula or relation states an analytic connection between some *physical values*, any physical measurement, experiment, empirical study comes to be specific information on *physical values*. According to this

Physics is the **science** of **physical values**

Hence:

Fundamental physics is the **science** of **fundamental physical values**

Fundamental physical theory is the **theory** of **fundamental physical values**

In any case the problem of choosing the primary objects, fundamental physical values, is of paramount importance. There are many alternative variants and the question is how to really perform the choice of such primary values, which are in full measure suited to the requirements of contemporary FPT. This problem is, at first sight, almost beyond belief and in any case it is amply clear that it do not enter in the scope of the physical theory per se. However, this key problem possesses a substantiated solution and to understand how it should be solved we must examine the environment of fundamental physical theory by first. The most suitable way is to present it by means of traditional image of tree [Arakelian 1992, 11–12]:

Atmosphere	philosophy
Ground	methodology
Roots	**logic**
Trunk	**pure mathematics**
Branches	**fundamental physics**
Crone	the rest physics
Fruits	applications in science and technology

It should be noted that the present research is not almost concerned with the applications of physics; the relevant philosophical, epistemological, methodological problems are discussed in [Arakelian 1984; 1989; 1992−1995]; many physical and mathematical questions are considered in the monographs [Arakelian 1984; 1989; also in 1995]. Now, to all appearances, there are all the necessary premises, preconditions for constructing a consistent theory including the formal logic as a part of unified trinomial logical-mathematical-physical monolith as well.

On the unity of logic, mathematics and physics

The given tree scheme is called to visually show that according to the proposed conception the fundamental physical theory grows supported by the trunk of pure mathematics, whose roots are stretching deeply into logic. Thereby, the question is that mathematics and logic (rather than mathematics solely) are not simply a language of the physical theory, just a method of describing the physical reality and so on, but a true unity, a holistic system with rather strict natural relationships between its separate parts. **The unity of logic**, **mathematics and fundamental physical theory** (intended as a theory of fundamental physical values) – **such is, in general outline, the essence of conception as a whole**. (The unity of Logic, Mathematics and Physics is reflected in the most name of the theory – LMP, which is just an abbreviation of these three words). To put it otherwise, **LMP is conceived as a basic**, **maternal theory of the physical world**. It can be said that, at least by the project and to some extent, it is cultivated on the ground of mathematical logic and pure mathematics a general theory of all physical theories.

It should be noted from the very outset that each part of LMP system, especially the first one (L) and, to a lesser extent, the second (M) are relatively independent constructions, obeyed at the same time to the claims of the overall project. So, each subsequent step of the ascending structure rests on the preceding one. From the constructive standpoint the main goal of the whole program is to reveal the very "navel-string", connecting the nucleus of physical theory with the logical-mathematical basis; and this, in its turn, helps us to reveal the general characteristics of fundamental theory. In other words, *we have need for such logic and based on it mathematics, that the extension of the latter leads to transition of designated mathematical values to fundamental physical values and then to the main physical principles and laws*.

The most rational, strict and logically reliable way of introducing a natural scientific theory consists, as it is usually accepted, in its axiomatization. Axiomatic method, proved to be in the highest degree effective in logic and mathematics has, however, limited area of application in other fields of science, including physics. Taking this into account, we limited the strict using of axiomatic method only by **AG** system, which constitutes the first two parts of LMP theory's formalism, including well known sections of formal logic and less known mathematical axiomatic.

The main logical and mathematical functions and variables

As indicated above, the foundation of LMP theory is an organic unity of logic, mathematics and fundamental physical theory, intended as a theory of fundamental physical values. Just in logic, besides in mathematical logic, that one can see the roots of, at least formalized, mathematics. That is to say that such theories of mathematics as (formal) arithmetic ought to start from logical atoms – propositions (statements) and other basic logical elements, forming the propositional calculus. On this basis is erected the predicate calculus with the initial notion of predicate, or logical function. And only thereafter to the logical-deductive formalism, constructed by the same procedure, is supplemented one or another system of mathematical axioms with some new elements, interpreted on one or another set of objects. The choice of adequate, called to assure the unity of all three parts of the system logical-mathematical basis for FPT is practically non-alternative in respect to the formal logic. The point is that the classical predicate calculus without equality, including as its component the propositional calculus, can serve, correspondingly modified, as a formal basis for set of rather different mathematical systems; therefore it is quite suitable for our purposes. Apart from the necessity of introducing the formal unity of logic and mathematics, we are highly interested to get a **completely full list** of **principal**, **initial components** of logical-mathematical system.

One of the most remarkable features of both logic and mathematics is the potentiality of reducing all their forms to a minimal basis of initial elements and principles. Beginning the successive exposition of general foundations and the construction of formal structure of LMP theory, it is convenient to fix the main classes of logical, mathematical functions and variables:

a) logical *propositional functions*, or *predicates*, the limiting case of which are *unit propositions (statements)*

b) *simple functions*, the limiting case of which are *constants*

c) *composite functions*, formed by means of *superposition*

d) *functionals*

e) *operators*

Accordingly there are four, potentially infinite sets of variables:

1) *objective (individual) variables*
2) *predicate* logical *variables*
3) *numerical variables*
4) operational *functions-arguments* of mathematics

Logical and mathematical operations, terms and formulas

The following step is to designate the initial operations, or operators. In the formalism of LMP system they are ten all in all: propositional connectives $\sim$, $\supset$, & , $\vee$, $\neg$, quantifiers $\forall$ and $\exists$ (turned over capital letters of words **A**ll and **E**xist), mathematical operations =, +, –. Every operator has a certain rank, and the lower is the rank of operator, the stronger it connects the variable, and it makes possible to get by with minimal number of brackets when writing the logical-mathematical expressions. In descending from left to right order the operators should be disposed in a line in such succession:

$$\sim \quad \supset \quad \& \quad \vee \quad \neg \quad \forall \quad \exists \quad = \quad + \quad -$$

Only these ten logical and mathematical operators must be taken as independent. Only they and reducible to them operations are acceptable and any other operation, used in this study, is just a *convenient contraction, which in all instances can be represented through the initial ten operations*.

With the alphabet of LMP system at our disposal we now proceed to a study of well formed, called "terms" and "formulas", expressions of the formal system. It is agreed that in the grammar of natural language the analogues of term are "word", "subject", "object", analog of formula – "sentence", as well as "judgment", though, because of certain ambiguity of the last word, its collation with formula seems somewhat far-fetched. Now the challenge is to be always able to differentiate between the well formed and *not* well formed successions of logical and mathematical symbols, and distinguish the words of the formal language – terms, from sentences – formulas.

Definition of term

1 All logical objective variables, all mathematical numerical variables and functions-arguments are terms

2 All simple and composite mathematical functions, all constants and all functionals are terms

3 If **Â** is an operator, and F is a function, then **Â**F is a term

4 0 is a term

5 If p is a term, –p is also a term

6 If p and q are terms, p + q, p – q are also terms

7 There are no other terms, besides those that are defined in 1–6

Definition of formula

1 All propositions (zero-placed predicates) are formulas

2 All predicates P(x_1, ..., x_n) and all predicate variables are formulas

3 If p and q are terms, p = q is a formula

4 If A and B are formulas, A $\sim$ B, A $\supset$ B, A & B, A $\vee$ B, $\neg$A are also formulas

5 If A is a formula, and x is a variable, then $\forall$xA, $\exists$xA are formulas

6 There are no other formulas, besides those that are defined in 1–5

All previously designated logical and mathematical variables and functions are covered by these definitions, and all ten primary operations are used in formation rules of new terms and formulas. Any finite sequence of designated graphical signs, obtained by using these rule, gives well formed terms and formulas of the system.

Logical postulates of LMP system

In the classical predicate calculus the simplest logical functions, propositions, can assume only two values, denoted as t (truth) and f (false). To values t and f of formula A correspond values f and t of formula $\neg A$, i.e. $\neg A$ is true if and only if A is false and $\neg A$ is false if and only if A is true. Such is the natural interpretation of formula $\neg A$ in the model theory of two-valued formal logic. It is clear that the equivalence $A \sim B$ is true if and only if A and B are both true or both false; implication $A \supset B$ is false only if A is true and B is false; conjunction $A \& B$ is true only in the case when A and B are both true; alternation $A \vee B$ is false only if A and B are both false and is true in all other cases. Now, connecting the logical *atoms* A and B by the use of implication and alternation to a logical formula $A \supset A \vee B$ and preparing a truth table of its values, is easy to make sure that, independently of the values of sub-formulas A and B, the compound formula is true in all cases. Formula which is true at any arbitrary distribution of true values of sub-formulas A, B, C, ... is a tautology and such formulas are often called identically true, or universally significant. Similar reasoning is applicable to formulas, containing predicates and quantifiers. It is apparent that just from the set of identically true formulas must be chosen the logical axioms, or, more precisely, the axiom schemes, which are transformed into certain axioms only when arbitrary A, B, C are substituted by concrete formulas. Fifteen axiom schemes together with three inference rules (transformation rules) form a system of postulates of classical predicate calculus, which are the logical postulates of LMP system at the same time.

$\mathbf{L}_1$ $\quad A \supset (B \supset A)$

$\mathbf{L}_2$ $\quad (A \supset B) \supset ((A \supset (B \supset C)) \supset (A \supset C))$

$\mathbf{L}_3$ $\quad \dfrac{A,\ A \supset B}{B}$ modus ponens, or $\supset$-rule

$\mathbf{L}_4$ $\quad A \supset (B \supset A \& B)$

$\mathbf{L}_5$ $\quad A \& B \supset A$

$\mathbf{L}_6$ $\quad A \& B \supset B$

$\mathbf{L}_7$ $\quad A \supset A \vee B$

$\mathbf{L}_8$ $\quad B \supset A \vee B$

$\mathbf{L}_9$ $\quad (A \supset C) \supset ((B \supset C) \supset (A \vee B \supset C))$

$\mathbf{L}_{10}$ $\quad (A \supset B) \supset ((A \supset \neg B) \supset \neg A)$

$\mathbf{L}_{11}$ $\quad \neg\neg A \supset A$

$\mathbf{L}_{12}$ $\quad (A \supset B) \supset ((B \supset A) \supset (A \sim B))$

$\mathbf{L}_{13}$ $\quad (A \sim B) \supset (A \supset B)$

$\mathbf{L}_{14}$ $\quad (A \sim B) \supset (B \supset A)$

$\mathbf{L}_{15}$ $\quad \forall x\, A(x) \supset A(r)$ $\forall$-scheme

$\mathbf{L}_{16}$ $\quad A(r) \supset \exists x\, A(x)$ $\exists$-scheme

$\mathbf{L}_{17}$ $\quad \dfrac{C \supset A(x)}{C \supset \forall x\, A(x)}$ $\forall$-rule

$\mathbf{L}_{18}$ $\quad \dfrac{A(x) \supset C}{\exists(x)\, A(x) \supset C}$ $\exists$-rule

The first fourteen postulates taken together constitute the axiomatics of propositional calculus; in conjunction with postulates $\mathbf{L}_{15}$–$\mathbf{L}_{18}$ they make up the predicate calculus. It is reasonable to suppose now that the first – logical part of constructing LMP system is completely executed.

From logic to mathematics: the choice of axiomatic system. The formal systems G and AG

Having understood the logical roots, it is necessary to think about the mathematical trunk of LMP system. It is one of the decisive moments of system construction, sophisticated by the existence of a great number of mathematical axiomatics, based on the logical predicate calculus. Advantages of this logical calculus is that in its different modifications it serves as a natural and rather simple basis for various mathematical systems, and so can be considered as universal, logical-deductive foundation for the most of formal mathematics. And now we stand before a problem of finding, figuratively, amongst the whole wood of trunks with nearly alike roots a trunk of a unique tree. We may say that thick and heavy branches of the physical theory cannot be supported by thin, under-grown trunk of arithmetic of natural numbers; and, if looking farther ahead, by any formal system with limited object range and restricted possibilities.

Thus, the transition from universal logic to yet unknown fundamental physics may be accomplished only by means of universal mathematics. This is not just a play upon words, but the only *modus vivendi* of triune LMP system, which should be taken for the present on trust, in the capacity of working hypothesis. Although the formal system, sought for, is not so popular as **N** system of natural numbers, but is known too and designated by symbol **G**. It contains the following formal symbols:

$$\sim \ \supset \ \& \ \vee \ \neg \ \forall \ \exists \ = \ + \ - \ 0 \ a \ b \ c \ \ldots \ x \ y \ z \ \alpha \ \beta \ \ldots \ \psi \ \omega \ (\ ) \ _{|}$$

These are seven logical and three mathematical operations, arranged in order of decreasing from left to right rank, individual object 0 (zero), 26 italic Latin letters, 24 small letters of the Greek alphabet, left and right brackets, and symbol in the end $_{|}$. Everything else in this text, including punctuation marks, words of the natural language, such abbreviations as ≡, ≈, ψ, ≠, <, >, lim, Σ of corresponding logical-mathematical expressions concern to metalanguage, i.e. language by means of which the objective language is being examined.

Definitions of terms and formulas were given above. It should not be forgotten that if the variables *a*, *b*, *c*, ..., *x*, *y*, *z* are understood as numbers, then zero, all variables and constant numbers, numerical functions, including composite functions, functionals, operator expressions, as well as any successions of enumerated terms, formed by the aid of operations + and – and by application of rules $-p$, $p + q$, $p - q$, are also terms. Formulas come to be equalities of type $p = q$ for terms p and q, in addition with expressions for formulas, formed by means of propositional connectives and quantifiers.

Following six axioms are the very mathematical axioms of **G** system:

$\mathbf{M}_1$ $a = b \supset (a = c \supset b = c)$

$\mathbf{M}_2$ $a = b \supset a + c = b + c$

$\mathbf{M}_3$ $a = b \supset c + a = c + b$

$\mathbf{M}_4$ $(a + b) + c = a + (b + c)$

$\mathbf{M}_5$ $a + 0 = a$

$\mathbf{M}_6$ $a - a = 0$

Axioms $\mathbf{M}_1$–$\mathbf{M}_4$ fix the properties of equality and addition, $\mathbf{M}_5$ establishes the unique properties of zero. $\mathbf{M}_6$ introduces the operation "–" and an object $-a$, opposite to *a*. Thus, eighteen postulates $\mathbf{L}_1$–$\mathbf{L}_{18}$ of predicate calculus together with six mathematical axioms for operations of equality, addition, subtraction of objects *a*, *b*, *c* and zero make up the logical-mathematical axiomatic **G** system.

A question arises: which are the advantages of **G** system in comparison with other formal systems and what is the meaning of the infinite set of objects *a*, *b*, *c*, ...? In contrast to the system **N**, with only interpretation on the set of natural numbers, the formal system **G** allows a great number of interpretations both of numerical and non-numerical, group-theoretic nature. But the chief thing here is not the amount of interpretations but their variety and, of course, exceptionally remarkable fact that equally with other interpretations there exists one on the set of all numbers. It should be also noted that if we strive to have for our purposes a formal system including all numerical sets, then quite certainly the operations of addition, subtraction and constant 0, not the operations of multiplication, division and number 1, ought to be chosen. Besides, it is quite reasonable to include in the list of axioms the commutative law for addition. Thus, the final system of mathematical axioms, designated as **AG**, contains the axiom

$$\mathbf{M}_7 \quad a + b = b + a$$

Hence, we can assert that on the universal logical basis a universal logical-mathematical system is being constructed; and now it is possible to axiomatically define the initial notion of mathematical number *in general*, define the continuum of all numbers without any omission or lack. It is also important that parallel with the set of initial objects system **AG** sets the complete collection of primary logical and mathematical operations, by aid of which all the other operations could be expressed.

On the necessity of introducing concrete numbers and functions

It is quite apparent that merely by "mechanical" extension of the system is impossible to unveil the intrinsic potential of **AG** system's formalism, reveal its hidden capacities. To attain these ends, some cardinal and rather subtle problems have to be solved first and foremost. What and exactly which numbers should follow, come next to the zero in the formal hierarchy of mathematical values? Which are the fundamental rules – laws, establishing a correspondence between different sets, composed of variable and constant values? In other words, which are the initial, primary, maternal functions, needed for constructing all the numerical functions? Giving certain answers to such questions, we suppose to have at our disposal all components, necessary and sufficient for the further construction of the physical theory's foundations. In the scheme of the tree it means transition from the logical roots to the mathematical trunk of LMP system.

Functional equations

How then, without exceeding the limits of initial formal basis of **AG** system, the concrete numbers should be introduced? By such stating a question the problem seems to be insoluble. Let us, therefore, formulate the question in somewhat other form and ask: which was the main lack of **AG** system up to now, which inherent potentials of the system are not claimed and exposed yet? Quite apparently without multiplication, division and properties of 1 it is impossible to speak seriously about a theory of numbers and mathematics in general, and in any event they ought to be defined and introduced.

We should agree beforehand about the following terminology. Equality, containing only constant values, we shall call *correlation*, equality with variable(s) *equation*, equality, where the sought value is function, *functional equation*. The introduction of new mathematical realities by reducing them by means of functional equations to the initial elements is a powerful facility, general method of formal system's deployment, complementing the axiomatically given properties of numbers. Functional equations, as we shall soon see, are the simplest and the most reliable way of reducing multiplication and division to addition and subtraction.

And so, having marked the new operation of multiplication by a point "·", we want with the aid of simplest functional equations to reduce the multiplication to addition. For two numerical expressions $x + y$, $x \cdot y$, consequently four functional expressions

$$f(x+y), \quad f(x \cdot y), \quad f(x)+f(y), \quad f(x) \cdot f(y)$$

and six functional equations are possible all in all. As far as equations

$$f(x+y)=f(x\cdot y),\quad f(x)+f(y)=f(x)\cdot f(y)$$

just mean an identification of multiplication with addition and in equations

$$f(x\cdot y)=f(x)\cdot f(y),\quad f(x+y)=f(x)+f(y)$$

there is no reduction of one operation to the other, only two functional equations, usually called Cauchy equations, remained. Designating the sought functions as $\psi(x)$ and $\alpha(x)$, we have:

$\mathbf{E}_1\quad \psi(x+y)=\psi(x)\cdot\psi(y)$

$\mathbf{E}_2\quad \alpha(x)+\alpha(y)=\alpha(x\cdot y),\quad (x\neq 0, y\neq 0)$

It is easy to generalize the functional equations $\mathbf{E}_1$, $\mathbf{E}_2$ for the case of many variables:

$\mathbf{E}_{10}\quad \psi(x_1+x_2+\ldots+x_k)=\psi(x_1)\cdot\psi(x_2)\,\ldots\,\psi(x_k)$

$\mathbf{E}_{20}\quad \alpha(x_1)+\ldots+\alpha(x_k)\;=\alpha(x_1\cdot x_2\,\ldots\,x_k)$

It is necessary now to introduce the constant λ – a functional analogue of the initial mathematical constant zero, i.e. to assign a functional character to the main properties $a\pm 0=a$, fixed in the axioms $\mathbf{M}_5$–$\mathbf{M}_6$. There is just one way for this: to replace the variables in the sum of variables by expressions $\pm\lambda$, so that

$\mathbf{E}_3\quad \psi(x+\lambda)=\psi(x)$

$\mathbf{E}_4\quad \psi(x-\lambda)=\psi(x)$

In a more general case, taking into account the possibility of multiple using of functional *rule(s) of zero* (periodicity), we should have the following equations:

$\mathbf{E}_{30}\quad \psi(x+\lambda+\ldots+\lambda)=\psi(x)$

$\mathbf{E}_{40}\quad \psi(x-\lambda-\ldots-\lambda)=\psi(x)$

Using, finally, one more basic component of **AG** formal system, that is the fundamental principle of superposition, we come to following functional equation

$\mathbf{E}_5\quad \lim\limits_{n\to\infty} S(S(\ldots S(x)\ldots)=\text{const}$

Here by symbol S is designated the unknown yet function, whose infinite superposition must bring to hypothetical and distinct from others constant(s); x means any arbitrary taken number.

The sophisticated treatment of equations **E** ($\mathbf{E}_1$–$\mathbf{E}_5$) unambiguously gives such solutions:

$$\psi(z)\equiv \mathrm{e}^z\equiv \exp z$$

$$\alpha(z)\equiv \mathrm{Ln}\, z=\ln z\pm 2\pi n\mathrm{i}$$

$$\frac{\Psi(\mathrm{i}x)+\Psi(-\mathrm{i}x)}{2}\equiv\frac{\mathrm{e}^{\mathrm{i}x}+\mathrm{e}^{-\mathrm{i}x}}{2}\equiv\cos x$$

$$\psi(-z)\equiv \mathrm{e}^{-z}$$

$$\psi(-\mathrm{W}(z))\equiv \mathrm{W}(z)$$

$$\frac{\psi(\mathrm{i}\pi)+\psi(-\mathrm{i}\pi)}{2}=\mathrm{i}\cdot\mathrm{i}$$

$$\frac{\psi(\mathrm{i}ш)+\psi(-\mathrm{i}ш)}{2}=ш$$

Hence the well-known exponent e^z and logarithm $\mathrm{Ln}\,z$ are the initial, maternal functions of **AGE** formal system. Now the equation $\mathbf{E}_5$ is presented in the forms

$\mathbf{E}_{51}$ $\lim\limits_{n\to\infty} \cos(\cos \ldots \cos(z) \ldots) = ɯ$

$\mathbf{E}_{52}$ $\lim\limits_{n\to\infty} \psi^{-1}(\psi^{-1} \ldots \psi^{-1}(z) \ldots) = W(1)$

with two new fundamental mathematical constants ɯ and W(1). They can be easily calculated from equations

$\mathbf{E}_{53}$ $\cos z = \arccos z = z$

$\mathbf{E}_{54}$ $e^{-z} = \mathrm{Ln}(-z) = z$

Solving these equations, we obtain the numbers

ɯ = 0.73908 51332 15160 64165 53120 87673 87340 40134 11758…

W(1) = 0.56714 32904 09783 87299 99686 62210 35554 97538 15787…

And so the numbers 0, π, e, i, 2, ɯ (superposition constant), W(1) (superposition constant, usually called omega-constant) and γ (Euler constant, not presented in equations **E**) are the primary numbers, fundamental mathematical constants of LMP theory and mathematics as a whole. Geometrically the constants ɯ and W(1) are threefold points of intersection of cos *x*, arccos *x*, *x* and e^{-x}, $\ln(-x)$, *x* correspondingly.

Trying to introduce in few words the most characteristic peculiarities and applied role of each of the eight FMC, we may have such picture:

0 signifies the absence of given quantity or property

π from rectilinear to curvilinear

e rapid increase

i periodical processes

2 appearance of nonlinear relationships

γ transition to integral forms

ɯ, W(1) transition from plural to single

Thus, we have at our disposal a new value ɯ which is called to play an utterly particular role in many constructions of LMP theory, referring to its last component – fundamental physics. These constructions concern, in particular, to some numerical problems of the physical theory, connected with the calculation of physical constants and considered as “inaccessible”, “unsolvable” and so on. In the light of foregoing we shall proceed from the assumption that the collection of required fundamental mathematical constant is sufficiently full. From the heights of present-day knowledge it seems obvious that within the borders of mathematics and mathematical natural science the FMC have been gained in the course of time a split-hair status, universal significance. Nevertheless, by means of the present list of FMC was no success, or if only real progress, not only in solving but even in advancing to the true solution of the physical theory’s numerical problems, concerning to the physical constants. In other words, only in the case when in the researching arsenal there is sufficiently complete collection of basic, primary FMC, including superposition constants ɯ and W(1), the mystery of theoretical definition of FC can be translated from the category of unsolvable in the category of solvable problems.

The system of physical codes

In the conception of triune logic, mathematics and physics the latter is considered as a continuation of pure mathematics, but not as just a scientific discipline, maintained, alongside with others, by mathematical methods. Therefore, instead of common *mathematical physics* the term *physical mathematics* seems to be more appropriate, due to the essence of matter. We assume that the central tenets, established or revealed for the formal logical-mathematical system **AGE**, are at the same time the basis, as well as the constructive inception of the physical theory. FPT, as a theory of fundamental physical values, at least in its unified half-formal representation, must naturally begin where the notion of fundamental mathematical value is definitively given, formed and detailed. In **AGE** system the concrete entailment of the idea of primary values and corresponding primary laws is, as we know, the group of eight FMC 0, π, e, i, 2, γ, ɯ, W(1) equally with two maternal functions ψ и α. From the standpoint of LMP conception it is the natural origin of FPT. There are simply no other possibilities here, so we declare that **just the exponential-logarithmic functional representation and just the mathematical constants are the only adequate form for defining the main physical laws and values, particularly the constants**.

Once again resorting to the image of tree it should be said that now we have to do with the branches, deviating from the mathematical stem of this tree, i.e. with foundations of the physical theory, or continuation of physical mathematics in the field of external world's realities. Physical mathematics as a constituent part of LMP system is called to solve a number of problems of about the same kind as in the logical, mathematical parts of the system. Hence, it is necessary to select the main components of fundamental physics, perform their clear systematization, and re-expose and supplement, if required, the corresponding material, presenting it in unified and extremely strict form; also to reveal system's potential by getting some new results which cannot be provided in other way.

Previously we arrived at ψ-α, exponential-logarithmic representation as a natural and essentially single, from the standpoint of **AGE** system, formal-analytical origin of the physical theory. In the general case it is an equation of type

$$\mathbf{C} \quad z = \psi[\alpha(a)\cdot z + b\cdot\alpha(u)] \equiv \exp(\mathrm{Ln}\, a\cdot z + b\cdot \mathrm{Ln}\, u)$$

It is also equal to the product of functions a^z ($a \neq 0$) and u^b ($u \neq 0$) with complex variables z and u and complex constants a, b; for the main value of logarithm and real numbers

$$\mathbf{C}' \quad w = \psi[\alpha(a)\cdot x + b\cdot\alpha(y)] \equiv \exp(\ln a\cdot x + b\cdot \ln y) = a^x\cdot y^b, \ \ (a \neq 0, y \neq 0)$$

The mathematical conservation law **C** and its special case **C′** are the general forms of representation of all complex and real numbers, excepting 0, already given in the axioms. Assigning different values to the constants a, b, one can get the whole collection of elementary functions or blocks, from which, by means of mathematical operations, more complicated functions can be composed. Fixing then the values of variables, one will come to definite relations between mathematical values, also called to perform a real transition from pure mathematics to the physical theory. We are obliged to use these theses for unification and codification of main physical laws, for their reduction to formal uniformity, for establishing a hierarchy of physical laws, dimensions and values, including constants.

Using the claim that all numbers should be single-valued and taking into account that all, at least "independent", mathematical and physical constants (excepting i) are real numbers, we shall take for base the equation **C′**. Fixing a certain, general for all cases constant value a_0 of exponential function, we identify b with fundamental mathematical constant 2: $w = a_0 y^2$. Representing the variable y^2 by (exhausting all the possible variants for square-law form) expressions u^2, $a_1 v^2$, a_2/t^2 with new constants a_1, a_2 and variables u, v, t and denoting the new functions as w_1, w_2, w_3, we have:

$$\mathbf{C}_1' \quad w_1 = \exp(\ln a_0 + \ln u^2) \quad = a_0 u^2$$

$$\mathbf{C}_2' \quad w_2 = \exp(\ln a_0 + \ln a_1 v^2) = a_0 a_1 v^2$$

$$\mathbf{C}_3' \quad w_3 = \exp(\ln a_0 + \ln a_2/t^2) = a_0 a_2/t^2$$

Similarly, on symmetrical grounds, fixing the constant value of power-mode function a_3 and identifying a_0 with fundamental constant 2, we have:

$\mathbf{C}_4' \quad w_4 = \exp(x \ln 2 + a_3) = a_3 \cdot 2^x$

Notice that the expression in parentheses is linear with respect to the variable *x*, multiplied by the constant ln 2, so there are no other variants for this case. Using index *j* to distinguish variables-functions and arguments from constants, we introduce the final denotations for variable and constant mathematical values:

$$a_0 \equiv 1/\hbar c \quad a_1 \equiv G \quad a_2 \equiv G_{\mathrm{F}} \quad \ln 2 \equiv 1/k \ \ (\text{or } k \equiv 1/\ln 2)$$

$$w_1 \equiv \alpha_{\mathrm{e}j} \quad w_2 \equiv \alpha_{Gj} \quad w_3 \equiv \alpha_{\mathrm{W}j} \quad w_4 \equiv \Omega_j$$

$$u \equiv e_j \quad v \equiv m_j \quad t \equiv \lambda\!\!\!^{-}_j \quad x \equiv S_j$$

Assuming that *c* is the velocity of light in the vacuum, *ħ* Planck constant, *G* gravitational constant, G_{F} Fermi coupling constant, *k* Boltzmann constant, e_j a family of charges (electric, weak, magnetic, strong), m_j mass, $\lambda\!\!\!^{-}_j$ Compton length, Ω_j number of micro conditions of macrosystem, in particular the Universe, S_j entropy, that is assigning to symbols their usual physical interpretations, we have now a system of four equations for physical constant and variables.

$$\mathbf{C}_1 \quad \alpha_{\mathrm{e}j} = \exp\left(\ln\frac{1}{\hbar c} + \ln e_j^2\right) = \frac{e_j^2}{\hbar c}$$

$$\mathbf{C}_2 \quad \alpha_{Gj} = \exp\left(\ln\frac{1}{\hbar c} + \ln G m_j^2\right) = \frac{G m_j^2}{\hbar c}$$

$$\mathbf{C}_3 \quad \alpha_{\mathrm{W}j} = \exp\left(\ln\frac{1}{\hbar c} + \ln\frac{G_{\mathrm{F}}}{\lambda\!\!\!^{-}_j{}^2}\right) = \frac{G_{\mathrm{F}}/\lambda\!\!\!^{-}_j{}^2}{\hbar c}$$

$$\mathbf{C}_4 \quad \Omega_j = \exp\left(\frac{S_j}{k}\right)$$

Equations $\mathbf{C}_1 - \mathbf{C}_4$ we shall call *system of physical codes* and denote by symbol **C**. This is one of the most key moments of LMP system construction, signifying the transition from logic-mathematics to foundations of physical theory by adding the system of codes **C** to the system of logical postulates, mathematical axioms and initial functional equations. **AGE** system, complemented in such way, becomes **AGEC** system. Integral role of the code system **C**, unifying the main physical values and covering in effect the whole of the theory, is obvious at a glance. Such equations and correlations could appear as peculiar syntheses, quintessence of all achievements of the physical theory only on a definite stage of its development. Without these equations the conception of unity, the idea of logical-mathematical formalism outgrowing into a formalism of the physical theory looks as a speculative chimera. On the other hand, the ideas prescribed in the base of LMP conception act as a code of prohibitive laws and allowed constructions, as a certain selector, correcting the investigation, selecting, systematizing, etc. just the things that are in accordance with the internal logic of their development. This logic imperatively requires that the pivotal transition from the formal mathematics to fundamental physics must occur by analytical laws and rules, designated as basic ones, by means of substantial elements.

In essence, the question is the systematic ψ-α-transition from mathematical values to physical ones; more particularly from mathematical variables and FMC to fundamental physical variables and constant values by using the satellite notion of dimension. Consequently, the clue, as we suppose, is kept in **C** system of four types of equations and correlations. Just as the functional equations **E** contain in the hidden form a stupendous information of mathematical character, in **C** system, continuing system **E** in the domain of physical mathematics, are codified the universal codes of the physical theory concerned with the principal physical values, laws, as well as dimensions. Dimensional analysis is practically completed theoretical product, owing to which the formal-mathematical method, avoiding the specifics of the physical theory and dealing with physical values only, successfully copes with the solution of some general problems.

Physical values and dimensions

Dimensional analysis is almost a ready fragment for physical mathematics. All that mathematics needs for dimensional analysis are the ready for usage physical values and they are just given by codes. All constant and variable values, included in the initial equation system **C**, are naturally considered as fundamental. For their differentiation and for determination of relationship between notions of *physical value* and *physical dimension* is necessary to introduce some notions and give corresponding definitions. Any physical value, which formally does not differ from mathematical value or, put very simply, is just a mathematical number, we shall name non-dimensional, or zero-dimensional, value. Thence, in accordance with the way the equations $\mathbf{C}_1-\mathbf{C}_4$ are obtained, automatically follows that functions-variables α_{ej}, α_{Gj}, α_{Wj}, Ω_j are zero-dimensional physical values. And if the differences in the way of getting the first three values are taken into consideration, then one can speak about two main types of non-dimensional values: family of coupling constants α_{jk} and entropic variable Ω_j. All the other values in equations **C** are called dimensional, so we have four types of non-dimensional equations between dimensional physical values. The same denominator $\hbar c$ in first three equations means the same dimension of expressions e_j^2, Gm_j^2, G_F/λ_j^2, hence of expressions e_j, $\sqrt{G}m_j$, $\sqrt{G_F}/\lambda_j$, which we shall name *charges*. Denoting the dimension of physical value by square brackets we have a total of five main dimensions, denoted by symbols A, V, J, S, Q:

A ≡ $[\alpha_{xj}] \equiv [\Omega_j]$ – dimension of α_{xj} or Ω_j, that is zero-dimension

V ≡ $[c]$ – dimension of the velocity of light in vacuum or simply of speed

J ≡ $[\hbar]$ – dimension of Planck constant or action

S ≡ $[k]$ – dimension of Boltzmann constant or entropy

Q ≡ $[e_j] \equiv [\sqrt{G}\, m_j] \equiv [\sqrt{G_F}/\lambda_j]$ – dimension of generalized charges

According to the general definition, *dimension* of arbitrary physical value is the analytical expression, establishing a formal relationship between this value and those that are chosen as main values. The same dimension of both parts of equality is a universal requirement, imposed on all physical sentences – formulas, equations, correlations. It is based in effect on excessively hard dismemberment of the physical universe on separate classes of physical numbers-values. Turn, in particular, attention on such nuance: dimension is saved when adding and subtracting homogeneous values, dimension is changed when multiplying and “disappears” when dividing them. It follows that one cannot add or subtract values with different dimensions, but only can multiply and divide them. Such strong restriction is absolutely inadmissible for mathematical numbers-values, as far as in mathematics one cannot divide on zero; in the rest cases all four operations are entirely permutable for any number. Notice, running ahead, that similar slip-up, alien to the idea of mathematical and physical value’s unity, indicates the evident insufficiency of dimensional analysis for establishing such unity.

It is urgent to continue the revealing of particularities of **C** system with respect to dimensions. From the first glimpse on equations $\mathbf{C}_1-\mathbf{C}_3$ is clear that it is impossible in the system of dimensions AVJSQ to get the dimensions of four fundamental values G, G_F, m_j, λ_j. It is easy to understand, taking into account that alongside with the form, containing only variables for generalized charges e_j, the charges are also presented in gravitational Gm_j^2 and weak G_F/λ_j^2 variants with constants G, G_F and variables m_j, λ_j. We introduce the following designations:

G ≡ $[G]$ dimension of gravitational constant

$\mathrm{G_F} \equiv [G_F]$ dimension of Fermi constant

M ≡ $[m_j]$ dimension of mass

$L \equiv [\lambda_j]$ dimension of Compton length

Replacing Q by any of these four dimensions and having in equations $\mathbf{C}_1$–$\mathbf{C}_3$ the dimension of charge $(\hbar c)^{1/2}$, we come to four other possible systems of main dimensions, where the problem of getting arbitrary physical dimensions is fully solvable.

In short, any taken from the initial equations dimension can be regarded as a main dimension; it causes their evident excess – nine main dimensions, while according to **C** system and specifics of the physical theory their minimum, including A, amount is five. This offers considerable scope for varying the list of main dimensions. Thus, it should be noted that in respect to fundamental values of **C** system the method of dimensional analysis is incapable of producing unambiguous results. Physical values are connected with each other by a multitude of formulas, containing different variable and constant values; moreover, the number of these "independent" relations is much more than the number of values themselves. Thence the considerable freedom in choosing the system of initial dimensions.

On the general physical laws. Conservation laws

Physics as a science about physical values is called to reveal and arrange the families of inter-connected values. The essence and theoretical capabilities of values may reveal themselves both by their internal properties and in analytical relations with other values. All this is encoded in the most general type in the system of equations **C**, needing a sequential decryption and interpretation. According to the initial notions of variable and constant we ought to speak about three main types of physical laws. They are laws of ***conservation***, ***variation*** and ***quantization***, encoded in **C** system in their wholeness and formal unity.

It is known that any sentence of mathematics can be introduced by the use of mathematical operation "=", propositional connectives and quantifiers; besides, any equality is a conservation law for the analytic connection between the values. But now we are interested not in the "conservation laws of laws" but in more particular case of conservation laws of fundamental physical values, including the constants, the initial group of which is given by the system of equations **C**. In addition to the values c, $\hbar$, k, G, G_F all designated, notable values of functions α_j, α_{Gj}, α_{Wj}, Ω_j, the variables e_j, m_j, λ_j, S_j, as well as all physically meaningful combinations of enumerated values fall into the category of FMC. To count the precise number of even "independent" physical constants is not easy, but approximately we can speak about more than ten designated in the present singular points of the continuum, i.e. fundamental physical numbers, preserving in all and at all variations.

One of these numbers, having the status of a great law of nature, embodies a unique peculiarity and is, in fact, the only representative of its class of values. We have to do with the constant c which appears in equations $\mathbf{C}_1$–$\mathbf{C}_3$ and is not only a universally preserving value, but the only designated speed in the nature as well. Keeping the letter and spirit of **AGEC** system, it is necessary to warn that for the correct formulation of the law c = const is not available the use of such words and expressions as *observer*, *in time*. For instance, to say that the physical value *is always* constant, or *always* has one and ditto value, that is to define the conservation law as numerical values' con-stantcy *in time*, is incorrect on many reasons. Obviously, the main source of millennial worship to *Time* is that we all are prisoners of limitedness, narrowness of our own perception of the external world, according to which any change of physical characteristics is imagined and introduced as something occurring in time and space. Meanwhile, it is reliably established that the "arrow of time" (Eddington) flies only from the past in the future through the present – due to the law of entropy increasing (equation $\mathbf{C}_4$).

Also is inadmissible to define the fundamental physical laws by the aid of such notions as *inertial coordinate system*, *closed system*, *insulated system* if for no other reason than the logical circle in definition. Indeed, if one tries to reveal the content of the notion of inertial coordinate system he will immediately realize that by this is understood a system in which are true the conservation laws which, in their turn, are true in such systems in which are true the conservation laws, which ... The logical circle is quite evident here. It is possible, in principle, to do without explicitly indicating the physical system, replacing it by corresponding equations, but after they must be in any event pertained to something. Thus, in one way or another it leads to setting up the problem of designated, privileged physical system's existence; only by using such system we can circumvent the indicated difficulties.

Actually the matter is not as difficult and hopeless as might appear at first sight. The way out of this situation have been found, in fact, already in **[**Clausius**]** and time and again, though often occasionally and intuitively, was reproduced or repeated by others. The *Universe*, or physical wholeness with all its parameters, properties, relations and characteristics exists in a single copy and so it is an absolutely unique system, designated just by the undoubted fact of its existence. Hence, only and only with respect to the Universe ought to be and can be defined all the general physical laws.

Conservation law of velocity of light in the vacuum:

Constant c is a fixed parameter of the Universe, that is the numerical value of c does not depend on any physical changes

In more mathematical, formalized, not containing direct references to physical system variant we have:

Number c is preserving in all physical equations and relations, in all physically meaningful mathematical transformations

Finally, in logical-mathematical terminology:

The individual term c is an absolutely invariant constant of the formalism of LMP system

The next one of the great conservation laws refers to the value, presented in codes **C** by the Planck constant $\hbar$ and called **action**, or quantity of motion, momentum, spin, etc. – depending on the physical domain and context in which it appears. Even the list of this many-sided value's names displays the large scope of its envelopment, conditioned by amazing characteristics. We shall take a quick look at some of them.

a) The *invariance* of quantum mechanical ψ-function with respect to transformations $\psi \rightarrow \exp(-i\ \varphi J/\hbar)$, where φ is the angle of rotation, that physically can be interpreted as isotropy, equivalence of all directions in space, non-measurability of absolute direction in it

b) *Classification* of all elementary particles, depending on the spin and the great, directly connected with the numerical value of spin distinctions, different mathematical models and ways of describing various particle groups

c) Heisenberg *uncertainty principle* for canonically conjugated values, whose product of dimensions has the dimension of action and lower limit equal to $\hbar/2$ or $\hbar$

d) The *variation principle* connected with the action integral, Lagrangian, Noether theorem and zero-value of action variation (principle of least action) in mechanics, quantum physics, field theory, elementary particles physics or, in short, everywhere

e) Obtaining, by means of mathematical *Noether theorems*, a whole family of secondary conservation laws; unified inference of greatly different equations of existing theory by action variation

Such are the main appearance and characteristics of the value, standing on the same level and alongside the constant *c*.

Conservation law of action:

The action of the Universe preserves

It is quite understandable that action is invariant with respect to all physically meaningful transformations, and after the previous case there is no use to formulate this law in mathematical or logical terminology. Action of course preserves in all physical processes, though, on essence, it is just the only possible corollary of its numerical values' constancy in the Universe.

There is also a group of charges in the system of codes.

Generalized conservation law of charges:

All the charges preserve in the Universe

The charges, of course, are also preserving in all processes occurring in the Universe; identically to that for action, it simply follows from the general law. But in contrast with action, there are several types of charges, so we ought to speak on the generalized law, using the plural number in the definition. The idea of conservation of generalized charge e_j, which is contained in the equation $\mathbf{C}_1$, is detailed by equations $\mathbf{C}_2$ and $\mathbf{C}_3$. Nowadays, with greater or smaller probability, we can speak about five varieties of fundamental charges: electrical e_e, magnetic e_m, strong e_s, weak e_W and gravitational e_G.

Quantization laws

From the formal point of view some physical values, forming a part of the system **C**, are numerical sequences, constructed by certain laws and reflecting the internal characteristics of values. The rules of composing such mathematical sequences from physical numbers make up in total the second group of fundamental physical laws – **quantization laws**. There are good grounds to believe that the Nature surely prefers the discrete, limited above and below sequences to the continuous, infinite continuums. The victorious onslaught of quantum physics, commenced from the opening of quantum action, lasts up to now; and step by step, slowly, but steadily the unceasing values of the classical physics are replaced by quantum values. There are many reasons to assert that the millennial dilemma: "continuous or discrete?" has been ultimately settled in physics in the favor of the last one.

Thus, we have the following laws of composing discrete numerical successions, forming discrete spectrums for fundamental physical values:

Quantization law of action: $J = \frac{\hbar}{2}\cdot n \qquad n = 1, 2, ..., N_U$

Quantization law of entropy: $S = \frac{k}{2}\cdot n \qquad n = 1, 2, ..., N_U$

Quantization law of charges: $Q = \pm e_{j0}\cdot n \quad n = 1, 2, ...$

In the last law the quantization of all types of charges is produced by the elementary charge; in the case of electrical charge it is equal to $\pm e$ for leptons and $\pm e/3$ for quarks.

Presenting the equation $\mathbf{C}_1$ in the form

$$1/\alpha_j = e_j/c^2\cdot\hbar$$

is easy to guess, what else quantization laws of secondary values, containing multiplier $\hbar$, can be received thence.

Integer quantization law of Hall resistance: $R_j = \frac{2\pi\hbar}{e^2}\cdot\frac{1}{n^2}$

Fractional quantization law of Hall resistance: $R_j = \frac{2\pi\hbar}{e^2}\cdot\frac{n}{2k+1}$

Quantization law of magnetic flow: $\Phi = \Phi_0 n = \frac{\pi c}{e}\cdot hn$

It only remains to notice that discreteness is one of the universal characteristics of the physical world and the quantization as a secondary law of other values is also possible; for instance, of combination $\pi\hbar/m_e$ from the equation $\mathbf{C}_2$ (with theoretically defined multiplier π), called quantum circulation.

Variation laws

Any mathematical equation with variable physical values can be considered as a variation law of these values. A statement about the conservation of some value is usually presented as an equation, containing, along with constants, some changing values as well. Actually the conservation law of some values is represented as a variation law of other values, on condition that the first ones are constant. It may appear that there are no principal differences between these two types of physical laws. But the differences between them, which become imperceptible when writing the laws by the use of secondary values, is undoubted when stating the laws in the general form. All fundamental variation laws (according to the assumption on the necessity and sufficiency of equation system **C** for solving such problems and with regard to characteristics of values which form a part of this system) refer to the functions-variables $\alpha_j, \alpha_{Gj}, \alpha_{mj}, \alpha_{Wj}, \alpha_{sj}$ and S_j. In accordance with this we have a group of variation laws for five coupling constants of fundamental interactions, coupled with five types of charges as independent variables; we also have, standing somewhat aloof, the law for entropy. The formulation of the last is quite simple.

Variation law of entropy:

The entropy of the Universe increases

Mathematically it is the equation $\mathbf{C}_4$: $S_j = k \ln \Omega_j$. Combining it with the quantization law of entropy $S_j = j \cdot k/2$, we come to the variation law

$$\Omega_j = \mathrm{e}^{j/2}, \quad j = 1, 2, 3, ..., N_U$$

for the number of micro conditions of the Universe, which generates a quickly increasing exponential series

$$\mathrm{e}^{1/2},\ \mathrm{e},\ \mathrm{e}^{3/2},\ \mathrm{e}^{2},\ \mathrm{e}^{5/2}...$$

As to the α-functions the discovery of these non-dimensional physical values is among the most remarkable events of the history of physics. In the unified exponential-logarithmic form of presenting the physical values by equations **C**, the variables α_{xj} play the role of functions, changing by the laws, which alongside with $\mathbf{C}_4$ are the main variation laws of the physical values. In general, all designated meanings of $\mathbf{C}_1$–$\mathbf{C}_3$ are matched by designated meanings of functions α_{xj}. On the other hand, all meanings of functions α_{xj} are put in correspondence to certain values e_{xj}, m_j, $\lambda\!\!\!^{-}_j$ on the base of equalities

$$e_j = \sqrt{\alpha_j \hbar c}\,, \quad m_j = \sqrt{\frac{\alpha_{Gj}\hbar c}{G}}\,, \quad \lambda\!\!\!^{-}_j = \sqrt{\frac{G_\mathrm{F}}{\alpha_{\mathrm{W}j}\hbar c}}\,, \text{ and also } \lambda\!\!\!^{-}_j = \frac{\hbar}{m_j c}$$

Such inverse dependency between function and argument is especially important for gravitational charge and mass, because there is no quantization law for them, at least as simple as for charges of other four fundamental interactions.

The A-system – absolute non-dimensional system of physical values' measurement

By this is meant the ultimate formal merging, unification of physical values with mathematical ones. It was declared from the very beginning and partly realized in system of codes **C** for constant $k = 1/\ln 2$, but not yet solved in general. The principal idea consists in recasting the physical values in the form of mathematical number. The necessary conditions for this are to build, first, a system of physical values' measurement, based not on grams, centimeters and so on, but solely on FPC – fundamental physical constants (M. Planck) and, secondly, to reduce all physical constants to MC –

mathematical constants (D.Hilbert). In all being in current use non-dimensional systems of Planck ($c = \hbar = G = k = 1$), Hurtree ($\hbar = m_e = e = 1$), relativistic quantum theory ($c = \hbar = m_e = 1$) and others only the first part of the program is executed. Put forward by Hilbert the idea of reducing all PC to MC so that physics should entirely become a science of the same type as geometry **[**Hilbert**]** is not actually fulfilled in these systems. The matter is that the basic physical constants are taken there equal to 1, rather than to FMC, or their simplest combinations. It turns out that all such non-dimensional systems really define not the *true numerical meanings* of physical values, but nothing more than their meanings in relation to *arbitrarily chosen unity scales*. In the Planck system, for example, all velocities $v_P \leq 1$ and all meanings of action, with due regard for its quantization law, are expressed by integers or half-integers.

The dogma of the natural numbers' primacy shows itself in foundations of physics too. Thus, the remarkable, probably outstripping its time Planck's idea was to a large extent depreciated by unreasonable equating PC with 1. The practical advantages of such equating, the more simple form of some physical equations in particular, do not compensate the losses, concerning the understanding of different equations' physical meaning and ontological essence. The fact that all equal to 1 constants are unjustified is particularly obvious on the background of zero-dimensional values, whose numerical values are unaffected by the choice of the measurement system. In the system of physical codes **C** this is true for non-dimensional functions α_{xj}, Ω_j which at any choice of measurement system are just mathematical numbers, different and often highly distant from 1.

It is natural to distinguish for FMC and their combinations the graphical designations π, e, i and composed of them true expressions of e^{π}, $\pi/2$, $ш/\pi^2$ type from corresponding numerical meanings. Hence, "the true expressions of the physical constant" ought to be understood as the formula of physical constant's connection with mathematical and other physical constants. As for the numerical value of the physical constant it is, as usual, its notation by the symbols of some, mostly decimal, number system. For example, the mathematical term 1/ln 2 is the true expression of Boltzmann constant k, while the number 1.44279604… is its decimal notation.

To have a full complement three more true expressions are needed: it will allow bringing any dimensional PC, any physical value to the form of non-dimensional mathematical number. Four, as a minimal number of the basic physical, mathematically expressed constants, is correlated with the number of independent equations of **C** system, and with the number of main dimensions except for the zero-dimension. It is quite clear that such coincidence is not occasional, because **C** system is formed so that it must contain as many types of main equations as it is necessary to solve the cardinal problems of physical theory's foundations, including those that are concerned with dimensions. The measurement system, built on the base of the true mathematical expressions for the initial PC, we name **A-**system and all concerning to it values, except for the non-dimensional values, shall be noted by index A.

The assertion that $k_A = 1/\ln 2$ is a true expression, besides the considerations directly connected with getting physical codes by means of ψ-α functional presentations, is supported by the comparison of Boltzmann formula $\mathbf{C}_4$ with Shannon formula for the minimal binary code. According to equipartition law the value $kT/2$ is the average energy accounted for each degree of freedom of a system at the thermodynamical equilibrium state. On the basis of equipartition law it should be considered that the Boltzmann constant, more precisely $k/2$, is a quantum, minimal quantity of entropy accounted here for each degree of freedom. In support of this we now turn to the third law of thermodynamics, or Nernst theorem. In the classical interpretation of the third law the entropy of any system tends to zero when tends to zero its temperature. In a more rigorous formulation, when, for instance, are taken into account the nuclear spins of a cooled body, the entropy, even as we approach the absolute zero temperature $T_{\min}$, tends not to a zero but to its minimal, finite limit S_0. This can be understood as a principal unattainability of the absolute order in nature. The minimal value of entropy is easy to find by means of Boltzmann formula: the minimum nonzero value of entropy is reached when $\Omega = 2$. We have the value

$$S_{\min} = k \ln 2$$

equal to the constant k with an accuracy of the number $\ln 2 \approx 0.693$. Hence, on the basis of the third law of thermodynamics, Boltzmann formula and equipartition law we conclude that k, with an accuracy of the order 1, is the elementary portion, quantum of entropy. It remains to find the multiplier of the order 1, and for this purpose we ought to continue the search in the field of information theory and cybernetics. Here entropy is defined as a measure of information uncertainty of the internal structure of a system, as a measure of system's disorder and so on. In all these cases it is measured in the same non-dimensional units – bits as the quantity of information. The entropy of two elementary events with the same probability is one bit or, in other words, entropy in bits establishes the number of binary symbols that are necessary for writing the given information. The entropy I (in bits) of a physical system with a number of micro conditions Ω_j is defined by Shannon formula

$$I = \log_2 \Omega_j$$

where $\log_2$ is the symbol of logarithm to the base 2. The comparison with Boltzmann formula gives a simple correlation

$$k = 1 \text{ bit}/\ln 2$$

which transforms the constant k to bits and vice versa. On the basis that the binary code of recording the information is minimal and accepting *bit* as an absolute unit of the quantity of information, we have the number $1/\ln 2$ equal to 1.44269… as a true value of the constant k. The Boltzmann formula takes now the form

$$S_{\mathrm{A}} = \ln \Omega/\ln 2$$

Thus, the physical consideration, supplemented by Shannon formula, indeed confirms the previously obtained "code" value of the constant k; so this problem may be thought of as conclusively solved.

For building the A-system three more expressions of correspondingly selected physical constants are needed. The most suitable values are the velocity of light in the vacuum, Planck constant and the mass of one of the fundamental particles, measured, besides, with a great accuracy. In **[**Arakelian 1981, 139–144**]** we come to certain expressions for c, m_{eA} and $\hbar_{\mathrm{A}}$, containing the new FMC ɯ and thereby providing its occurrence into mathematical expressions of many physical constants. The ultimate list of initial correlations of the physical values' absolute measurement system is such:

$\mathbf{A}_1$ $\quad k_{\mathrm{A}} \equiv 1/\ln 2$

$\mathbf{A}_2$ $\quad c_{\mathrm{A}} \equiv \alpha^{-1}$

$\mathbf{A}_3$ $\quad m_{\mathrm{eA}} \equiv ɯ/\pi^2$

$\mathbf{A}_4$ $\quad \hbar_{\mathrm{A}} \equiv \pi^2\alpha^2/ɯ$

The sufficiently full empirical corroboration of the basic expressions and **A-**system as a whole is possible only by analyzing the numerous consequences, which result from this choice and are accessible for direct comparison with experimental data. The ultimate list of initial formulas is presented in the table, where are given not only the true A-expressions of constants, but their decimal values as well.

Constants	The equation and the true expressions	Decimal values
c_A	$\cos x + \frac{e^{x-44\pi}}{x^2} - e^{-\sqrt{x}} - \frac{1}{e} = 0$	137.03599 94520 214...
k_A	$\frac{1}{\ln 2}$	1.44269 50408 88963...
m_{eA}	$\frac{ш}{\pi^2}$	0.07488 49805 09814...
$\hbar_A$	$\frac{\pi^2\alpha^2}{ш}$	0.00071 11086 07804...

Any physical constant as a combination of initial constants can be expressed now by mathematical constants. So, for charges e and e_{m0} or for the Compton time $\tau_{Ce} = \hbar/m_e c^2$ and Bohr magneton $\mu_B = e\hbar/2m_e c$ we get the expressions

$$e_A = \pm\frac{\pi\alpha}{\sqrt{ш}}\,,\quad e_{m0A} = \frac{\pi}{\sqrt{ш}}\,,\quad \tau_{CeA} = \frac{\pi^4\alpha^4}{ш^2}\,,\quad \mu_{eA} = \frac{\pi^5\alpha^4}{2ш^2\sqrt{ш}}$$

Herefrom we have some curious relations

$$e_A = \pm\sqrt{\hbar_A}\,,\ \ e_{m0A} = \pm 1/\sqrt{m_{eA}} = \pm c_A\sqrt{\hbar_A}\,,\ \ \tau_{CeA} = \hbar_A^2\,,\ \ \mu_{BA} = c_A\sqrt{\hbar_A^5}\,/2$$

reducing those constants to c_A and $\hbar_A$.

As to arbitrary physical values, we have only to do with their decimal meanings, calculated by rules that are common for all non-dimensional systems. If some physical value has, to say, in LMTθ system (L – length, M – mass, T – time, θ – temperature in Kelvin) numerical value $B_{LMT\Theta}$ and dimension

$$L^p M^q T^r \Theta^s$$

then its value B_A in **A**-system is defined from the general formula

$$B_{LMT\Theta} = B_A\, l_A^p\, m_A^q\, t_A^r\, \theta_A^t$$

Here l_A, m_A, t_A, θ_A are uniquely determined coefficients of transition from LMTθ to **A**-system, or vice versa. They are calculated by the same rules as the Planck values or any other coefficients of transition between dimensional and non-dimensional measurement systems. We are using the recommended values for α, k, m_e and for Rydberg constant R_∞. Indicating the absolute and relative errors in parentheses, we have the following expressions and numerical values for the coefficients of **A**-system:

$$l_A = \frac{ш^2}{4\pi^5\alpha R_\infty} = 5.572\,626\,246(19)\cdot 10^{-7}\ \text{см} \quad (3.4\ \text{ppb})$$

$$t_A = \frac{ш^2}{4\pi^5\alpha^2 R_\infty c} = 2.547\,263\,565(17)\cdot 10^{-15}\ \text{с} \quad (6.7\ \text{ppb})$$

$$m_A = \frac{m_e}{m_{eA}} = \frac{m_e\pi^2}{ш} = 1.216\,449\,89(21)\cdot 10^{-26}\ \text{г} \quad (0.17\ \text{ppm})$$

$$\theta_A = \frac{\pi^2\alpha^2}{ш\ln 2}\,\frac{m_e c^2}{k} = 6.083\,550(12)\cdot 10^{6}\ \text{К} \quad (2.0\ \text{ppm})$$

For some other, used in physics, dimensional measurement systems, whose connection with CGSQ is known, the calculation of analogous transition coefficients is rather trivial. There is also a need to add the coefficient

$$m_{A0} = 6.823\ 783\ 61(58)\cdot 10^{-3}\ \text{GeV} \quad (85\ \text{ppb})$$

translating the A-value of any mass into GeV/c^2.

Thus, we have fulfilled the construction of **A-**system, supplemented by revealing its relations with other physical values' measurement systems, in particular, with CGSQ (centimeter, gram, second, Kelvin). Now all physical values can be represented as sets of zero-dimensional mathematical numbers, distinguishing only by some formal properties and ontology. There are no more dimensions as such, and all ordinary mathematical operations, not only the multiplication and division, are available for physical numbers.

Part II. Applications of LMP Theory

The Fermi constant in A-system

There is one private but rather significant correlation, valuable by the fact that neither new, aside from the given above, suggestions are required for its getting. We find out that, in accordance with the idea of mathematical and physical values' formal merging, any dimensional physical value is brought in **A**-system to a non-dimensional form of mathematical number. In so doing the designated physical values c, $\hbar$, k, m_e, as well as physically meaningful combinations $\hbar/m_e c$, $e\hbar/2m_e c$ and so on can be directly expressed by mathematical constants, using equations or such correlations as $m_{eA} = ш/\pi^2$ and $k_A = 1/\ln 2$. These equations and correlations reveal the genuine mathematical nature of the physical constants, which can contain corrective multipliers or summands, requiring special and generally laborious calculations giving usually an approximate result only. A serious restriction on the accuracy, imposed by the total influence of various corrections, is impossible to ignore. At the same time, being presented in the form of close to 1 non-dimensional multipliers, they are separated from the constant as such. Taking this into account, we expect that all FPC are in any case defined by correlations and equations, often containing close to 1 corrective multipliers.

From the five *code* constants c, $\hbar$, k, G, G_F we have mathematical, though empirically not yet confirmed, expressions for c, $\hbar$, k. Let us see now, how the matter with the Fermi constant stands. The exceptional role of G_F in the physical theory does not cause doubts. Suffice it to say that G_F, often in degrees 1/2, 2, 3, ..., characterizes all 156 four-fermion interactions between 24 fundamental particles – 12 leptons and antileptons and 12 quarks and antiquarks. There are no concrete considerations as to the question, how the Fermi constant must be expressed through mathematical constants, and it remains only to calculate with the maximum accuracy its A-value in a *purely formal*, mechanical way. In CGS system G_F is computed from the formula for the muon mean lifetime, which is suitable to present in such form:

$$G_F = \left(\frac{192\,\pi^3 \hbar^2 c\, \lambda\!\!\!^{-5}_{C\mu}}{R_\mu \tau_\mu} \right)^{\frac{1}{2}} \tag{1}$$

Here

$$\tau_\mu = 2.197\,019(21)\cdot 10^{-6}\ \text{s} \quad (9{,}6\ \text{ppm}) \tag{2}$$

is the muon lifetime, multiplier $192\pi^3$ has been derived as a result of diagram calculations, the corrective multiplier R_μ is being calculated over a quarter of a century. Using the consistent values for α, m_μ, m_e/m_μ and the last value $m_W = 80.403(29)$ GeV/c^2 of Particle Data Group, we have close to 1 multiplier

$$R_\mu = 0.995\,611\,(14) \approx 1 - 4.4 \cdot 10^{-3} \tag{3}$$

Substituting data in (1) we have the empirical value

$$G_\mathrm{F} = 1.435\,841\,(12) \cdot 10^{-49}\ \mathrm{cm}^5\,\mathrm{g} \cdot \mathrm{s}^{-2}\quad (8.4\ \mathrm{ppm}) \tag{4}$$

$$G_\mathrm{F} = 1.166\,371\,(1) \cdot 10^{-5}\ \mathrm{GeV}^{-2}\qquad (16\ \ \mathrm{ppm}) \tag{5}$$

Transition to **A**-system by general formula (1) brings about the expression

$$G_\mathrm{FA} = G_\mathrm{F}\, l_\mathrm{A}^{-5} m_\mathrm{A}^{-1} t_\mathrm{A}^{2} \tag{6}$$

In explicit form we have:

$$G_\mathrm{FA} = \frac{64\,\pi^{13}}{\text{ш}^5} \cdot \frac{R_\infty^3\,\alpha}{m_\mathrm{e} c^2}\, G_\mathrm{F} = 1.425\;1495\,(121) \cdot 10^{-21}\quad (8.5\ \mathrm{ppm}) \tag{7}$$

In decimal notation this number is not notable at all, but as soon as it is presented in the initial exponential $\psi(x) \equiv \exp(x)$ form we come to an absolutely amazing result

$$G_\mathrm{FA} = \mathrm{e}^{-48.000\;0102\,(85)}\qquad (0.18\ \mathrm{ppm}) \tag{8}$$

which practically, within the limits of experimental error, is equal to

$$\mathrm{e}^{-48} \equiv \exp(-48) \equiv \psi(-48)$$

It should be particularly emphasized that this expression is got entirely automatically, just as a result of identity $c_\mathrm{A} \equiv \alpha^{-1}$ and initial correlations for m_eA and $\hbar_\mathrm{A}$, obtained quite apart from the Fermi constant. It is difficult, even impossible to perceive that it is just a curious mathematical oddity. From the viewpoint of mathematical harmony of the physical world the chief thing is that the numerical term $\psi(-48)$ is not only extremely simple, but also extremely suitable for just those calculations, where the Fermi constant invariably appears. It has been known that G_F appears in different equations and correlations in the powers $\pm 1/2$, ± 1, $\pm 3/2$, ± 2, ..., and correspondingly we have terms $\psi(\pm 24)$, $\psi(\pm 48)$, $\psi(\pm 72)$, $\psi(\pm 96)$, ... which are greatly suitable to deal with. As for the power of exponent, most likely it is exactly -48, particularly if taking into consideration that all the small and super-small corrections are included in the multiplier R_μ. Even independently from this the approximation degree (0.18 ppm) here is such that unwittingly arises the question: why 48, what aspects of the physical reality are hidden under this number? From the formal point of view it is practically the most suitable number to handle with, and now we want to understand its physical meaning. In the genuine mathematical expressions for FPC can appear *unexplained yet* numbers, but accidental, random numbers have nothing to do there and there is no place for them in fundamental physics.

We have a rather convincing explanation of the number 48 and its homologues. The point is that the sum total (including the antiparticles) of just characterized by the Fermi constant leptons and quarks is 24. In parallel with this, G_F relate to bosons with the spin $\hbar$; in accordance with the theory of Grand unification the famous symmetry group $SU(5)$ contains just 24 generators. And for every generator there is corresponding vector boson – $W^\pm$ or Z^0 bosons, photon γ, 8 gluons and 12 X and Y-particles. It should be added that the formula $G_\mathrm{FA} \approx \mathrm{e}^{-48}$ appears for the first time in [Arakelian 1995] far later than the **A**-system in [Arakelian 1981]; the number 24 for α^{-1} (see below) – only now. Isn't then the number 48 in the power of the exponent just the sum total of all enumerated fundamental particles: 24 fermions and 24 bosons?! If so, we can state with assurance that 24 is the number of fundamental fermions (leptons and quarks with spin $\hbar/2$) as well as of fundamental bosons (spin $\hbar$), and 48 is their sum total. Herefrom the existence of only three generations of leptons and quarks, corroborated by experimental data; at the same time is must more justified the great importance of the symmetry group $SU(5)$ for the physical theory. Designating the number of fundamental fermions by n_F, bosons n_B and supposing that the power 48 has not a decimal "tail", we can write

$$G_{FA} = e^{-(n_F + n_B)} \tag{9}$$

Immediately appears the analogy with entropic formula $\Omega_j = e^{j/2}$ for the number of micro conditions of the Universe. The formal resemblance between Ω_j and G_{FA} is by no means accidental and results from the content relationship of these values. By its physical meaning Ω_j varies in inverse proportion to the probability (of conditions), but probabilistic features are inherent for the Fermi constant as well: suffice to look at the formula (1), where $G_F^2 \sim 1/\tau_\mu$. And so far as τ_μ varies in inverse proportion to the probability of decay, the connection of Fermi constant with probability is quite obvious. By the way, the exponential character is primarily built into the very notion of the mean lifetime of quantum-mechanical system, in particular of non-stable particles, as far as the value τ is defined as a time interval during which the probability of finding the particle in a certain state decreases in e times. Certainly, this is not a result of a free convention, but mathematical reflection of exponential nature of probability, which is ultimately determined by some properties of the maternal ψ-function, encoded in the system of functional equations **E**. In general, the mean lifetime of any particle can be presented in universal form

$$\tau = \tau_C \cdot a = \tau_C \cdot a_1 e^{a}{}_2, \quad (a_1 > 0, a_2 > 0$$

where $\tau_C = ƛ_C/c$ is the Compton time of particle, a_1, a_2 – positive non-dimensional coefficients. With due regard for the available A-expressions,

$$\tau_\mu = \tau_{C\mu} \frac{192\pi^3 \hbar_A^{10}}{R_\mu d_\mu^4 \alpha^6} e^{\boldsymbol{96}} \tag{10}$$

where $d_\mu = m_\mu/m_e$, the bold italic conditionally designates the relative empirical error of the power in the expression for G_{FA}. In **A-**system

$$\tau_{\mu A} = \frac{3\pi^3 d_\mu}{R_\mu}\left(\frac{2\pi^4\alpha^3}{ш^2 d_\mu} e^{\boldsymbol{16}}\right)^6 \tag{11}$$

and we assume that this is the true mathematical expression for the muon lifetime – "ancestor" and in the great number of cases the constituent part of similar formulas.

Reverting to the Fermi constant, let us resume the preceding. The **A**-system, experimental data, the Fermi constant and entropy, τ and probability, the numbers of fundamental fermions, bosons and micro conditions, the great syntheses with the symmetry group *SU*(5) and, as we shall see subsequently, the fine structure constant – all this comes wonderfully together in a simple and elegant expression $G_{FA} = e^{-48}$. Actually we have an "exact hit" in one of the significant points of the infinite number continuum without any "sight" and even without any expectation of such result! The possibility of accidental numerological coincidence seems to be absolutely improbable here. Thus, it is safe to assert the following. Somewhat unexpected, unprovoked test by *mathematical harmony* is found to be so successful for the system that there are strong grounds to think that it is already beyond the reach of any serious refutation. Certainly, in the strict sense the statement that the present system is actually "unsinkable" must pertain only to those parts of the system (the constant ш, initial correlations of the **A-**systems), which automatically have culminated in the formula (7). But in so far as the LMP theory, its formal nuclei **AGECA** composes an organic unity of all its constituents, we can legitimately state the existence of a quite powerful factor of theory's verification.

PC and yet another formula for the Fermi constant

In connection with the result, deduced for the Fermi constant, arises the question about the possibility of theoretical determination of other FPC within the framework of LMP theory. The question is all the more important, as not only the theoretical determination, but even the correct statement of the physical constants' formal construction is beyond the capabilities of any existing canonized physical theory. It is not casual that the problems of this sort have gained with time the reputation of absolutely inaccessible ones. Meantime, the LMP theory contains, in principle, all the necessary components for the correct statement and solution of these problems. With some of them it is able to cope quite easily, i.e. unambiguously, actually in the form of the deductive inference from the initial elements and principles. The solution of some other problems would require a more thorough consideration and non-trivial application of mathematical methods from the formal arsenal of **AGECA** system. Fully automatically is obtained the amazing result $G_{\mathrm{FA}} \cong \mathrm{e}^{-48}$, which actually is a direct and decisive, though rather peculiar verification of the **A-**system's validity and, indirectly, of the LMP theory as a whole. Within the context of this theory we can distinguish four levels of fundamental physical numbers' theoretical definition: *deduction*; *almost canonical construction*, supported by indirect data; *half-intuitive construction*, without such support; arbitrary *play with numbers*. The first – ideal level is, for good reason, achievable in rear instances only; the second, rather high level is the most perspective and desirable; the third one is not sufficient and deserve no credit; the fourth is fully unacceptable and does not deserve attention. A highly efficient way of increasing the degree of theoretical construction reliability is the method of unified determination of physical numbers within the framework of some system of mutually correlating each other values. The uniformity in calculating more than one, related by the physical meaning values can give a clue to the solution of many "inaccessible" problems of physical theory. And naturally a factor of paramount importance is the representation of all dimensional values in the units of the **A-**system: without this the solution of some problems is practically impossible.

Elaborating the subject of PC, different aspect of which have been discussed and investigated in the works of M. Planck, P. Dirac, A. Eddington, W. Heisenberg, A. Einstein, D. Hilbert, H. Weyl, B. Russel, M. Born and many others, we should continue the consideration of the Fermi constant. Connections between physical values are highly multiform, and the formula (1) is not the only one for G_{F}. The equation $\mathbf{C}_3$ prompts us the dependency of G_{F} from other values. The dimension of the Fermi constant is equal to $(e_j ƛ_{\mathrm{C}j})^2$, or $(e_j \cdot \hbar/m_j c)^2$. The fundamental value of such dimension is Bohr magneton μ_{B}, i.e. the magnetic moment of electron in "pure" – without corrections – form. It should be supplemented by its quantum-relativistic corrections a_{e}, a_{μ}, called anomalous magnetic moments of electron and muon. Obviously is seen the dependency between G_{F} and μ_{B}^2 and, with consideration for corrections, between $G_{\mathrm{F}}\sqrt{R_{\mu}}$ and μ_{B}^2, $(a_{\mathrm{e}}/a_{\mu})^2$. To characterize the intensity of different interactions we introduce the exponential value $\mathrm{e}^{-9\theta\mu/4}$, where the fundamental parameter θ_{μ}, in analogy with tangential expression for Cabibbo angle, is defined from the equation

$$\mathrm{tg}\ \theta_{\mu} = 2ɯ - 1 \qquad (12)$$

The correlation, connecting all these values, has the form:

$$G'_{\mathrm{F}} = \left(\frac{a_{\mathrm{e}}}{a_{\mu}}\right)^2 \frac{\mu_{\mathrm{B}}^2}{\sqrt{R_{\mu}}}\, \mathrm{e}^{-9\theta_{\mu}/4} \qquad (13)$$

where

$$\theta_{\mu} = 3\pi - 2\theta_{\mathrm{C}} = 8.978\,746\,151\,439..., \quad \theta_{\mathrm{C}} = \frac{\mathrm{arctg}(2ɯ - 1)}{2} \approx 0.223\,015\,904\,665\ldots \qquad (14)$$

Substituting θ_{μ}, R_{μ}, consistent values for a_{e}, μ_{B}, a_{μ}, we come to a number

$$G'_{\mathrm{FA}} = \mathrm{e}^{-47,999\,9954(71)} \quad (0,15\ \mathrm{ppm}) \qquad (15)$$

which is very close (deviation $\delta \approx 0.65$) to e^{-48}.

It is believed that everything is on its place in the formula (13): the exponent, the correction associated with G_{F} in combination $G_{\mathrm{F}}\sqrt{R_{\mu}}$, the values a_{e}, a_{μ}, μ_{B}, directly related with G_{F} which, among other things, is a constant of four-fermion interaction, connected with electron and muon. And yet, admittedly, the main criterion should be the agreement between formula and experimental data. Without such agreement everything is unreliable and uncertain. Experiment is of great importance but in this instance, because of its poor precision, it can say neither “yes”, nor “no”. In conformity with existing data we can say only that the formula (13) gives a number which, within the limits of experimental accuracy, is practically indistinguishable from “deductive” $\cong e^{-48}$. The further fate of the formula depends mainly on empirical verification of prediction

$$\tau_{\mu} = \tau_{C\mu} \cdot \frac{192\,\pi^{3}}{\alpha^{2}} \left(2\,\frac{a_{\mu}/a_{\mathrm{e}}}{m_{\mu}/m_{\mathrm{e}}} \right)^{4} \mathrm{e}^{9\,\theta_{\mu}/2} = 2.196\,9540(45)\cdot 10^{-6}\ \mathrm{s}\quad (2.0\ \mathrm{ppm}) \tag{16}$$

referring to the muon lifetime.

A brief review of the chapters 4–6

LMP theory not only provides the necessary tools for theoretical definition of any known physical constant and not only ascribes, with limited or unlimited accuracy, a true numerical meaning to every physical value. In the light of LMP theory some mathematical values, studied seemingly far and wide, reveal some new qualities, gain additional features, not known before. It first of all refers to the mathematical value, named *proportion* in geometry (Euclides), *golden section* (Leonardo da Vinci?), *golden mean*, *golden ratio* and known as a *number of golden mean* (section, ratio) or just a *golden number* in arithmetic. The traditional theory of golden mean, as well as the theory of Fibonacci and Lucas numbers with all their various applications in mathematics, different fields of science and techniques, nature, architecture, art, music and so on, has been detailed and rather fully considered in chapters 4 and 5. In chapter 6 we construct the generalized theory of golden proportion (GTGP) as an application of LMP theory. Here are given the main formulas of GTSP, based on generalized exponential form

$$\phi_{mk} = \mathrm{e}^{\pm \operatorname{arsh}(m/k)}$$

of the golden number. We also have in this chapter the generalized Benford’s law (the law of the first-digit distribution), generalization of silver sequences, Fibonacci and Lucas numbers, Lévy’s formula, the consideration of golden logarithmic spiral, Plato’s bodies, da Vinci constant and some other applications of LMP theory.

General principles of PC constructing. The mass formula

Before proceeding to consideration of PC, theoretical definition of which, especially dimensional constants, is possible only in the **A**-system, a general reasoning should be made. The logical-mathematical base of all PC, defined and revealed above, is associated with some special relations and connections between them. Besides, the correlation, expressing one value in terms of others, the analytical relation between constants may be implicit as well. It can be, for instance, presented by means of transcendental equations, containing, along with MC, some unknown values presenting the roots of the given equation. For sufficiently full comparison of theory with experiment is necessary to supplement the list of results, gained above, by new systematized data. In doing so we ought to neatly entertain the construction canons and set of methodological rules of **AGECA** system, exhibited here in the form of brief theses.

a) All PC are expressed by means of mathematical and/or other physical constants in either explicit form, or through transcendental e-i-2-equations

b) The genuine mathematical expression of any dimensional PC can be obtained only in the **A**-system

c) Apart from MC such expressions can contain if only simple coefficients, as well as corrective multipliers and summands

d) In the system of PC the number of various relations is much greater than the number of PC itself. It enables to perform a mutual correction, agreement of results, obtained by different calculations *e*) When determining PC it is not unusual to take into account the physical meaning of the constant, its membership in one or another sub-family of values, and so on

It should be also indicated that the more precisely is measured PC, the narrower is the experimentally founded interval of its error, the less are the chances of accidental hit in this interval by the use of any method. But even the most precise fit in a narrow interval of experimental error is not enough to assure a great success. Moreover, even the ideal agreement between mathematical form and experimental meaning is not enough to consider this form as a real pretender on the role of genuine mathematical expression for empirically obtained value.

Taking all this into account, let us consider a group of constants, the theoretical determination of which is possible only in the **A-**system. It should be pointed out that the whole burden of LMP theory's verification falls on the most precisely measured and admitting a direct comparison with theory experimental data. These are, in particular, the relations m_μ/m_e, m_p/m_e, m_n/m_e, measured with error of 10^{-8}–10^{-10} order. The general formula, proposed for them, may be written in a form

$$m_{j\mathrm{A}} = n_j\pi - f^{-1}(n_{1j}/n_{2j})[1 - \sigma_j(\Delta m_{j\mathrm{A}}) - k_j\varepsilon)] \tag{17}$$

Here f_j is one of the trigonometric (e-i-2) functions; n_{1j}, n_{2j} integer "quantum numbers", θ_C = 0.223 015… universal coupling constant (14); $\Delta m_{j\mathrm{A}}$ differences of masses for nucleons or leptons, therewith $n = 1$ for barions and $n = 2$ for leptons; φ function of isospin, determined by formula

$$\varphi(I_j) = \gamma_j[I_j(I_j+1) - Q^2] \tag{18}$$

where $\gamma_j = 2$ is for leptons and $\gamma_j = 4$ for nucleons. The meanings of function φ for three well known and precisely measured particles are shown in the table.

	I	γ	*Q*	φ
μ	1/2	2	–1	**–1/2**
p	1/2	4	1	**–1**
n	1/2	4	0	**3**

As may be seen from this table, the meanings φ_μ, φ_p, φ_n differ greatly by modulo and are not of the same sign.

There is also a formula

$$\tau_\mu = \tau_{C\mu}\mathrm{e}^{\theta_\mu(9/2-\varepsilon)} \tag{19}$$

different from (16). The correlation of these two formulas gives an expression

$$\varepsilon = -\frac{1}{\theta_\mu}\ln\left(\frac{192\pi^3}{\alpha^2}\left(2\frac{a_\mu/a_e}{m_\mu/m_e}\right)^4\right) = 7{,}81(23)\cdot10^{-6} \tag{20}$$

of order $(\alpha/\pi)^2 \sim 5\cdot10^{-6}$. In the general formula (17) the groups of coefficients n_{1j}/n_{2j} and k_j (j = μ, p, n) are related to each other.

Transforming masses in the **A-**system and using designations

$$m_{n\mathrm{A}} - m_{p\mathrm{A}} \equiv \Delta m_{np\mathrm{A}}, \quad m_{\mu\mathrm{A}} - m_{e\mathrm{A}} \equiv \Delta m_{\mu e\mathrm{A}},$$

we finally come to the following form of non-dimensional A-expressions for muon and two nucleons:

$$m_{\mu\mathrm{A}} = 5\pi - \arcsin\frac{2}{9}\left[1 + \frac{1}{2}\theta_C\left(\Delta m_{\mu e\mathrm{A}}\cdot\frac{\alpha}{\pi}\right)^2 - \frac{2}{3}k\right] = 15.483\,838\,804(36) \tag{21}$$

$$m_{\mathrm{pA}} = 44\pi - \arcsin\frac{2}{3}\left[1 + \theta_{\mathrm{C}}\left(\Delta m_{\mathrm{npA}}\cdot\frac{\alpha}{\pi}\right) + \frac{3}{5}k\right] = 137.500\,257\,09(13) \qquad (22)$$

$$m_{\mathrm{nA}} = 44\pi - \mathrm{arctg}\frac{3}{5}\left[1 - 3\theta_{\mathrm{C}}\left(\Delta m_{\mathrm{npA}}\cdot\frac{\alpha}{\pi}\right) - \frac{5}{6}k\right] = 137.689\,790\,089(86) \qquad (23)$$

It is easy to define that in all three formulas the "superfine structure" is nearly by three orders less that the "fine structure" which, in its turn, is by three orders less than the "main member". As would be expected the total additives do not exceed $(\alpha/\pi)^3$, consequently we have mass formulas in a third approximation. The higher degree approximations are connected with rather complex and never-ending calculation of various corrections. Now the null result of whenever undertaken attempts of theoretically defining and calculating the physical numbers m_μ/m_e, m_p/m_e, m_n/m_e find its natural explanation: they have not been searched in a correct form. We can state now with assurance that it is necessary, at first, to determine the true A-value of mass by formula (6) and then, dividing this value by $m_{eA} = ш/\pi^2$, we come to the experimentally given relation. The resulting numbers

$$m_\mu/m_e = 206.768\,282\,49(47) \quad (2.3\ \text{ppb}) \qquad (24)$$

$$m_p/m_e = 1836.152\,6724\,(17) \quad (0.93\ \text{ppb}) \qquad (25)$$

$$m_n/m_e = 1838.683\,6606\,(11) \quad (0.6\ \text{ppb}) \qquad (26)$$

actually coincide with the recommended experimental data with a precision of 9−11 significant figures. To summarize, these mathematical numbers

a) can be obtained only by the use of the **A-**system

b) are uniformly constructed according to the formulas (17)−(23)

All this suggests that we are dealing here with formulas of the third level of reliance, the verity of which is rather high.

The equation for the fine structure constant

Recall that the Sommerfeld constant α^{-1} and constant *c*, named velocity of light in vacuum, are one and the same. This conclusion is completely confirmed by the analysis of equations $\mathbf{C}_1$ for the certain value *e* of variable e_j: $e^2/\hbar c = \alpha^{-1}$ along with comparing the main characteristics of constants α^{-1} and *c*, α and $1/c$, as well as from the comparison of magnetic charge e_{m0} with electric charge *e*. In short, the identity $c_A \equiv \alpha^{-1}$ is exhaustively justified and is beyond question. In **[**Arakelian 1981, 136, 146; see also Arakelian 1989, 46−50**]** we determine α^{-1} as a mathematical value by equation

$$\cos x \equiv \frac{e^{ix} + e^{-ix}}{2} = \frac{1}{e} \qquad (27)$$

having, among others, such solution:

$$x = 2\pi\cdot 22 - \arccos(1/e) = 137.036\,007\,939\,214... \qquad (28)$$

It is of interest that after two tens this equation, giving now only the first crude approximation to the recommended experimental value $\alpha^{-1}(2002)$, appears in internet as an exact mathematical number for α^{-1}. Meantime, the equation (26), taken later as a basic equation for determining α^{-1}, needs further improvement and refinement, originated in **[**Arakelian 1997**]** and completed in recent work.

The empirical material associated with α^{-1} contains a great deal of direct and indirect measurements realized in the last eight decades. The consistent value

$$\alpha^{-1}(2002) = 137.035\,999\,11(46) \quad (3.3\ \text{ppb}) \qquad (29)$$

must be taken as sufficiently reliable and solid orientate for the theoretical search of the constant's true value. The deviation $\delta \approx 19$ of number (27) from $\alpha^{-1}(2002)$ may be thought of as an evidence for the existence in the basic equation cos $x = 1/\mathrm{e}$ of small correction summand, the total contributeon of which shall be no more than α^2:

$$\cos x = 1/\mathrm{e} - \varepsilon_\alpha, \quad (0 < \varepsilon_\alpha < \alpha^2) \tag{30}$$

It is a common form of many physical values: the main member complemented by small and super-small corrections. In QED the fine and superfine structures of many values include summands proportional to α, α^2, α^3 and so on. But how should be determined α itself? Guided by the ideas, which form the basis of LMP theory, we accept that here the main principle of mathematical definition is that the equation for $x = \alpha^{-1}$ must not contain any constants except for FMC and the most important PC. Herefrom the sought-for equation, constituted on the basis of (26) on the principle: "the main member + fine structure + superfine structure", may be such:

$$\frac{\mathrm{e}^{\mathrm{i}x} + \mathrm{e}^{-\mathrm{i}x}}{2} + \frac{\mathrm{e}^{x-2\pi n}}{x^2} - \mathrm{e}^{-\sqrt{x}} = \frac{1}{\mathrm{e}} \tag{31}$$

The variable x is directly connected with FMC by mathematical forms $\mathrm{e}^{\pm\mathrm{i}x}$, $\mathrm{e}^{x-2\pi n}$, $\mathrm{e}^{-\sqrt{x}}$, x^2 and contains incomprehensible yet integer multiplier n, defining the period of the function

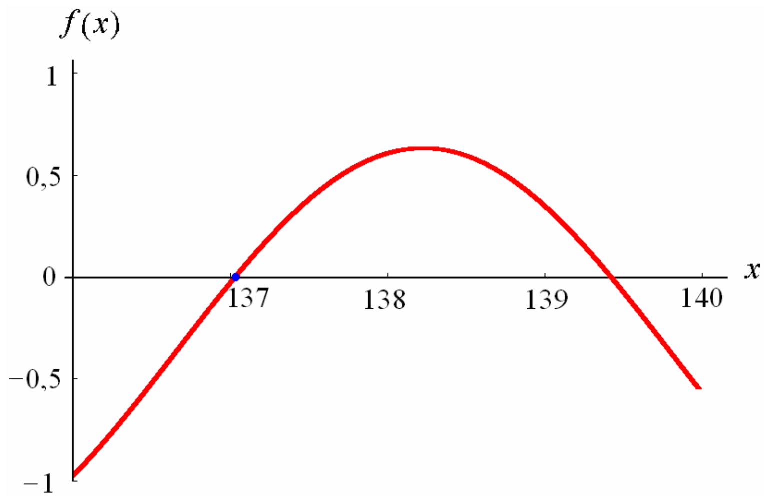
$$f(x) = \cos(x) + \frac{\mathrm{e}^{x-2\pi n}}{x^2} - \mathrm{e}^{-\sqrt{x}} - \mathrm{e}^{-1} \tag{32}$$

The main difficulty is not in finding, but understanding and justifying the whole number n.

It is natural to seek the solution of this transcendental equation in real numbers. The expressions x^2 in denominator of fraction and $x^{1/2}$ in the power exclude negative meanings; it is easy to see that there are no real roots if $n = -1, -2, -3,\ldots$ Hence, n can take positive values only, and all real roots of the equations are positive. The analysis of function $f(x)$ shows that from the meaning $n = 10$ takes place the relation $n_\lambda = n + 2$ between n and the number n_λ of the function's periods. As for roots close to 137, they appear beginning with $n = 21$.

n	**Value**	n_λ
10	71.103 0850…	12
……	………………	…..
15	103.836 8208…	17
……	………………	…..
20	135.669 5885…	22
21	137.026 8256…	23
22	137.035 9994…	24
23	137.036 0167…	25
24	137.036 0168…	26
……	………………	…..
500	137.036 0168…	502

Thus, for any $n > 20$ (and every time in the end of 22nd period) the equation has the only root close to 137. Therewith, for $n > 22$ all these roots only slightly differ from each other and are very far from empirical orientate. And only the value for $x_{n=22}$ (separated in yellow) suits the requirements. It can be stated now that the equation (31), in 22nd period and coupled with $n = 22$, possess a solution which is in full agreement with the accepted experimental value. The intersection point of the curve and abscissa, appropriate to the constant α^{-1}, is shown below.



The point on abscissa appropriate to α^{-1}

The geometrical significance of the power $2\pi n - x$ is quite evident. The length of projection of the curve $f(x)$ on abscissa, reckoned from the origin of the coordinates to the point x_n, is equal to x, whereas for the limiting value of the period 2π we have $2\pi n$. The difference of these two lengths is just equal to $\Delta x_n = x - 2\pi n$. The relation $\Delta x_n/x$ is characteristic of non-periodicity of function; for periodic function it is equal to zero.

Now, when the examination of the function $f(x)$ is actually completed, the time is right to try to secure the ultimate answer. It should be recognized that the main characteristics of partly-periodic, with restricted number n_λ of periods function are the (limiting) meaning λ of the length of period and the whole number n_λ. As far as λ for the given function tends to 2π and this value appears in the equation for α^{-1}, it remains to understand the number n_λ. While the number n_N of the period containing solution is equal to n (the number of the root is $n_N + 1$), the only parameter that stood in need of explanation is the integer n_λ, equal to 24. In the long run the problem reduces to the clue of number 24 as a fundamental physical value. The essence of the explanation that has been put forward for number 24 is such. The Sommerfeld constant or in other words the velocity of light in vacuum is closely related to the quantum of electromagnetic field, photon, which has a spin equal to $\hbar$ and is ranked among the fundamental bosons. But the famous symmetry group $SU(5)$ contains, as indicated above when interpreting the power $48 = 24\cdot 2$ in A-expression of Fermi constant, just 24 generators. So there is good reason to think that just to these 24 generators (24 particles), uniquely bringing to $n_N = n = 22$ in equation (31), owes its origin the Sommerfeld constant. It is plausible that here (along, of course, with equation for α^{-1} and equality $\alpha^{-1} \equiv c_\mathrm{A}$) is the solution of centennial mystery of number ≈ 137, one of the greatest scientific numerical mysteries of modern physics. Indeed, mustn't be taken as a FPC the number of fundamental bosons or fermions? The solution of equation for periodic function requires an integer and what can be here better than this constant? If that's how matters stand, the equation for α^{-1} may be written in a form, containing no constant values other than e, π, i, 2 and PC $n_\mathrm{B} = 24$:

$$\cos(x) + \frac{\mathrm{e}^{x - 2\pi n(n_\mathrm{B})}}{x^2} - \mathrm{e}^{-\sqrt{x}} - \mathrm{e}^{-1} = 0 \tag{33}$$

with additional condition $n_N = n = 22$. The single solution

$$\alpha^{-1} = 137.035\,999\,452\,021\ldots \tag{34}$$

accords well ($\delta = 0.74\sigma$) with $\alpha^{-1}(2002)$. To perform a direct empirical verification of this value it is necessary to increase the accuracy of experimental measurement of α^{-1} on two-three orders.

Part III. The Boundaries and Generalized Laws of the Physical World

On the extreme meanings of physical values

The actual construction of principal components of **AGECA** system from logical postulates and mathematical axioms **AG**, functional equations **E**, physical codes **C** and non-dimensional system of physical values' measurement **A** is performed above. Now we pass on to consideration of some problems, having a direct relationship to the singular points of the physical reality, that is, physical constants. Physical constants are many-sided, many-functional and not in the last if not in the first place they are extreme values, milestones by which the Nature itself outlines boundaries of physical reality. "**From and to**" of the physical world, the **initial conditions** and corresponding **generalized laws** are the main contents in the following. Accepting the physical world as a system of values, interrelated by laws, it is natural to try to outline its boundaries by means of minimal and maximal, meanings of physical values. It is directly connected with the conception of atomistic, discreteness, quantization of the outer world, precisely with its theoretical reflection in the form of physical values. With the discovery of electromagnetic charge's atomicity, quantum of action, minimal mass of charged particles, with the achievements of quantum theories and quantum approach as a whole it becomes apparent the discreteness of all physical values. Including the most "stubborn" space and time, although the idea of their atomicity is perceived as one of the first conjectured natural scientific hypotheses. The sources of this conception can be clearly followed from atomism of Leucippus and Democritus, after Epicurus and only in XIX century occurs the return to the idea of space discreteness.

In contemporary physics the atom of space, called fundamental length and connected with time quantum, "chronon", by relation $l_f = ct_f$, is usually appreciated as hypothetical universal constant, determining the limits of applicability of fundamental physical conceptions – relativity theory, quantum theory, principle of causality. At the same time the fundamental length and chronon are indivisible atoms of space and time, limiting the meanings of these values; so it makes no sense to speak e.g. on the half of l_f or t_f. The fundamental length is, as a rule, expressed through FPC by means of dimensional analysis. The idea persists to the present, though the main pretenders are changing from time to time. Very early the pretenders were: the Compton lengths of electron ($\lambda\!\!\!^{-}_{\mathrm{e}} \sim 10^{-11}$ cm, electromagnetic interaction), π-meson ($\lambda\!\!\!^{-}_{\pi} \sim 10^{-13}$ cm and nucleon $\lambda\!\!\!^{-}_{N} \sim 10^{-14}$ cm, strong interaction). Later we have the characteristic length of weak interaction $(G_{\mathrm{F}}/\hbar \mathrm{c})^{1/2} \sim 10^{-16}$ cm and gravitational (Planck) length $l_{\mathrm{P}} \sim (G\hbar/c^3)^{1/2} \sim 10^{-33}$ cm at last. The experiment has been successively rejected all these meanings with the exception of the last one. In some sense l_{P} may be really thought of as a fundamental length, as a rather important limit of intermediate character, a singular point on the way to a new, poorly explored range of physical phenomena. Beginning with $l_{\mathrm{P}} \sim 10^{-33}$ cm the classical notions on the continuity of space-time are inapplicable, but this is not to say that it makes no sense to anticipate lesser lengths. The Planck length occupies the last place in the hierarchy of decreasing by numerical values characteristic lengths of fundamental interactions, but on the other hand it is easy to indicate many significant values lesser than l_{P}. For instance, such physically meaningful value as gravitational radius of electron, defined by general formula $R = 2Gm/c^2$ which can be obtained by dimensional analysis accurate to non-dimensional multiplier 2, refined by gravitational theory. And the matter is that $R_{\mathrm{e}} \approx 1.4{\cdot}10^{-55}$ cm, that is less than l_{P} on 22 orders; gravitational radiuses of, to say, hadrons lie in the interval $3.6{\cdot}10^{-53} – 3{\cdot}10^{-51}$ cm and also are much lesser than the Planck length.

This brings up the question: if l_{P} is fundamental (in the sense of being further indivisible, minimal) length then what about the gravitational radiuses of elementary particles? And if the problem is to be solved be means of dimensional analysis, then its possibilities ought to be used in full measure. So, it should be accepted the existence of some other limit for the space (length) and accordingly for time (time interval). Actually, the challenge is to find, using dimensional analysis, the extreme values having in CGS dimensions of length L, time T, mass M, hence the extreme values of arbitrary dimensions. Therewith we assume: firstly, that the matter is discrete in all its manifestations and that, similarly to the quantum of action, elementary charge, etc., there exist non-zero $l_f = l_{\min}$ and $t_f = t_{\min}$; secondly, the fundamental length and chronon, as well as the other significant values, can be expressed through FPC; third, the relation between constants is to be revealed by dimensional analysis. To this natural assumptions, which are usually used in obtaining $l_{\min}$ and $t_{\min}$, should be added one more and the most constructive prerequisite: all extreme meanings of fundamental physical values constitute a closed system of consistent, profoundly interrelated fundamental parameters. It immediately follows that if the extreme meanings of some values are known, the meanings of the remaining values can be expressed through them. Consequently, we are now facing a problem of revealing the list of extreme values and establishing analytical connections between them. From the viewpoint of LMP theory the task is to find a system of physical numbers of the required type which can be expressed in terms of FPC.

The full set of physical extremes must refer not only to fundamental values: it should refer to the secondary physical values as well. But for now we have to define the extreme values of length and time interval. At first, by using the dimensional analysis, only a rough approximation would be accomplished; after, applying more fine methods, we shall try to obtain a more exact solution. Not touching yet the most peculiar equation $\mathbf{C}_4$, recall that the initial list of values given by equations $\mathbf{C}_1$–$\mathbf{C}_3$ includes non-dimensional coupling constants α_{xj}, dimensional constants c, $\hbar$, G, G_{F} and variables e_j, m_j, $\lambda\!\!\!^{-}_j$. As a constant meaning of variable m_j, taking into account the character of the goal to be sought, should be taken the mass of the Universe which has an estimated magnitude $\sim 10^{57}$ g. Dimensional analysis provides quite a number of possibilities for constituting a value of length dimension from seven dimensional values. Not depressing the generality and for the sake of convenience there is no use yet to consider some other dimensional values, including the time interval. So, any available combination of L dimension contains from three to seven values and some meanings of l among them are much lesser than l_{P}. We shall, however, restrict our consideration to the case when the number of values, constituting a combination of L dimension, is minimal, that is equal to three. As initial extreme values, we shall take, along with m_U, the quantum of action $\hbar$, the maximal velocity c and the elementary electrical charge e. Dimensional analysis brings about to the expressions

$$\lambda\!\!\!^{-}_U = \frac{\hbar}{m_U c} \sim 10^{-95}\ \mathrm{cm} \tag{35}$$

$$l_U = \frac{e^2}{m_U c^2} \sim 10^{-97}\ \mathrm{cm} \tag{36}$$

$$a_{U0} = \frac{\hbar^2}{m_U e^2} \sim 10^{-93}\ \mathrm{cm} \tag{37}$$

related to one another by constant α:

$$\lambda\!\!\!^{-}_U = l_U/\alpha = \alpha a_{U0} \tag{38}$$

These, purely obtained by dimensional analysis rather simple results are once again witnessing that there is no way of considering the Planck l_{P} as a “fundamental” length. Moreover, these results give the first evaluation of the minimal meaning of length: $l_{\min}$ ought to be searched for in the vicinity of the point $\sim 10^{-95}$ cm, or $\sim 10^{-89}$ in the **A-**system, and it is more than 60 orders less than the Planck length. But the latter itself is more than 60 orders less than presumed meaning of maximal length, usually called “radius of the Universe”. Here we have a good fit not by the numerical magnitude only, but first and foremost by physical meaning, by understanding the two values as physical extremes and one as a value, intermediate in relation to them. It can be also refined that just the Compton length of the Universe $\lambda\!\!\!^{-}_U$ should be accepted as a fundamental length; as for the preliminary character of the Planck length, it is the geometric mean of extreme values. Designating the non-dimensional multiplier of Planck values by k_P, we have:

$$l_P = \sqrt{l_{\min} \cdot l_{\max}} \ , \quad \sqrt{k_P \frac{G\hbar}{c^3}} = \sqrt{\frac{\hbar}{m_U c} \cdot R_U} \tag{39}$$

whence it follows that $R_U = \dfrac{k_P G m_U}{c^2}$. In the theory of gravitation the multiplier in the expression for gravitational radius is equal to 2, so finally $k_P = 2$. It means that amongst several alternative understandings of plankeons must be preferred the one based on equality of Compton and gravitational lengths: $\hbar/mc = 2Gm/c^2$. In regard to extreme values $l_{\min}$, $l_{\max}$ they should be defined as the Compton length and gravitational radius of the Universe correspondingly. The last number, radius of the Universe $2Gm_U/c^2$, must be thought as the limitary meaning of L dimension.

It should be emphasized that the special status of Compton, gravitational and Planck values is actually built into the initial physical equations. In particular, the equation $\mathbf{C}_2$ contains all the values of $c\hbar m_j$, cGm_j, $c\hbar G$ type, therewith the first two contain the variable mass m_j, while the last one only the code constants. The equation $\mathbf{C}_2$ can be easily presented in the form of correlation between Compton and gravitational values:

$$\alpha_{Gj} = \frac{Gm_j^2}{\hbar c} = \frac{1}{2}\frac{2Gm_j}{c^2} : \frac{\hbar}{m_j c} = \frac{1}{2}\frac{l_{Gj}}{\lambda\!\!\!^{-}_{Cj}} \tag{40}$$

It is an easy matter to guess that this correlation is true not only for length but for other dimensions as well:

$$\frac{\alpha_{Gj}}{\alpha_P} = \frac{B_{Gj}}{B_{Cj}} \tag{41}$$

It is valid to say that in a very simple formula, by the aid of functional variable α_{Gj}, independent variable m_j and FPC G, $\hbar$, c, are encoded three physical essences of exceptional importance. And of special attention is, of course, worthy the particular case $m_j = m_U$.

In the general case of extreme values, using obvious designations B_P, $B_{\min}$, $B_{\max}$, we have:

$$B_P = \sqrt{B_{\min} \cdot B_{\max}} \tag{42}$$

and it provides a simple way of defining one extreme value through the other. For instance, replacing m_P and $m_{\max} = m_U$ we obtain for the minimal mass the meaning $m_{\min} = \dfrac{m_P^2}{m_{\max}} \sim 10^{-68}$ g, which is forty orders less than electron mass. In the **A-**system the meanings of the three masses are:

$$m_{\min} \sim 10^{-42}, \quad m_P \approx 1{,}3 \cdot 10^{21}, \quad m_{\max} \sim 10^{83}$$

and the ratio of $m_{\max}$ to $m_{\min}$, the same in all systems, is expressed by an abundance number

$$N_U \sim 10^{125} \tag{43}$$

A comprehend review and study of number N_U, being one of the most important problems here, requires some additional reasoning concerning the code $\mathbf{C}_4$.

Entropy and the number N_U

The speculative character of some concerning the fundamental length constructions, the serious difficulties in determining the precise value of fundamental parameter N_U impose to refer to another independent source. Hereunder we expect to confirm, support the preceding by new independent data, called to help in solving the emerged difficulties. The only such source is, in effect, the equation

$\mathbf{C}_4$ for entropy and Ω. For the best understanding of the potential, inherent in $\mathbf{C}_4$, is necessary to make a little digression concerning the notion of entropy.

In a general way the subject of constant and variable values has been touched above, when discussing the laws of conservation and variation. It is obvious in respect to parameters of Universe, that some physical values, e.g. the mass, total energy, action, electromagnetic charge, are unchangeable, others, such as radius, lifetime, temperature, density, volume, etc., tend to their extreme meanings. Amongst all these changeable values the first place is occupied by entropy, the main source of changes in the physical world. Entropy enables to understand and explain the unity of various processes, it is thought to be a universal characteristic of many physical processes.

In statistical mechanics the entropy is defined on the base of Boltzmann formula $S_j = k \ln \Omega_j$ which was taken above as one of the four initial equations of physical theory. What to the dependence of spatial-temporal values of entropy, we have the Hawking formula

$$S = \frac{k}{4}\frac{A}{l_\mathrm{P}^2} = \frac{k}{4}\frac{c^3}{G\hbar}A \tag{44}$$

for the black holes. It is strictly deduced in relativistic astrophysics, establishing a simple relation between the entropy S of the black hole, area of its horizon A, the Boltzmann constant k and the Planck length l_P. When it is considered that the quantum of entropy is equal to $k/2$, the formula is written as

$$\frac{S_{\max}}{S_{\min}} \equiv \frac{S_{\max}}{k/2} = \frac{A_{\max}}{2G\hbar/c^3} \tag{45}$$

The multiplier 2 is an obvious argument in favor of the version about the Planck values as physical numbers, obtained from the equality of Compton and gravitational values, particularly, from the equality of the Compton length and gravitational radius. The variable in both cases is the mass, and beginning from the Planck length, i.e. intersection point $\lambda\!\!\!^{-}_\mathrm{C} = l_G$, the Compton length with increasing (decreasing) of m decreases (increases) to $l_{\min}$ ($l_{\max}$), while the gravitational radius, in contrast to this, increases (decreases) to $l_{\max}$ ($l_{\min}$). In view of the fact that the maximal length is, by definition, a limiting meaning of Universe radius, it is not difficult to evaluate the last correlation. The horizon A is proportional to the square of radius $R_G = 2Gm/c^2$ of black hole and in rough approximation is defined by formula

$$A = 4\pi R^2 = 4\pi(2Gm/c^2)^2$$

for the area of three-dimensional sphere. Though the more fine analysis leads to a lesser, not of the order 10 ($4\pi \sim 12.6$) but 1, meaning of the multiplier; sometimes the horizon is just thought to be equal to R_G^2. But here the important point is that if our Universe is taken as a black hole, so that $A_{\max}$ accords with the mass $m_U \sim 10^{57}$ g, we have an evaluation

$$\frac{S_{\max}}{S_{\min}} = \frac{R_U^2}{2G\hbar/c^3} \sim 10^{125} \tag{46}$$

The relation between extreme meanings of entropy culminated once again in a stupendous number, equal, at least by its order, to the sought-for N_U. Moreover, the second appearance of N_U, if not bearing in mind the fine internal relationships, is by no means connected with the first appearance.

Hence

a) previously made assumption that plankeons are the intersection points of Compton and gravitational values is confirmed now

b) independently is supported and strengthened the existence of fundamental constant $N_U \sim 10^{125}$

c) in the exponential form this number is close to $e^{288} = e^{48\cdot 6}$, consequently it can be thought about as a member of a numbers' family of $\psi(48\cdot n)$ type

Once more recall that the first appearance was connected with the assumption concerning the quantization of space, the profound importance of Compton and gravitational values and radius R_U. What for the second appearance, the formula (46) already contains nearly all the necessary information and the only assumption refers to the possibility of applying this formula to the Universe. But there is also the third, the most direct appearance of the constant N_U, connected with replacing the meaning of the Universe mass in the initial equation $\mathbf{C}_2$, which brings about the number N_U accurate to the multiplier 1/2. Thus, we can state with assurance that the existence of fundamental constant N_U is a well-established scientific fact.

Boundaries of the physical reality

The large subject of extreme physical values requires its logical development and completion. All the initial principles are already indicated, therefore it is sufficient to restrict ourselves by the example of length, though any other physical value can be taken as well. We have at hand the paramount importance of Compton and gravitational lengths and their equality in the point, called the Planck length. To these two theses can be reasonably added the third one which can be named "the small in the great and the great in the small". We are reminded that gravitational and Compton lengths are correspondingly in direct and inverse proportion to the mass. That is why the farther they are from the intersection point, the more is the difference between them and generally between values of $c\hbar m_j$ and cGm_j families. Finally, according to the last thesis, in the limiting points of the physical world the Compton and gravitational lengths are interchangeable: one transforms into the other. That is, the Compton length of super-small mass $m_{\min}$ is *precisely* equal to gravitational radius R_U of the Universe and the Compton length $\lambda\!\!\!^{-}_U$ of the Universe is *precisely* equal to the gravitational radius of the mass $m_{\min}$. Presenting all the foregoing theses on the mathematical language we come to a system of three equalities:

$$\hbar/m_{\mathrm{P}}c \ = 2Gm_{\mathrm{P}}/c^2 \qquad (47)$$

$$\hbar/m_U c \ = 2Gm_{\min}/c^2 \qquad (48)$$

$$m_U/m_{\min} = N_U \qquad (49)$$

Solving these correlations as a system of equations for unknown $m_{\min}$ and m_U, we have the formulas

$$m_U \ = \sqrt{\frac{\hbar c}{2G}N_U} \ = \ l_{\mathrm{P}}\sqrt{N_U} \qquad (50)$$

$$m_{\min} = \sqrt{\frac{\hbar c}{2GN_U}} \ = \frac{l_{\mathrm{P}}}{\sqrt{N_U}} \qquad (51)$$

Replacing these expressions in the equation $\mathbf{C}_2$, we come to formulas which may be written in the form

$$N_U = \frac{\alpha_{\mathrm{P}}}{\alpha_{G\min}} \ , \quad N_U \ = \frac{\alpha_{GU}}{\alpha_{\mathrm{P}}} \qquad (52)$$

Thus, the assumption made above leads to a rather simple correlation between the constant N_U and the meanings of the initial function α_{GU}: N_U is equal to the meaning of α_{Gj} in the point $m_j = m_U$. It is completely coincident with results, obtained earlier by other facilities. Also is substantiated the meaning R_G^2 for the horizon A of the black hole. The formulas, obtained on the basis of (48), (49) and well-known correlations, as well as the highly approximate numerical estimations of various values are given in the table. Therewith some formulas, for the sake of clearness, are given in two different configurations: by means of the code constants c, $\hbar$, G, k and through the Planck value.

Value	Designation	Formula	Decimal meaning	
			A-system	CGS or other systems
Initial function	$\alpha_{j\min}$	$\dfrac{1}{2N_U} = \dfrac{\alpha_P}{N_U}$	$5\cdot10^{-126}$	$5\cdot10^{-126}$
	$\alpha_{j\max}$	$\dfrac{N_U}{2} = \alpha_P\, N_U$	$5\cdot10^{124}$	$5\cdot10^{124}$
Entropy	$S_{\min}$	$k/2$	0,7	$7\cdot10^{-17}$ erg/K
	$S_{\max}$	$N_U\cdot k/2$	$7\cdot10^{124}$	$7\cdot10^{108}$ erg/K
Action	$J_{\min}$	$\hbar/2$	$4\cdot10^{-4}$	$5\cdot10^{-28}$ erg·s
	$J_{\max}$	$N_U\cdot\hbar/2$	$4\cdot10^{121}$	$5\cdot10^{97}$ erg·s
Mass	$m_{\min}$	$\sqrt{\dfrac{\hbar c}{2GN_U}} = \dfrac{m_P}{\sqrt{N_U}}$	$4\cdot10^{-42}$	$5\cdot10^{-68}$ g
	$m_{\max}$	$\sqrt{\dfrac{\hbar c}{2G}N_U} = m_P\sqrt{N_U}$	$4\cdot10^{83}$	$5\cdot10^{57}$ g
Fill energy	$E_{\min}$	$\sqrt{\dfrac{\hbar c^5}{2GN_U}} = \dfrac{E_P}{\sqrt{N_U}}$	$8\cdot10^{-38}$	$4\cdot10^{-47}$ erg
	$E_{\max}$	$\sqrt{\dfrac{\hbar c^5}{2G}N_U} = E_P\sqrt{N_U}$	$8\cdot10^{87}$	$4\cdot10^{78}$ erg
Temperature	$T_{\min}$	$\sqrt{\dfrac{\hbar c^5}{2Gk^2N_U}} = \dfrac{T_P}{\sqrt{N_U}}$	$5\cdot10^{-38}$	$3\cdot10^{-31}$ K
	$T_{\max}$	$\sqrt{\dfrac{\hbar c^5}{2Gk^2}N_U} = T_P\sqrt{N_U}$	$5\cdot10^{87}$	$3\cdot10^{94}$ K
Length	$\lambda\!\!\!^{-}_{C\min} = l_{G\max}$	$\sqrt{\dfrac{2G\hbar}{c^3N_U}} = \dfrac{l_P}{\sqrt{N_U}}$	$1\cdot10^{-89}$	$7\cdot10^{-96}$ cm
	$\lambda\!\!\!^{-}_{C\max} = l_{G\min}$	$\sqrt{\dfrac{2G\hbar}{c^3}N_U} = l_P\sqrt{N_U}$	$1\cdot10^{36}$	$7\cdot10^{29}$ cm
Time	$\tau_{C\min} = t_{G\max}$	$\sqrt{\dfrac{2G\hbar}{c^5N_U}} = \dfrac{t_P}{\sqrt{N_U}}$	$1\cdot10^{-91}$	$2\cdot10^{-106}$ s
	$\tau_{C\max} = t_{G\min}$	$\sqrt{\dfrac{2G\hbar}{c^5}N_U} = t_P\sqrt{N_U}$	$1\cdot10^{34}$	$2\cdot10^{19}$ s
Critical density	ρ_C	$\dfrac{3c^5}{16\pi G^2\hbar N_U} = \dfrac{3\rho_P}{4\pi N_U}$	$4\cdot10^{-26}$	$3\cdot10^{-33}$ g·s^{-3}

Universe volume	V_U	$\frac{4\pi R_U^3}{3} = \frac{4\pi l_P^3 N_U^{3/2}}{3}$	$9\cdot10^{108}$	$2\cdot10^{90}$ cm^3
Number of microconditions	$\Omega_{\min}$ $\Omega_{\max}$	$e^{1/2}$ e^{N_U}	1,6 $10^{0.43\cdot10^{125}}$	1,6 $10^{0.43\cdot10^{125}}$

It is characteristic that all presented in the table formulas contain, in different degrees, the constant N_U. Intermediate nature of plankeons, as geometric means of minimums and maximums of physical values, brings about an exceptionally simple form of writing the extremums. Entering the notation $B_{j\text{ext}}$, we have a general formula

$$B_{j\text{ext}} = B_{j\text{P}} N_U^n, \quad n = \pm1/2, \ \pm1, \ \pm3/2, \ \pm2, \ \pm3 \tag{53}$$

It should be also added that the problem of extremums is identical to the problem of the greatest and smallest physical values.

The consideration is not full without discussing the question, whether the axiomatically given in LMP theory zero can be accepted as an extreme value or not. For an appreciable length of time, particularly in 18-th and 19-th centennials, the conception of continuous, infinite continuums had complete dominion in science. It accustomed the mind to the idea that the physical world is boundless and endless: infinite space and time, infinitely great and small magnitudes of physical values, endless diversity and so forth. Meantime, the physical reality, the system of fundamental physical values proves to be discrete and finite in all those cases, where it was possible to reach certainty and clarity. We do not know any worthy of notice natural scientific fact proving the opposite. On the language of mathematics the sign ∞ is, strictly speaking, impermissible in physics, as distinct from the number 0, indicating the fact that the given physical object lacks some characteristics, for instance electrical charge.

As applied to the mass a question arises: if numerous particles have zero spin, or charge, why such particles as photon, graviton and gluon can not have a zero mass? In existing physical theory the zero mass is assigned in QCD to carriers of strong interaction – gluons and the Goldstone theorem from QFT asserts the existence of particles – Goldstone bosons – with zero mass, when some symmetries are spontaneously violated. And in regard to carriers of electromagnetic and gravitational interactions there are some arguments in favor of their zero masses, connected with very great but finite radiuses of these interactions. Taking this into account, note as a methodological digression that when the experimental basis of theoretical constructions is highly scanty, or even completely absents, there are three efficient ways to partially overcome the empirical “vacuum”. It is, firstly, the system interrelationship, secondly, the system consistence, thirdly, the possibility of obtaining results by at least two independent ways. Even the availability of all three components cannot fully ensure the correctness of the ultimate results; however, the chance of success is considerably higher in this case. Turning back to the problem of extreme values and allowing the existence of zero mass particles with small, of nearly nuclear action radiuses, we can try to come to a reasonable interpretation of Compton and gravitational extremums. Therewith it should be taken into account the fundamental nature of electromagnetic and gravitational powers and their agents – photon and graviton, the relationship between the mass and action radius of carriers of fundamental interactions and some other considerations. That is, the Compton length of super-small mass $m_{\min}$ is equal to gravitational radius R_U of the Universe and the Compton length $\lambda\!\!\!^{-}_U$ of latter is equal to radius of the mass $m_{\min}$. And if it is the mass of photon or graviton, it turns out that the maximal radius as well as other physical parameters of the Universe are fully consistent with the action radius and other parameters of electromagnetic and gravitational interactions. Therefore, it is felt that parameters of the Universe are defined by characteristics of smallest particles and, vice versa, the greatest is as if built into the smallest which, in its turn, is built into the greatest. It should be added that geometric mean of the smallest and greatest values are plankeons. In this instance the Planck mass is geometric mean of photon or graviton masses and mass of the Universe. In the light of the foregoing it is natural to assume that the constant 0 means not a minimal quantity of the given physical value, but simply its absence. The ultimate conclusion is rather obvious: minimums, “quanta” of various physical values are expressed by finite and not always very small numbers (e.g. quantum of the entropy $k/2 \approx 1.44$).

The consideration of physical extremums has brought either in the case of the length or entropy to the same gigantic natural number N_U, encoded in the initial equation $\mathbf{C}_2$. The general chains, bringing about the number N_U, are such.

1 Physical codes $\mathbf{C}_1$–$\mathbf{C}_3$ and the choice of the initial FPC → dimensional analysis for getting the dimension of length → application to parameters of the Universe → account of the intermediate value of the Planck length with respect to extremums → signification of the Compton length → N_U as a relation of two extreme values of length

2 Formula for the entropy of black hole → application to parameters of the Universe with regard to the quantum of entropy → N_U as a relation of extreme values of entropy

3 Substitution of the value $m_j = m_U$ in the equation $\mathbf{C}_2$

The reasoning, which is long, sinuous in the first case, shorter and straighter in the second and very short in the third case, is completed every time by the number N_U as a main physical-mathematical value, defining *from and to* of the physical reality. Generalizing, it should be assumed that through the entropy, as fundamentally varying value with lower $S_{\min} = k_A/2 = 1/2 \cdot \ln 2$ and upper $S_{\max} = N_U \cdot k/2 = N_U/2 \cdot \ln 2$ limits, is able to express all varying parameters of the Universe. Then, in consequence of the limits $S \to S_{\min}$ and $S \to S_{\max}$, we have for extreme relations of $B_{\max}/B_{\min}$ type the following chain of equalities:

$$\lim \frac{l_{\max}}{l_{\min}} = \lim \frac{\lambda\!\!\!^{-}_{\max}}{\lambda\!\!\!^{-}_{\min}} = \lim \frac{t_{\max}}{t_{\min}} = \lim \frac{\tau_{C\max}}{\tau_{C\min}} = \lim \frac{T_{\max}}{T_{\min}} = \lim \frac{V_{\max}^{1/3}}{V_{\min}^{1/3}} = \lim \frac{\rho_{\max}^{1/2}}{\rho_{\min}^{1/2}} = \lim \ln \frac{\Omega_{\max}}{\Omega_{\min}} \ldots = N_U \quad (54)$$

Relations between the extreme meanings of preserving fundamental values are quite obvious:

$$\frac{J_{\max}}{J_{\min}} = \frac{m_{\max}}{m_{\min}} = \frac{Q_{\max}}{Q_{\min}} = \ldots = N_U \quad (55)$$

The question of exact numerical value of the cosmic constant N_U is still open by virtue of the absence of any reliable orientates. Nonetheless, the order of the constant N_U is known and it is easy to ensure that it is a number of $\exp(288 \pm \varepsilon)$ type, where ε makes up, most probably, the tenth parts of 1 but maybe the hundredth parts only. However, in so far as $288 = 24 \cdot 12$, there is good reason to think that N_U is one of the numbers of $\psi(24 \cdot n)$ family. These numbers are, by the way, exceptionally beautiful and suitable with respect to such mathematical operations as multiplication and division, rising to a power and extracting roots, differentiation and integration. The reason is that in all listed here cases the operations on the function $\psi(24n)$ are greatly simplified and are reduced, in essence, to the simplest transformations, concerning the argument $24n$. Thus, as a result of the properties of exponent and peculiarities of number $288 = 2^5 \cdot 3^2$, all numbers of N_U^n type for all physically available meanings of n are members of that family. Thereby the constant N_U turns out to be the central member of the family to which has been uniquely assigned the Fermi constant G_{FA} and particular meanings of initial physical value Ω. Herefrom the constant N_U attaches to the whole totality of physical problems concerning, for instance, the supersymmetry and Grand Unification, number of fundamental fermions and bosons, mentioned in the context of the constant $G_{FA} \cong \psi(24 + 24)$.

Generalized physical laws

However, the list of the merits of the cosmic constant is not yet exhausted. The circle of reasoning, closed by number N_U as a main physical-mathematical value defining from and to of the physical reality, reverts us to the sources of **AGECA** system, to principal physical laws. Now recall that the correct statement of fundamental physical laws of conservation and variation is possible only for the Universe: “The action of the Universe preserves”, “The mass of the Universe preserves”, “The entropy of the Universe increases” and so on. Any attempt to replace the Universe in such definitions by inertial coordinate system or, to say, closed system inevitably leads to contradictions. Consideration of the borders of the physical reality, revealing the number N_U, gives a rear opportunity to assert a statement which adds a quantitative certainty to qualitative characteristics of the physical laws. And the first importance is that it allows turning to the generalized forms of fundamental laws of conservation, variation and quantification. It should be also mentioned that any statement concerning the Universe, considered as a holistic physical system existing in the single copy, must me, certainly, perceived as a speculative judgment.

We shall begin with the formulation of the law directly not connected with appearance of the number N_U.

The generalized law of conservation of FPC

The numerical values of FPC are unchangeable

To be precise, to the category of FPC must be, in principle, referred all those physical constants which are elements of unified system of interrelated physical numbers. First and foremost the code constants c, $\hbar$, k, G, G_F, some other important values, such as m_e, e, N_U, as well as combinations composed of various physically meaningful constants, including parameters of the Universe. The basis for the postulate on FPC’s numerical values constancy is the understanding of their two-unit nature rather than the absence of corresponding empirical data. Any FPC is a natural physical value on the one hand and a definite mathematical number on the other hand.

The generalized law of ratios between extremums

The ratios between extremums of various physical values are expressed through the constant N_U by formulas

$$\frac{B_{j\max}}{B_{j\min}} = N_U^n \quad (n = 1/3,\ 1/2,\ 2/3,\ 1,\ 3/2,\ 2,\ 5/2,\ 3) \tag{56}$$

$$\ln\frac{\Omega_{\max}}{\Omega_{\min}} = N_U \tag{57}$$

The arguments in favor of these formulas as generalized laws are quite obvious. For a broad class of fundamental and secondary constants and variable physical values the ratios of extreme values are expressed by integer or fractional degrees of the cosmic number N_U.

The generalized law of conservation, variation and quantification

For any whole-number quantified physical value is true the correlation

$$B_j = n_j B_{\min}, \quad n_j = 1, 2, ..., N_U \tag{58}$$

Obviously in fundamental laws of quantification of action and entropy, either as in the principle of entropy increase, the upper limit of whole-number series must be equal to N_U. Owing to this the conservation, variation and quantification of whole-number quantified physical values can be expressed in the form of a simple formula, symbolizing the internal and formal unity of the physical laws of three types as different sides of the three-sided universal physical law. Assigning definite meanings to $B_{\min}$ or fixing constant values $n_j = N_j$, we have corresponding laws for the action, entropy, etc. Here occurs a direct correlation of N_U with the laws of conservation, variation and quantification and, moreover, just through this value is realized the interrelation between all three types of physical laws.

In the context of generalized laws arises one rather delicate question, which presently pertains to the category of intractable scientific problems. The question itself is the following. The physical world, judging by all evidences, is discrete in all its manifestations; as a matter of fact the theoretical reflection of it is the quantization of various physical values. But why some values, for instance, entropy, action, electrical charge are whole-number quantified, while there is no clarity with respect to such values as mass, length, time? Strictly speaking, the finiteness of all allowable meanings of e.g. mass or, in other words, the discreteness of the mass spectrum is just a scientific hypothesis. Highly plausible, moreover, practically not casting any serious doubt, but all the same a hypothesis, not supported by any undoubted empirical fact. Generalized laws do not like exceptions and any such law, if only it is not wrong, tends to spread its action on a greatly broad domain of the physical reality. *Why*, the question is, some code variables, with the ratio of extreme values equal to the magic number N_U are whole-number quantified, while some other code variables with the same ratio of extremums ought not to obey this law? In any event, if the ratio of the maximal meaning to the minimal one is expressed by an integer (precisely by the number N_U^n), it can be assumed that any other ratio of any allowed meaning of the given value to its minimal meaning also must be expressed by an integer. There is no convincing answer to this *why*, but, just the same, we shall try to address the problem somewhat differently. Is there any separating line, any selective principle, distinguishing the whole-number quantified value from the non-quantified one (if there are such at all) or from a value quantified by some other law? We know that some values are quantified by one rule or another and know nothing about other values, though we suppose that it is impossible for any physical value to be continuous. In essence, it is all that is known for certain. It looks like a deadlock, the way out of which the physical science is not able to find for almost hundred years. This is a subject that does not fall into the anthology of physical science's achievements, but before leaving it let us take a good look at the last table. Here are represented the "favorites" as well as the "outcasts" of the quantum-discrete world. In the last column are given decimal A-meanings of physical extremums, i.e. their true numeric values in the decimal number system. Given in rough approximation, but it is important to know just the order of values. The great difference between minimums of "favorites" and "outcasts" can be noticed at a glance. The fact is that quanta of entropy and action, which can be supplemented by all known today and not presented in the table quanta of other values, are expressed by numbers close in order of magnitude to 1. On the real numbers axis they are placed in the close neighborhood with the points, corresponding to the numerical values of FMC and the most important secondary mathematical constants. A quite different situation arises in the case of other minimums of such values as mass, length, temperature: they all turn out to be small or super-small numbers. What is it: an accident, whimsy of nature, or something more?

It is thought that there can be at least three mutually exclusive assumptions:

a) a meaningless circumstance

b) all whole-number or fractional-number quantified physical values are expressed by numbers close in order to 1

c) the world is discrete and all values are quantified by the same laws, but some minimums of physical values are too small to be empirically found

The assumption (*a*) intuitively seems to be the least probable. The numerical gap of thirty and more orders of magnitude between two groups of values is too great to be understood as something accidental. So, there is no need to dwell on it, but two other variants are worthy of notice. It is reasonable to expect that just in the central and adjoining parts of the number set (real numbers axis) are placed the meanings of not only mathematical constants but of whole-number and fractional-number quantified physical values as well. The rest values are quantified by other rules, or constitute a collection of discrete values not falling under the general law. This assumption fixes, in effect, the situation as it stands at present, but the evident discrimination of some physical realities, including the Compton, gravitational and Planck values, can be considered as its weak point. At last, from the standpoint of generalized laws, the most preferential is the last variant. If the generalized law of ratios between extremums is a universal law, is it realistic to assume that the generalized law of conservation, variation and quantification is true for some selected physical values only? Considering that there is not a good reason for this, one may come to a conclusion that all the allowable meanings of collection of physical values are multiple to corresponding minimums. Except for quantified by the exponential law values, such as Ω. Naturally it is extremely complicated to deal with small and super-small physical numbers, placed very far from the range, available for empirical research. It should be never forgotten that the pure theory, deprived of serious empirical base, always faces the threat of self-deception, when something that is imaginary or potentially possible may be displayed as really existing. The great risk, connected with the expansion of the theory in very far from the experimental potentialities ranges, is quite obvious. However, bringing this speculative analysis to its logical close, we ought to formulate the last generalized law, though it is not nearly so reliable and motivated than the other three ones.

The generalized law of conservation, variation and quantification 2

The numerical values of many physical values are divisible by their minimums

$$B_j = n_j B_{\min}, \quad n_j = 1, 2, ..., N_U \tag{59}$$

The distinction from the law (58) is that here the case in point is not a group of whole-number quantified values, but a vastly greater class of physical values.

Concluding, it should be only added that the precise numerical value of N_U remains a great mystery. If we were able to essentially increase the empirical accuracy of determining N_U, it would be, maybe, possible to calculate the exact mathematical value of this integer. But to make such a leap it is necessary, for instance, to know the more precise meaning of the Universe mass; in the foreseeable future it is hardly accessible. However, the number N_U, to a greater probably extent than any other number, may be considered as a magic number of nature or cosmos, symbolizing its unity and mathematical harmony.

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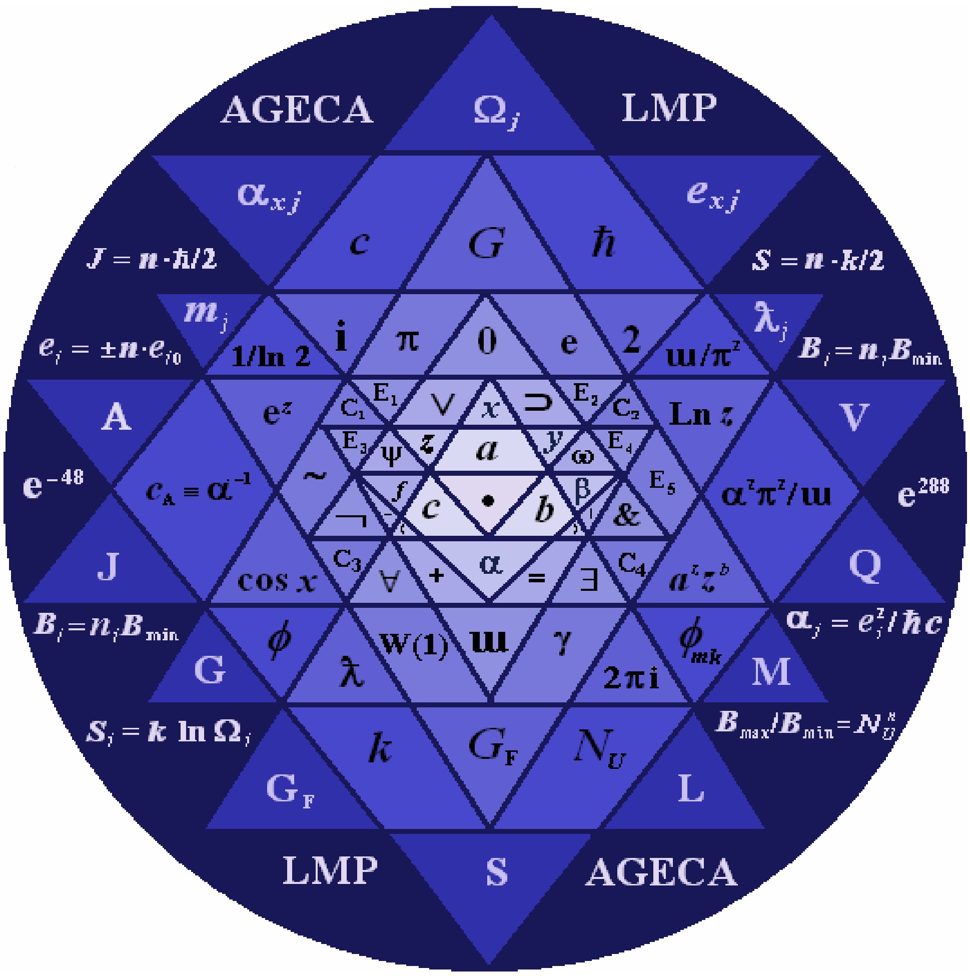

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