G. GAMOW AND CALCULABILITY PROBLEMS OF WORLD CONSTANTS AND THE LIFE CODE

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ABSTRACT. Developing the George Gamow ideas, the fine structure and the life code calculation possibility, resulting from fundamental principles of quantum logic, the Galois field $GF(257)$ and combinatorial configurations on the tetrahedron, is shown.

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The origin and perhaps, the fundamental physical constants variability in time have been engrossed the G. Gamow's imagination and directed his efforts in the last years of his life. The great questions, left without answer, relate to the connections between the elementary particles masses and, also, to the very big numbers, representing the relations between nuclear, electrical and gravitational forces. Gamow considered these numbers could not appear as the result of a primary fortuity and they could be obtained from topological or theoretical set considerations. He believed in the final simplicity of the theory, that one day must explain these numbers (Ulam, 1970).

In one of his last letters to his son, Gamow writes that his paper with the variable e^2 will appear in the number of Phys. Rev. Letters dating from September, 25, but the storm-clouds appear on the horizon. In a number of Ap. J. Letters (July 1967) Maarten Smidt and others analyze a quasar spectra $3C = 191$ and get that, although the red shift has the factor 3 (more exactly, $2,945 \mp 0,001$), the fine structure constant $\alpha(= e^2/hc)$ "changes" only with the factor $0,98 \mp 0,05$, i.e. does **not** change at all.

But since we do not know **what are** quasars, it is difficult to say what does it mean (Gamow, 1994).

In paper (Cernobai, 1971) we have proposed a trivalent logic use for describing the electron interference. We have put forward the idea that a Planck's constant value in unities $e = 1$, $c = 1$ can be explained by the decrease of 256 truth tables for conjunction and disjunction and of 8 truth tables for negation to a single triplet of these functions for a bivalent logic.

It can sound paradoxically, but the classical logic looks to be the most quantum object. Its universality extends even to the introducing the measure for aleatory phenomenons. The response to the eternal question "to be or not to be" in many different environments is given by a coin throwing. But the coin, in addition to its two sides, has thickness, and therefore it exists the third possibility – it drops on the edge, no matter how small would be this probability.

Exactly the existence of the third logical possibility – non-determination – could serve for a logical description of the elementary particles interference phenomenon. This idea realization needs a serious analysis of the most fundamental notions and an adequate language development for description and measuring of a new, apparently ephemeral, logical notion – the non-determination.

We have proposed these ideas development in (Cernobai, 2002a). In fuzzy logic, proposed by Zadeh, any logic function takes values on the interval [0,1], while the logic functions can be an infinity for any operations. This refers to the connection between x and the $x^\ominus$ negation.

"The subtraction on a circumference" presents a particular attention for the connection with a quantum mechanics and for other uses:

$$x^\ominus = \sqrt{1 - x^2}.$$

We can unite x and $x^\ominus$ in a complex number $l = x + ix^\ominus = \sin\alpha + i\cos\alpha$.

We use the same trigonometric parametrization for building the logical operations such as conjunction, disjunction and implication.

In fuzzy logic there exist more definitions (an infinity) for every operation of negation, conjunction and disjunction, but for passing to the limit case of a bivalent logic, these operations must satisfy Morgan's laws:

$$(x_1 \vee x_2)^\ominus = x_1^\ominus \wedge x_2,$$
$$(x_1 \wedge x_2)^\ominus = x_1^\ominus \vee x_2.$$

Further we will show that a fuzzy logic based on the complex numbers algebra we have proposed in (Cernobai, 2001) satisfies this law.

Also, it is important to find physical conditions, when the non-deterministic logic takes place. The following argumentations show some limits of this kind.

Non-deterministic conditions are discussed for an electron interference experiment on two slits within an absorbent screen. It is shown that the non-determination caused by the relativity theory is $\triangle t \sim d/c$, where d is the distance between the slits, c is the velocity of light in vacuum and the energetic speed is $\triangle\varepsilon \sim e^2/d$, where e is an elementary electron charge. So the non-deterministic action is $\triangle t \triangle\varepsilon \sim e^2/c$ (Cernobai, 1971). This non-determination makes necessary the trivalent logic application (Cernobai, 1971) or, more generally, the discrete fuzzy logic application for description the interference in a quantum mechanics.

The non-determination in the quantum mechanics expresses by Planck's constant, that to within a coefficient coincides with e^2/c : $\hbar \approx 137e^2 = \frac{1}{\alpha} \cdot \frac{e^2}{c}$, where $e \approx \frac{1}{137}$ is a constant of the fine structure. It is discussed the possibility of the constant calculation using some combinative principles connected with the passing from the multidimensional fuzzy logics (fuzzy generalizations of the multivalent logics) to the classic ones.

These reasons explain to some extent the connection between the composition laws of a quantum phenomenons extension and the composition laws of probabilities, emphasized by R. Feynman in many times.

If we introduce three basic vectors in the three-dimensional logical space:

$$f = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}; \; ? = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}; \; t = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix},$$

then we can show easily that they are eigenvectors of a matrix

$$\nu_3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix} = \frac{1}{2}\lambda_3 + \frac{\sqrt{3}}{2}\lambda_8 =$$

$$= \frac{1}{2}\begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix} + \frac{1}{2}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 2 \end{pmatrix}$$

with eigenvalues $+1$, 0 and -1, correspondingly, where λ_3 and λ_8 are Gell-Mann's matrixes, known from the elementary particles physics (Cernobai, 1995).

Those 256 matrixes of the trivalent logic, numbered from 1 to 256 with bivalent representations of their elements:

$$C_1 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & t \end{pmatrix}; \; C_2 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 1 & t \end{pmatrix};$$

$$C_3 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 0 & t \end{pmatrix}; \; C_4 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 1 & t \end{pmatrix}; \ldots$$

can be organized in 128 complex matrixes

$$Z_k = C_k + i(C_{256} - C_k).$$

They form, together with fuzzy negations represented by Gell-Mann's matrixes $\lambda_1 - \lambda_8$ and with the unity matrix E basic operations of the trivalent fuzzy logic and can be named with the numbers of a field Z_{137} from 1 to 137. It is important that the roots of the equation $x^{137} - 1 = 0$ are algebraically calculable, because a regulate polygon with 136 sides can be built using the compasses and ruler, since $136 = 2^3 \cdot 17$ and 17 is a number of Fermat-Gauss type.

In our paper (Cernobai, 2002b) we have paid attention to the problem of passing to limit from a discrete space-time with a finite number of symmetry groups to an unique continuum.

This problem does not produce big complications in non-relativistic quantum mechanics, because for the time ordering, representing an one-dimensional operation, the iterative Dedekind's process based on sequence of irrational numbers corresponds to the approximation with irrational numbers. However, for the case of space ordering there exists a finite number of 230 discrete transformations groups, called Fyodorov groups, which make an ambiguous transition to the limit to the same point (vacuum); this fact produces a non-determination. We do not exclude the fact that an exit from this difficulty may be found in the general principle of the statistical mechanics: the initial system states averaging and the final states summation. It is obvious, exactly like in the case of a genetic Gamow's triplet, that some transformations would turn out to be equivalent ones, and this fact would decrease the groups number from 230 (for the case of three-dimensional space) to a smaller number. Calculating the average, we may need to apply some particularities of the theory structure based on multidimensional logics or on fuzzy logics, that allow a description within grates theory also.

G. Gamow also emphasized the fundamental role of the "discrete", quantum, combinatorial concept in modern science: "The nature is sly, but the existent amino acids number is still equal to the number of triplets that can be composed from four different elements. It is possible that one day we will see why it is so." (Gamow, 1968).

From the fundamental mathematical structures Kepler has noted the golden section and its connection with Platonic bodies: "There exist two regulate bodies, the dodecagon and the icosagon; the first of them is bounded by regulate pentagons and the second one by equilateral triangles, but these ones are adjacent one to another such that some pentahedral spatial angles are created. The building of these bodies and especially of a pentagon itself is impossible without that proportion, called by contemporary mathematicians a divine one. It is built in such a way that two minor terms of this infinite proportion add up to the third term, and any two of the last terms being summed, give the next term, and this proportion maintains ad infinitum. It is impossible to bring a numerical example, where would be written out all the terms. However, as far as we will go from the unity, our example will become more complete. Let both of two minor terms will be numbers 1 and 1 (you can consider them as being unequal ones). Adding them we get 2. Adding to 2 the biggest minor term we get 3, and adding to 3 number 2 we get 5. Then, adding to 5 number 3 we get 8, adding to 8 number 5 we get 13, adding to 13 number 8 we get 21. The ratio of number 5 to 8 is approximately equal to the ratio of number 8 to 13, and the ratio of number 8 to 13 is approximately equal to the ratio of number 13 to 21.

In the image and likeness of this continuing proportion by itself is created, as I assume, the constructive force, and by this constructive force the authentic symbol of a pentagonal figure is embodied in a flower. I omit all other considerations I could adduce in the support of what has been said in these very pleasant discussions. They would require a special place. And here I brought them only as an example, so that we would be more versed and better prepared for the hexagonal snow figure study" (Kepler, 1982).

For his part, H. Weyl emphasizes the symmetry role in the fundamental notions forming: "As I can appreciate, all "a priori" affirmations of the physics have the symmetry as source" (Weyl, 2003). And further: "...every time you having to do with some object S provided with structure, you try to define its automorphisms group, i.e. a group with elements representing transformations that do not change all structural relations".

Operations of addition, subtraction, multiplication, division and extraction of the square root are the algebraic operations that are geometrically realizable by using *the compasses and ruler*. Exactly because of this, the regulate triangle, pentagon and 17–gon can be built using the compasses and ruler; for each of these cases the automorphisms group is a cyclic group, its order being some power of number 2:

$$3 = 2^1 + 1, \;\; 5 = 2^2 + 1, \;\; 17 = 2^4 + 1,$$

$$257 = 2^8 + 1, \; 65.537 = 2^{16} + 1.$$

Thereupon, let us consider automorphisms of Platonic bodies and, first of all, the tetrahedron automorphisms. The tetrahedron considered as a simplex, i.e. the most elementary regulated polyhedron of a three-dimensional space, contains the following elementary polyhedrons: four triangles (faces), six edges, four vertexes, forming a set of 16 elements with itself and the nullity set. The set of all sets, composed from these 16 elements, is 2^{16} and formes an algebraic group of the tetrahedron with the operation of inclusion; it is a group of tetrahedron automorphisms.

Let us paint the faces in four different arbitrary colours, e.g. in blue, yellow, green, red. Each edge has two colours and each vertex has three colours. Let us distribute three balls between the tetrahedron faces; such a distribution can be made in $4 \times 4 \times 4 = 64$ different ways. Every time we will associate the ball with an edge in such a way that each ball will situate on different edges for every distribution. This is possible, because in the case when maximum three balls are situated on a face, one single face is associated with each side. Every distribution will give us a combination of six edges by three: $C_6^3 = 20$, attributing every time to each ball the colour of one single face. In order to avoid the uncertainty of a ball coloration, let us make the next projection of tetrahedron: we dissect it from a vertex and so we obtain four triangles in the plane. For example let us consider that we have made the projection on a green base of the tetrahedron; so we have made a spontaneous rule violation. We will cut each of the three vertexes of lateral triangles and one vertex of the interior triangle. Paint each edge in two complementary colours and distribute the edges in the form of a matrix 3×4. Here, we deal with the second rule violation; in our case one edge and more exactly, the one that belongs to the red colour face, has the same complementary colour with the green colour of the base situated in the center.

$$A \times \begin{pmatrix} b \\ y \\ g \\ r \end{pmatrix} = \begin{pmatrix} b_r & y_b & g_b & r_y \\ b_g & y_g & g_r & r_g \\ b_y & y_r & g_y & r_b \end{pmatrix} \times \begin{pmatrix} b \\ y \\ g \\ r \end{pmatrix}.$$

Let us put each of the three balls on a separate line. We will give the value 1 to the places where the balls intersect with columns, and the value 0 to other matrix elements. Multiplying this matrix by a vector-column with four coordinates of colours, we obtain a vector with three colour components every time.

Taking into account the restrictions between the matrix elements caused by their connections on the tetrahedron, we obtain 20 matrixes reflecting 20 combinations (by three of six) of the tetrahedron edges. One of them is expressed by three equivalent matrixes, and this degeneration is connected with non-determination of the vertex with three colours, opposed to the base. Other two contain two synonyms each, caused by symmetry violation in the last phase of the figure splitting. We establish the fact that, with precision of colour marking, the 20 obtained vector-triplets together with their synonyms correspond with 20 triplets of amino acids studied by G. Gamow. The colour symmetry of 20 Gamow invariants $C_4^3(r)$ is a latent symmetry.

Other triplets generated by this matrix encode the same 20 elements. The same thing takes place for other three projections on the bases with other three colours. In this way we obtain $4 \times 64 = 256$ triplets. To each of the 256 triplets it corresponds a matrix of order 3×3 from 256 matrixes, obtained by excluding the fourth column from the matrix A, where g_r is fixed and other elements have values 0 or 1. We recognize the definition of conjunction in the trivalent logic in these matrixes. In order to identify these matrixes and their respective triplets, we associate to each of the matrixes a nonzero root of an equation $x^{257} = x$. The set of polynomials in a finite field Z_{257} of the order 257^n is a finite one, and forms a Galois field $GF(257^n)$, the polynomial roots being periodical with the period $257^n - 1$ (Birkgoff and Barti, 1976).

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