The polarization theory of the unification of fundamental Interactions

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Annotation

The foundations of a new - polarization - approach to the creation of a universal theory of the Megauniverse[1], capable to interpret a wide spectrum of phenomena in inert and living matter on the fundamental physical level using only three world constants, including those phenomena that are not understood or not covered by modern science, are presented. As an example of this approach, a decision to one of the main problems in fundamental physics – the unification of the fundamental (including gravitational) interactions is presented. The calculation of the fine structure constant has demonstrated a coincidence with the recommended experimental value in the eighth digit. This accuracy has become possible due to taking into account the 116 vector and tensor fields that implement the interaction in the Universe and physical vacuum, including the fifth - tensor - fundamental interaction acting between the particles participating in the rotational motion.

1. Basics of the polarization approach

Unification of fundamental interactions, which today include electroweak, strong and gravitational interaction, remains one of the main problems of fundamental physics for about a half of a century. Electroweak and strong interactions are the foundation of the standard model (SM) of elementary particles containing about 20 experimental parameters. It allows describing the phenomena of the microcosm in which gravity plays a secondary role. Attempts to build a more general theory, taking into account gravity, have been unsuccessful.

One of such attempts was the superstring theory, which claimed to be the final theory. Unlike the quantum theory which considers a point particle, the string theory considers a single-dimensional particle - a string, the oscillations of which determine its mass. In order to avoid non-physical results, it is assumed that supersymmetry is realized (each particle has a superpartner – a particle with a spin differing by 1/2) as well as a hidden six-dimensional real space. In superstring theory, spin 2 particles can be interpreted as gravitons. It is assumed that this will be enough to combine the four fundamental interactions. The number of possible modes of string vibrations is huge, and so far there is no algorithm for selecting particles from this spectrum of real particles. The number of possible types of universes turns out to be huge, and the regularities leading to the formation of our Universe are not clear. Therefore, there is a doubt in the ability of superstring theory to describe a known reality.

Another attempt to approach the construction of the final theory is the polarization theory of the Megauniverse published by the author in 2008 [1]. The new approach is based on mono-fundamentalist generalization of the paradigm of SM and the ΛCDM model of the Universe and contains four original postulates.

According to the first postulate, the Megauniverse arises through the *polarization* processes of the birth of non-zero physical quantities with a zero sum from an extra-natural substance, the *zero-vacuum*, where there are no physical substances. Thus, it is postulated that the corresponding non-local laws of conservation of physical quantities are satisfied[2] in all processes in the Megauniverse.

[1] The new term "Megauniverse" is introduced to refer a world including all physical worlds of Nature. Today it is not studied by orthodox physics. The term "The Everything" had to be abandoned, as more often this term refers to all that exists, but only in our Universe. In order to avoid confusion, we note that the term "Multiuniverse" is commonly used to refer to a world consisting a set of universes like the Universe.

[2] In the work of D. Andrews [Phys. Rev. Lett., 118, 133602 (2017)] experimentally detected nonlocal formation of EPR pairs, which are polarized nascent pairs of particles. This contradicts the ideas of quantum mechanics and confirms one of the main tenets of the polarization theory about the nonlocal formation of physical quantities.

It follows that the universe was born with *Antinegauniverse*, a substance which contains an antiparticle with negative mass (*antinegaparticle*), and *Antiuniverse* formed by antimatter arises with *Negauniverse* containing negaparticles with negative mass[3]. Thus, in contrast to the accepted ideas of the Big Bang, the universes are born charge-asymmetric, i.e. there is no unsolved problem of disappearance of antimatter. The quartets of these universes have a common physical vacuum where their particles and fields are born. In contrast to the physical vacuum of Dirac in the physical vacuum of polarization theory the average values of all physical quantities, including mass and energy, are zero, and nonlocal polarization processes, which cause nonlocal manifestations in our world, are realized.

According to the second postulate, all physical quantities are generally represented by complex numbers. A new physics is associated with their imaginary components, the study of which is the subject of a polarization theory. The phases of space, time, mass, and charge change synchronously, forming different physical worlds. When the phase changes to $\pi/2$, a world of the Universe with imaginary masses and charges of particles and measurements of space and time ("otherside world") arises. The phase change on π leads to the formation of the real world of Antinegauniverse, and at $3\pi/2$ - of its imaginary world. The surrounding inert matter is localized in the real subspace of the Universe, and living matter ("imaginary" substance with imaginary masses) – in the imaginary subspace of the "otherside" world of the Universe.

Polarization theory considers the Universe with spherical symmetry of space as an expanding inclusion in a centrally symmetric space of the physical vacuum, in which the average values of all physical quantities (including energy) are zero. This expansion is accompanied by the transition of a part of particles formed in the physical vacuum with a complex internal space into the real or imaginary subspace of the Universe. Particles are considered as blotches with complex space in the real or imaginary subspace of the physical vacuum and the Universe. The difference between the nature of the inner and outer space of the particles leads to the presence of a sharp boundary.

The symmetry of space and time plays an important role in the formation of the physical entities of the Megauniverse. The third postulate states that three possible symmetries of space generate three types of worlds of the Megauniverse. In the case of the simplest and initial – translational – symmetry of space, unlimited worlds are born, which differ in the speed (c) of the scalar field propagation. These are non-material (field) c-worlds, generating material worlds with a higher symmetry of space. Matter arises when blobs with axisymmetric space are born in the c-worlds, in which closed trajectories and limited in-size vortices – appear-vortex particles formed during the polarization of vibrational excitations. These inclusions are h-worlds, the vortex excitations of which are characterized by the quantum of the angular momentum h. This type of worlds is characterized by two constants c and h and the appearance of vector fields. In h-worlds, blobs of the worlds of the physical vacuum are possible, that have a centrally symmetric space in which tensor fields are born. In the spherically symmetric subspace of the physical vacuum, a new type of excitation arises –the gravitational field with the gravitational interaction constant G. Worlds with a spherically symmetric space are gravitating G-universes, one of which is our Universe. Its matter is described by three “universal” constants — the speed of light c, Planck’s constant h, and the gravitational constant G. Therefore, the general theory of gravitating universes must contain only three constants. As shown in [1], the polarization theory satisfies this requirement.

In the spherically symmetric space of the Universe, all directions are physically equivalent, whereas in the centrally symmetric space of the physical vacuum there are separate axes of symmetry having two opposite (polarized) directions determining the velocities of the particles generated in it. Unlike the *unpolarized* space of the Universe, the space of the physical vacuum is *polarized*. There are processes of polarization of physical quantities in it, leading to their equilibrium value. The average values of non-polarized physical quantities that determine the state of thermodynamic equilibrium and the direction of the *thermodynamic* time arrow (when the heat passes from a heated body to a less heated one) are equilibrium in the space of the Universe.

The *polarization* equilibrium that is the result of the polarization process becomes realized in the polarized space of the physical vacuum. The physical quantities are polarized in it. The degree of

[3] Confirmation of the existence of nonparticles obtained in another recent work [Phys. Rev. Lett., 118, 155301 (2017); arxiv: 1612.04055]: in a specially prepared Bose condensate, areas are found in which particles have a negative mass, which is absent in the Standard Model of Elementary Particles.

polarization increases in the transition to this equilibrium, and the structure of the physical system becomes more complicated, i.e. the *polarization* arrow of time arising in this case has a direction opposite to the thermodynamic arrow of time. Therefore, the polarization of energy in a physical vacuum will lead to the fact that the heat will be transferring to a more heated body.

With the effective contact of the substance of the Universe with the substance of the physical vacuum, when the polarization prevails over the processes of depolarization (dissipation), the polarization arrow of time will be realized. This relation to the physical vacuum is a necessary condition for the development and evolution of both inert and living matter. If we consider the universe as a closed thermodynamic system, the development will be possible only due to fluctuations inside it, which are the result of weak interaction with the physical vacuum in the polarization theory. The time arrow problem is one of the main unsolved problems in the fundamental physics.

The fourth postulate of polarization theory is insignificant for further consideration. According to it, the causal predetermination of events in the Megauniverse, determined by the physical laws of polarization processes, is realized at all hierarchical levels of matter. This predetermination is difficult to notice in complex physical systems formed by interacting substances of several hierarchical levels as in such systems the wide range of polarization processes is realized, and events appear as casual. It is unacceptable for the general theory that the world is deterministic at the macro and mega levels and indeterminate at the micro level. The phenomenon of self-fulfilling prophecies is possible only in a predefined world. Therefore, in the polarization theory it was necessary to give a deterministic interpretation of quantum mechanics.

Primary vortex bosons are generated by $(2l+1)$-plets (l – is the spin of the boson) having a zero total projection of angular momentums on the selected direction. Fermions arise from the exchange interaction of two $(2l+1)$-plets with opposite spin directions [1]. After the exchange of part of its members, the multiplets will contain an even number of their components and an odd number of others (or vice versa), i.e. acquire a two-component structure. An odd number of components corresponds to a multiplet with an integer spin value, forming the core of the particle surrounded by a shell with a half-integer moment value. The total value of the angular momentum (spin) of such a particle is a half-integer. At the same time two fermions with oppositely directed spins are born. Fermions with a minimum spin ½ are of particular importance, being a constructing material for the multiplets of fundamental fermions – leptons and quarks. They consist of a core and a rotating shell. The nucleus does not rotate only in known leptons and quarks (with $l = 1$). They form the first hierarchical level of baryon matter particles. The number of hierarchical levels of particles in the modern Universe is $l = 12$ [1]. The zero hierarchical level is occupied by the scalar neutral substance of dark matter [2].

The central symmetry of the physical vacuum space determines the properties of particles and fields. The birth of scalar particles takes place in the spherically-symmetric subspace. Symmetries of the central symmetric space are manifested in Plato figures, among which a special role in the formation of spectra of vector and tensor fields, particles and their charges is played by the dodecahedron and icosahedron, whose elements (faces, vertices, edges) form multiplets of dimension 12, 20 and 30.

Non-polarized states of physical quantities (fields, particles, charges, spin projections, etc.) are singlets. At the polarization birth of N-plets of complex physical quantities (with the number of independent quantities N-1), there are N^2 pair combinations of their real and imaginary components, which are connected by the polarization condition, i.e. the number of independent combinations is equal to $N^2 - 1$. These three types of physical quantities form a multiplet with the number of terms $1 + N + (N^2 - 1) = N (N + 1)$. The sums with N = 3, 4, and 5 correspond to the number of faces, vertices, and edges of the dodecahedron and icosahedron. For example, N = 5 represents the number of edges in both shapes. The geometric symmetry of these two figures reflects the properties of polarization-forming physical quantities in the centrally symmetric space of the physical vacuum. These same properties reflect special unitary groups SU(N) where first three irreducible representations have dimension 1, N and $N^2 - 1$ (N is the dimension of the complex space of the group).

The matrix representation of the SU(N) group with $N \geq 2$ describes the charged Yang-Mills fields. Today, the first two representations (singlet and N-plet) of QCD are not taken into account. The singlet represents a field with the sum of non-electric charges (or anti-charges) of its quanta equal to zero. N-plet determines the number of polarizing charges e_j, satisfying the polarization condition $\sum_{j=1}^{N} e_j = 0.$ Fields produced by the charge, like the electromagnetic field, are neutral and therefore maintain the appropriate charge of the particle in the interaction. Uncharged fields play an important role in the formation of stationary states of physical systems.

The number of types of charges *F* plays the role of the dimension of the complex space of charges in polarization theory. The dimension of the matrix representation of the unitary group *U (F)* Q = F^2, where Q is the total number of different charges of this space. For *F* = 1, 2, 3 the number of charges is 1, 4, 9, respectively, i.e. the second type of charges contains three, and the third one – five charges.

The charges of the particle reflect the symmetry of the space in which the particle is formed. The number of charges of one type is determined by the number of rotational states allowed by the central symmetry. As shown in [3], the electric charge reflecting the interaction between the spins of the particles of the Universe and Antinegauniverse, and the weak charge arises from the interaction of particles of the Universe and the Antiuniverse, in which times has different signs. Therefore, there are two weak charges.

There are also charges that are born in the Universe independently of the other universes of the quartet. These charges reflect the central symmetry of its physical vacuum. The faces of the icosahedron and the dodecahedron generate three and five physically equivalent states of rotation with respect to the possible axes of symmetry respectively, and the center of symmetry of these figures is one state, common with the center of the spherical – symmetric space of the Universe. This means that the birth of vector and tensor fields is possible in the centrally symmetric space of the physical vacuum. Their states of rotation can be associated with three and five charges, respectively, i.e., along with three color charges of gluons, there is a quintet of new charges, called *tastes* (by the number of human tastes) [1]. If the triplet color charges are also possible in axially symmetric space of the *h*-universe, where leptons and quarks are born, then the quintet of taste charges will reflect the pentasymmetry of the physical vacuum space and determines the interaction of particles rotating in orbits [2, 3].

Thus, the charges, except of weak charges, can be considered as a manifestation of the geometric symmetry of the dodecahedron-icosahedron system: the electric charge corresponds to its center of symmetry, and the other two – the number of sides (or angles) of the faces of the icosahedron and dodecahedron. The total charge of each face is zero.

As mentioned above, there are singlets and N-plets of uncharged fields along with the Yang-Mills fields and, in particular, the uncharged gluons absent in the QCD. New tensor fields with symmetry *SU*(5) named *gravionic*. The quintet of uncharged fields and 24-plet of Yang-Mills charged gravionic fields is not considered by SM. Thus, the specific spatial symmetry of the physical vacuum of the Universe and its fields are not taken into account. This is one of the reasons for the failure to combine three vector interactions with the gravity.

Another reason is the discrepancy between the matrix representation of the strong interaction group *SU*(3) and the spherical symmetry of the Universe's space, where the charges of the electroweak interaction with the group symmetry $U(1)\times SU(2)$ are localized. Therefore, it is necessary to consider the "projection" of the strong interaction in the space of the Universe when combining interactions in it, where color-neutral particles are formed. Therefore, the three-dimensional color charge space of the physical vacuum is transformed into two color subspaces: one is formed by a zero color charge localized in the space of the Universe, and the other one – by two independent color charges in the space of the physical vacuum. This leads to the generation of a strong field with group symmetry $U(1)\times SU(2)$ [3]. The same group symmetry of the three vector interactions makes their Great Union possible.

The presence of another tensor interaction in the polarization theory, along with the gravitational interaction, changes the approach to the unification of fundamental interactions. It is necessary to take into account the appearance of uncharged gluon and gravionic fields. The triplet of neutral gluon fields together with the electromagnetic field forms a quartet of uncharged vector fields, and five gravionic fields together with the gravitational field form a sextet of uncharged fields with spin 2. The interaction of the fields of the quartet and the sextet forms the 24-plets of neutral fields corresponding symmetry of *SU*(5). This fields were called *combined*:

$$(\gamma + \sum_{i=1}^{3} gl_i)(g + \sum_{k=1}^{5} gr_k) = \gamma g + g\sum_{i=1}^{3} gl_i + \gamma \sum_{k=1}^{5} gr_k + \sum_{i=1}^{3} gl_i \sum_{k=1}^{5} gr_k$$

Here, the uncharged fields are indicated by symbols: γ – electromagnetic field, gl – gluon field, gr – gravionic field and g – gravitational field. The field γg is called *photon-graviton*. It is localized in a spherical-symmetric space unlike other combined fields. *Glueon-graviton* $gl_i g$ and *photon-gravion* γgr_k fields implement the interaction between the particles of the Universe and its physical vacuum.

The spins of the resulting combined fields are 1 and 3. Spin 3 forms a seven-plet of spin projections with the symmetry of the *SU*(7) group, which does not correspond to the symmetry of the dodecahedron-icosahedron system. This leads to the decay of the 48-plets fields of the *SU*(7) group into two orthogonal 24-plet fields with spin 2 and symmetry of the *SU*(5) group. This decay is possible because the square of the original spin equal to 12 is the same as the squares of two spins equal to 2 [1]. As a result, three 24-plets uncharged combined fields are formed, one of which is formed by vector fields, and the other two – by tensor fields.

A 12-plet of uncharged fundamental fields is involved in the formation of combined fields. These are five vector fields (electromagnetic singlet, gluon singlet and triplet) and seven tensor fields (gravitational singlet, gravionic singlet and quintet). The only possible combination of them forming 24-plets of combined fields is the above combination of the quartet of vector and sextet of tensor fields. In addition to electromagnetic and gravitational fields, the components of combined fields can be gluon and gravionic singlets.

Combined fields are involved in the formation of fundamental particles [2], and they must be taken into account when combining five interactions.

2. Hyperunification of fundamental interactions

The unification of the five fundamental interactions named in [1] the *Hyperunification*. Association to establish a connection between the constants of the five interactions in the space of the Universe is understood under this unification. These interactions are different in nature: gravitational interaction between the masses and four interactions between charges. There is a more rigorous theory of Hyperunification below than it is described in [1].

The gravitational interaction has the same group symmetry as the *U*(1)-electromagnetic interaction. The particles have zero taste charge in the Universe, i.e. the color charges are implemented in the composition of the triplet, and the taste charges – in the quintet. So the dimension of the space of the color charge is reduced from three to two in the Universe, and of the taste charges from five to four, which leads to a reduction of groups of gluon and gravionic fields, respectively $SU(3)\to SU(2)\times U(1)$ and $SU(5)\to SU(4)\times U(1)$. This group of gravionic fields satisfies the symmetries of the dodecahedron-icosahedral system, but not the $U(1)\times SU(2)$-symmetries of vector interactions. Therefore, only the gravionic singlet can participate in the unification of interactions in the space of the Universe. The singlet gravionic interaction combines with the gravitational interaction in the group $U(1)\times U(1)$ and with the strong interaction in the *graviostrong* interaction with the group symmetry $U(1)\times SU(2)$ necessary for the unification. Thus, the gravionic singlet turns out to be a link between the three interactions of vector fields and the gravitational interaction.

The primary scalar gravitational field at point *Z* (Fig. 1) forms primary – Planck – particles with masses m_{pl} at high energies:

$$\alpha_G \equiv \frac{Gm_{pl}^2}{\hbar c} = 1,$$

where α_G – is the constant of gravitational interaction. According to [1, 2], the mass of particles with $m < m_{pl}$ is determined by the number *K* of polarized fields:

$$K = 2\ln\frac{m_{pl}}{m} = 16(l+1)+n, \tag{1}$$

where l – is the spin of the primary vortex field, which determines the hierarchical level of the particles, and n – is the number of combined fields involved in their formation. The polarization of the primary scalar and vector fields of the *G*-world necessary for the birth of particles of the first hierarchical level occurs respectively on segments 0*A* and *AB* Fig. 1. Note that in the theory of the Great Union the running constants depend on the transmitted pulse, which determines $\ln m_{pl}/m$, i.e. from *K*/2.

The decay of the primary field for *l*=1-particles with spin 3 occurs at point *B* Fig. 1, where the mass of particles is equal to $1.37 \cdot 10^{12}$ GeV/c^2.

$$SU(7) \rightarrow SU(5) \times SU(5)$$

two orthogonal fields with *s* = 2 are formed at disintegration. If symmetry of one of the groups *SU*(5) is violated at point *B* in the form

$$SU(5) \rightarrow SU(3) \times SU(2) \times U(1)$$

we obtain a group symmetry corresponding to the space-time symmetry of the physical vacuum and the Universe for fields born at point *B*

$$SU(7) \rightarrow SU(5) \times SU(3) \times SU(2) \times U(1),$$

that is, according Emmy Noether theorem, along with electric, weak and color charges, the quintet of taste charges generated by the symmetry of the *SU*(5) group, which is not taken into account by quantum theory, is realized. Since the total number of dimensions of the first three irreducible representations of *SU*(N) groups is N(N+1), the groups with N = 5, 3 and 2 form 30 + 12 + 6 = 48 fields[4]. The same number of fields is in the *SU*(7) group, i.e. the primary field with spin 3 generates three types of fields that carry interactions between the three types of charges. Group *U*(7) with 49 fields is formed with the electromagnetic field additional to these fields. The number of fields of the Universe and its physical vacuum is 116 without taking into account scalar fields. Namely, 43 (= 1 + 6 + 12 + 24) vector fields and 73 (=1 + 72) tensor ones. There are 53 fields in the SM, for comparison.

The 49 fields of group *U*(7) will have interaction constants equal to

$$\alpha(X) = \alpha_i = 1/49,$$

at the splitting point *X*, where $\alpha_i = g_i^2/4\pi\hbar c$, and g_i – is charges of splitting fields (*i* =1, 2, 3, 5 – indices of charge multiplets). At the splitting point

$$g_1(B) = g_2(B) = g_3(B) = g_5(B)$$

and the formation of "charge" fields does not affect the gravitational interaction constant, which remains equal $\alpha_G(B) = 1$ at point *B*, despite the change in its spin of the gravitational field (its spin is 0 and 1 at points *0* and *A*, respectively).

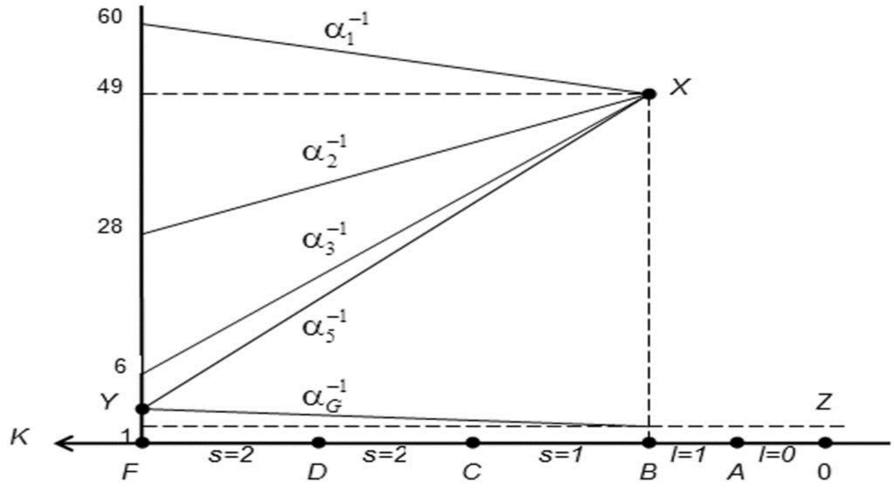

Fig. 1. Scheme of changing the constants of the fundamental interactions of the *G*-world.

Points *C*, *D* and *F* marked in Fig.1 correspond to the completion of polarization of the vector 24-plete (without photon-graviton singlet affecting the value of the mass of particles in a different way) and two tensor 24-plets combined fields that form the fundamental bosons and fermions [2], respectively. Therefore, for the first hierarchical level (*l* = 1), the points *C*, *D* and *F* correspond to the values *K* = 55, 79 and 103 and, therefore, the masses of the corresponding neutral scalar particles are equal

[4] For example, the six *SU*(2) group fields correspond to the number of faces of a cube.

$$m_C = 1.39\cdot10^7\ \text{GeV}/c^2;\quad m_D = 85.5\ \text{GeV}/c^2;\quad m_F = 0.525\ \text{MeV}/c^2.$$

According to [1, 2], the masses m_F and m_D determine the masses of the electron and intermediate vector bosons, and m_C presumably characterizes the mass of dark matter particles, respectively. The combined fields involved in the formation of particles should be taken into account for determination of the constants of the fundamental interactions between particles.

The combining electroweak and graviostrong interactions are orthogonal and must be determined by two different polarization angles θ and φ. By analogy with the theory of electroweak interaction, the ratio between the charges g_i of two orthogonal $U(1)\times SU(2)$ - interactions is written as:

$$\frac{g_1}{g_2} = \text{tg}\ \theta;\quad \frac{g_5}{g_3} = \text{ctg}\ \theta;\quad \frac{g_1}{g_3} = \text{tg}\ \varphi;\quad \frac{g_5}{g_2} = \text{ctg}\ \varphi. \tag{2}$$

Since all g_i are equal at the moment of splitting (point X),

$$|\theta| = |\varphi| = \frac{\pi}{4}$$

Entering the electric charge e in the relations (2) and doing a procedure as in the SM one can obtain

$$g_1 = \frac{e}{\cos\theta\cos\varphi};\quad g_2 = \frac{e}{\sin\theta\cos\varphi};\quad g_3 = \frac{e}{\cos\theta\sin\varphi};\quad g_5 = \frac{e}{\sin\theta\sin\varphi}; \tag{3}$$

$$e^{-2} = \sum_i g_i^{-2};\quad i = 1;\ 2;\ 3;\ 5.$$

We have obtained a generalization of the theory of electroweak interaction: no longer two, but all four charges of fundamental interactions are included in the expression for e^{-2}.

According to [4] in the approximation, which takes into account the loops of virtual bosons and fermions, as the masses (energy) of particles *m* increase, the change in the interaction constants occurs according to the law

$$\frac{1}{\alpha_i(m)} - \frac{1}{\alpha_i(M_B)} = b_i \ln\frac{M_B}{m} = b_i n/2,$$

where *m* is a variable mass, and M_B – is the mass of particles at the point of splitting of interactions *B*, and *n* – is the number of combined fields in (1). The formation of particles and their forming fields (n = 71) is completed at point *F*. Denoting through α_{iF} the interaction constants at point *F* and taking into account that at point *B* $\alpha_i(M_B) = 1/49$, we obtain:

$$\frac{1}{\alpha_i(m)} = 49 + \frac{n}{71}\left(\frac{1}{\alpha_{iF}} - 49\right),\qquad 0 \le n \le 71.$$

These traveling constants of interactions are shown in Fig. 1. We just have to find the values α_{iF}.

3. Low-energy Hyperunification Limit

The process of joint polarization birth of two particles is considered in [1], in which negaparticle with a mass m_ξ is born motionless (relative to the expanding space of the Universe), and posiparticle[5] (with mass m_η) receives a speed $\vec{u}_\eta$ satisfying the law of conservation of energy[6]:

$$m_\xi + \frac{m_\eta}{\sqrt{1-\beta_\eta^2}} = 0;\quad \beta_\eta = \frac{u_\eta}{c} \equiv \sin\Phi_j. \tag{4}$$

Here Φ_j – polarization angles θ and φ, dependent of spins $\vec{s}$ massless fields involved in the formation of particles and determine the selected direction and magnitude of the velocity of one of the

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[5] Posiparticle is a particle with a positive mass.
[6] The formation of supersymmetric fermion-boson pairs occurs in the same way.

particles $\vec{u}_\eta$ generated. It is assumed that these two vectors are connected by a linear polarization condition

$$\vec{u}_\eta / c + \lambda \vec{s} = 0, \quad \text{or} \quad \sin\Phi_j + \lambda s = 0.$$

The constant λ is determined by the initial state at point *B*, where the primary field with *s* = 3 generates secondary fields with *s* = 1 and 2. According to (2), $\Phi = \pm\frac{\pi}{4}$, i.e. $\lambda = \pm\sqrt{2}/6$ and hence,

$$\sin^2\Phi_j = \frac{s_j^2}{18};$$

and

$$\sin^2\Phi_1 = \frac{1}{18} \quad \text{for} \quad s_1 = 1,$$

$$\sin^2\Phi_2 = \frac{2}{9} \quad \text{for} \quad s_2 = 2.$$

Angles Φ_j close to the experimental values of the angles of the Cabibbo and Weinberg:

$\sin\theta_C = 0.226(9)$ [5]; $\sin^2\theta_W = 0.313(15)$ [6]

In this approximation, we can assume that the Cabibbo angle characterizes the processes of particle production with the participation of vector fields and the angle of Weinberg $\theta_W = \Phi_2$ – the same with the participation of tensor fields. These polarization angles will be called the polarization angles of the Cabibbo and Weinberg.

From (4) one can obtain the ratio

$$\rho = \frac{m_\xi^2 \cos^2\Phi_j}{m_\eta^2} = 1,$$

which is tested experimentally for electroweak interaction. From the definition (2) of angles θ and φ one can get $\theta = \theta_W$, $\varphi = \theta_C$ ..

These values are used to calculate the interaction constants α_i at point *F*, i.e. in the low-energy limit. As shown in the theory of gauge interactions, the charge normalization condition leads to the appearance of a multiplier of 5/3 in the constants *U*(1)-interactions α_1 for fields with group symmetry *U*(1), *SU*(2) and *SU*(3).

The same multiplier has α_5. Entering the fine structure constant $\alpha = \frac{e^2}{4\pi\hbar c}$ and using (3) we find the relations of the constants α_{iF} at point *F*:

$$\frac{\alpha_{1F}}{\alpha} = \frac{5}{3\cos^2\theta_W \cos^2\theta_C} = \frac{270}{119}; \quad \frac{\alpha_{2F}}{\alpha} = \frac{1}{\sin^2\theta_W \cos^2\theta_C} = \frac{81}{17};$$

$$\frac{\alpha_{3F}}{\alpha} = \frac{1}{\cos^2\theta_W \sin^2\theta_C} = \frac{162}{7}; \quad \frac{\alpha_{5F}}{\alpha} = \frac{5}{3\sin^2\theta_W \sin^2\theta_C} = 135 \equiv \xi^{-1}. \tag{5}$$

We just have to figure out the meaning of α_{5F}. In order to do this, we need to find a connection between gravionic and gravitational interactions. The formation of fundamental particles is completed at point *F*. It is accompanied by depolarization of the doublet of the gravitational and singl gravionic fields, which has a zero spin in the spherically symmetric space of the Universe. This situation is similar to the splitting of fields at point *B*, which gives rise to the formation of fundamental particles of the Universe. The condition for the depolarization of the doublet of tensor fields is the equality of the constants of their interactions in a physical vacuum (marked by a stroke), i.e.

$$\alpha'_{GF} = \alpha'_{5F}. \tag{6}$$

The relations (5) are derived for the interaction constants in the space of the Universe. The transition from it N-plet of complex fields to the physical vacuum corresponds to the transition *U*(*N*)→*SU*(*N*) and is accompanied by a decrease in the number of independent fields by one. As in this case, the interaction constant per one state does not change, the interaction of the physical vacuum is weakening by a factor

$$1 - N^{-2}.$$

The relations (5) do not take into account the contribution to the interaction constants symmetry of $SU(5)$ groups. It manifests itself in two forms: four 24-plets of fields are formed at point *B*, and the formation of a doublet of 24-plets of combined tensor fields involved in the formation of fundamental fermions at point *F* is completed.

The weakening of the gravitational interaction constant in the physical vacuum determined by formation of the quartet of 24-plets ($N_1 = 96$) at the point *B*, and it occurs on the factor $1 - N_1^{-2}$:

$$\alpha'_{GB} = 1 - N_1^{-2}\ . \qquad (7)$$

The transformation of $SU(7) \to SU(5) \times SU(5)$ fields leads to the birth of two 24-plets of combined tensor fields, the photon-graviton fields of which are localized in the spherical-symmetric subspace, and the remaining 46 fields - in the central symmetric space. This leads to the weakening of gravitational and gravionic interactions in the physical vacuum. The number of spin states of the 46 fields $SU(7)$ group is $N_2 = 46 \cdot 7 = 322$. These degrees of freedom determine the relationship between the gravionic interaction constants in the physical vacuum α'_{5F} and in the Universe α_{5F}:

$$\alpha'_{5F} = (1 - N_2^{-2})\alpha_{5F}\ . \qquad (8)$$

The formation of two tensor photon-graviton fields determines the values of the gravitational interaction constant α'_{GF} in the spherically symmetric subspace of the physical vacuum, where each photon-graviton field weakens the action of the gravitational field by electric repulsion on the factor

$$1 - \alpha'_F / \alpha'_{GF} = 1 - \alpha'_F / \alpha'_{5F},$$

where α'_F – is the fine structure constant at the point *F*. The photon-graviton fields are localized in the spherically symmetric subspace of the physical vacuum and in the space of the Universe with the same symmetry. Since the interaction constants with the group symmetry $U(1)$ in these spaces are the same, then taking into account (5) we obtain $\alpha'_F / \alpha'_{5F} = \alpha_F / \alpha_{5F} = \xi$, i.e. the change in the gravitational constant at the transition from point *B* to point *F* in Fig. 1 is determined by the ratio

$$\alpha'_{GF} = (1 - \xi)^2 \alpha'_{GB}\ . \qquad (9)$$

It means that the combined photon-graviton field localized in the space of the Universe weakens in the low-energy limit the gravitational interaction between its free particles, which occurs with a constant $(1-\xi)^2 G$. This field is absent in the space of the physical vacuum of the coupled physical system, and the gravitational interaction between its particles occurs with a constant G.

Since, the mass of particles is proportional to the Planck mass $\sqrt{\frac{\hbar c}{G}}$, according to [2], there is a difference between the masses of free (m') and bound (m) particles due to the difference in their effective gravitational constants: $m' = (1-\xi)m$. This ratio is used in the calculations of the masses of fundamental particles [2] and atomic nuclei [7].

From (7) – (9) follows

$$\alpha_{5F} = \frac{(1-\xi)^2(1-N_1^{-2})}{(1-N_2^{-2})} = 0{,}98514265.$$

Using the relations (5) we obtain the following values of the other four constants:

α^{-1} = 137.0359916; α_{1F}^{-1} = 60.3973445;

α_{2F}^{-1} = 28.76064021; α_{3F}^{-1} = 5.9213008278.

High-precision measurements are carried out only for a constant fine structure α., The values of α, averaged by using one or another procedure on the set of available experiments are given in the literature. For example, [8] gives the value recommended by CODATA for 2014 which is $\alpha^{-1} =$

137.035999139(31), and it differs from the value (9) in the ninth digit. This indicates a high precision of the polarization theory of Hyperunification in determining values α_{iF}, the polarization angles of the Weinberg and Cabibbo allowing us to answer R. Feynman question about the fine structure constant [9]: "Everyone would like to know how this number appears?

Nobody knows. This is one of the greatest cursed mysteries of physics: the magic number that has been given to us and that man does not understand." It should be noted that the Hyperunification is carried out without the use of dimensional empirical constants. This means that the values of the constants of fundamental interactions are universal for G-universes. In contrast to the general theory of relativity, the gravitational field is not a special field deforming space-time in the polarization theory: the symmetries of space-time determine the properties of particles and fields, and not vice versa.

We have considered the Hyperunification of fundamental interactions for known fundamental particles belonging to the first hierarchical level. A similar Hyperunification takes place for particles of higher hierarchical levels with a corresponding decrease in the energy range of particle formation.

4. Conclusion

The basic principles of the polarization theory are presented and it is shown that its ideas about the nature of the Megauniverse allow to solve one of the key problems of the universal physics – the problem of the origin and correlation of fundamental interactions: four interactions between the four types of charges, and gravitational interaction. The quintet of charges (tastes) that are unknown today is polarized in the central symmetric space of physical vacuum. Their fields are not taken into account by the standard model of elementary particles. Their *gravionic* interaction forms with the strong interaction a *graviostrong* interaction with the same group symmetry $U(1)\times SU(2)$, which characterizes the electroweak interaction. This makes possible their unification, which occurs at energy values of about 10^{12} GeV/c^2 for known particles.

The singlet gravionic and gravitational fields with spin 2 are correlated by a common origin. This allowed us to establish the relationship between the gravitational constants and constants of the four interactions between the charges (*Hyperunification*). Calculation of constants in the low-energy limit, taking into account the contribution of fields with symmetry of $SU(5)$ group, which are unknown today, have shown coincidence with the recommended experimental value of the fine structure constant up to the eighth digit. It is shown that the dependence of the interaction constants on energy is determined by one parameter – the number of *combined* fields participating in the formation of particles with this energy and not taken into account by the Standard model.

Thus, the fifth – gravionic – fundamental interaction turned out to be the missing link in the polarization theory, and the Superintegration of the four fundamental interactions is impossible without this link.

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