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Physics of Currents and Potentials III. Octuplet Sector of the Classical Field Theory with Non-Point Particles

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Abstract: We have described the Standard Model postulates of the classical singlet-triplet-octuplet field theory with continual current fields, substituting point particles which appear in customary formulations of theoretical physics. The problems of charge conjugation and coordinate inversion in the octuplet sector of classical physics have been considered. We have provided the classification of states in the octuplet sector. There has been presented a qualitative description of zero-current states (gluons), one-current states (quarks) and multy-current states. We have suggested a visual classical interpretation of phenomenological quantum concepts "color" and "strangeness", based on the existence for a one-current particle of a few field shell variants consisting of three or four potentials of Yang-Mills' octuplet. The version of the octuplet (chromo-dynamical) theory under consideration includes eight quarks. One of them is dichromatic, the others are trichromatic. We have provided a qualitative discussion of some of characteristics for hypothetical particles which contain (probably existing but still undiscovered) massive quarks of the fourth generation.

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1 Introduction. The Standard Model Postulates. Base Lagrangian of the Standard Model

Let us extend the approach developed in articles [1] and [2], so that the chromodynamical sector of physics was also included into the theoretical scheme. Within the framework of

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this extension, the ***complete*** – i.e. not allowing further expansion – ***classical*** picture of physical reality is based on the following postulates:

- **The postulate of the three-sector physics.**
  Physics is three-sector. Physical reality consists of singlet (maxwellian) sector and two Yang-Mills' sectors – the triplet and octuplet ones. The base Lagrangian L consists of the sum of three sector Lagrangians – singlet Lagrangian L_S, triplet Lagrangian L_T and octuplet Lagrangian L_O:

$$L = L_S + L_T + L_O. \tag{1}$$

- **The postulate of the dyadic field character.**
  In each sector of physics, physical reality is locally (i.e. in a small neighborhood of each point of the four-dimensional space-time continuum) ***a field***. Field in each sector is a ***dyad***. It consists of a **current** and **potential**. The dyad components are unequal: potentials can exist while currents are missing, currents cannot exist without potentials. Currents and potentials are functions of the space-time coordinates.
  Current of the singlet sector is specified by one Lorentz 4-vector J^ν. Potential of the singlet sector is specified by one Lorentz 4-vector W^ν.
  The triplet sector contains Yang-Mills (further – YM) triplet of currents $\mathbf{J}^\nu = \left\{\overset{\alpha}{\mathrm{J}}{}^\nu\right\}$, $\alpha = 1, 2, 3$, where each of them is a Lorentz 4-vector. Potential in the triplet sector is also described by YM-triplet of Lorentz 4-vectors $\mathbf{W}^\nu = \left\{\overset{\alpha}{\mathrm{W}}{}^\nu\right\}$.
  For any two YM-vectors of the triplet sector $\mathbf{A}$ and $\mathbf{B}$ at one point of the four-dimensional space-time continuum, irrespective of their Lorentz tensor dimension, the operations of scalar and vector multiplication are determined. The scalar product will be denoted by $\mathbf{A}\cdot\mathbf{B}$ ($\mathbf{A}\cdot\mathbf{B} = \overset{\alpha}{\mathrm{A}}\overset{\alpha}{\mathrm{B}}$, the repeated over-letter YM-indices of the triplet sector from the beginning of the Greek alphabet mean summation from one to three).
  Vector product $\mathbf{C}$ of two YM-vectors $\mathbf{A}$ and $\mathbf{B}$ of the triplet sector will be denoted by $\mathbf{C} = \mathbf{A}\times\mathbf{B}$. This product is specified in an ordinary way with a 3-symbol of Levi-Civita $\overset{\alpha\beta\gamma}{\varepsilon}$:

$$\overset{\alpha}{\mathrm{C}} = \overset{\alpha\beta\gamma}{\varepsilon}\,\overset{\beta}{\mathrm{A}}\,\overset{\gamma}{\mathrm{B}}\,.$$

  Currents of the octuplet sector are YM-octuplet $\mathfrak{J}^\nu = \left\{\overset{a}{\mathfrak{J}}{}^\nu\right\}$, $a = \overline{1, 8}$. Each of the octuplet currents is a Lorentz 4-vector. Potentials of the octuplet sector also form YM-octuplet of the Lorentz 4-vectors $\mathfrak{W}^\nu = \left\{\overset{a}{\mathfrak{W}}{}^\nu\right\}$.
  Over-letter YM-indices of the octuplet sector will be denoted by the letters of the beginning of the Roman alphabet, and, to avoid confusion, we shall use the letters of the beginning of the Greek alphabet only for over-letter YM-indices of the triplet sector. For the same reasons, we should use a different type to refer to the octuplet vectors in order to distinguish them from the triplet YM-vectors.
  The Greek indices from the middle of the alphabet μ, ν, ... are used here to denote

Lorentz indices. They run the values from zero to three. A zero value of an index corresponds to the time component of the 4-vectors.

For any pair of $\boldsymbol{\mathfrak{A}}$ and $\boldsymbol{\mathfrak{B}}$ vectors of the octuplet sector, at the same point of space-time, the scalar and vector product is determined, similarly to the triplet sector. The scalar product is $\boldsymbol{\mathfrak{A}}\cdot\boldsymbol{\mathfrak{B}} = \overset{a}{\mathfrak{A}}\overset{a}{\mathfrak{B}}$ (the doubly repeated octuplet index means summation from $a = 1$ to $a = 8$). Vector product $\boldsymbol{\mathfrak{C}} = \boldsymbol{\mathfrak{A}} \times \boldsymbol{\mathfrak{B}}$ for the octuplet sector is specified by means of the structural anti-symmetric 3-symbol of the group SU (3) $\overset{abc}{f}$:

$$\overset{a}{\mathfrak{C}} = \overset{abc}{f}\,\overset{b}{\mathfrak{A}}\,\overset{c}{\mathfrak{B}}\,. \tag{2}$$

Structural symbol $\overset{abc}{f}$ is completely anti-symmetric in all pairs of indices. Nonzero components $\overset{abc}{f}$ are specified as follows (see, e.g., Appendix C in [3]):

$$\begin{aligned} &\overset{123}{f} = 1; \\ &\overset{458}{f} = \overset{678}{f} = \frac{\sqrt{3}}{2}; \\ &\overset{147}{f} = \overset{246}{f} = \overset{257}{f} = \overset{345}{f} = \overset{165}{f} = \overset{376}{f} = \frac{1}{2}. \end{aligned} \tag{3}$$

Mathematicians usually call the bilinear anti-symmetric form (2) "the Lie bracket". In the octuplet sector it seems convenient to keep to the same conventional vector terminology and the same conventional vector notations which are used in the triplet sector. One just has to get used to the fact that the octuplet vector product is determined not by the Levi-Civita symbol, but by the structure constants $\overset{abc}{f}$ (3)[2].

The structure of the octuplet vector product (2) is such that, in accordance with coefficient values $\overset{abc}{f}$ (3), in the eight-dimensional vector space of YM-octuplets, vector subspaces of a smaller dimension, closed relative to the operation of vector product (if vectors $\boldsymbol{\mathfrak{A}}$ and $\boldsymbol{\mathfrak{B}}$ belong to this subspace, their vector product also belongs to it) are formed[3].

From form $\overset{abc}{f}$ (3) it is easy to see that there are five closed three-dimensional subspaces of this kind: $\{\mathbf{1}, \mathbf{2}, \mathbf{3}\}$, $\{\mathbf{1}, \mathbf{4}, \mathbf{7}\}$, $\{\mathbf{1}, \mathbf{5}, \mathbf{6}\}$, $\{\mathbf{2}, \mathbf{4}, \mathbf{6}\}$, $\{\mathbf{2}, \mathbf{5}, \mathbf{7}\}$, and there are two closed four-dimensional subspaces: $\{\mathbf{3}, \mathbf{4}, \mathbf{5}, \mathbf{8}\}$, $\{\mathbf{3}, \mathbf{6}, \mathbf{7}, \mathbf{8}\}$. The figures in these symbolic notations of subspaces correspond to octuplet YM-indices.

Availability of such closed vector subspaces mean, in particular, that in the octuplet

[2] As it is well known, in vector algebra, mathematicians have entered such a rigid determination of a vector product (determination of this object by geometrical characteristics), that it allows existence of vector product only in vector spaces of dimension of $k = 3$ and $k = 7$. It seems that determination of vector product by formula (2) through structural constants of the group SU (n) is more appropriate for objectives of theoretical physics: it allows the existence of vector product within the dimension spaces of $k = n^2 - 1$ for any $n > 1$. Group SU (2) corresponds to vector algebra of the triplet sector of physics, group SU (3) corresponds to the octuplet sector of physics.

[3] At the same time, mathematicians dwell about "sub-algebras of Lie's algebra".

sector of physics, in contrast to the singlet and triplet sectors, there is not one wave which is free of currents, but eight diverse types of free waves, differing in a set of YM-potentials which are available in the wave: five triplet waves, two quartuplet waves and one complete octuplet wave. These waves, existing in the octuplet sector of the ***classical*** field theory, are the ***classical*** models of gluons (see p.8).

- **The postulate of the three-part ("three-deck") structure of the sector Lagrangians.**
Each of the three sector terms of the base Lagrangian of the classical field theory (1) (or the **Standard Model Lagrangian** in generally accepted terminology) consists, in its turn, of three terms: the current Lagrangian L_{cur}, the interaction Lagrangian L_{int} and the Lagrangian of free fields L_f:

$$\begin{aligned} L_S &= L_{S,cur} + L_{S,\text{int}} + L_{S,f}; \\ L_T &= L_{T,cur} + L_{T,\text{int}} + L_{T,f}; \\ L_O &= L_{O,cur} + L_{O,\text{int}} + L_{O,f}. \end{aligned} \tag{4}$$

- **The postulate of the interaction Lagrangian.**
In each sector of physics, the interaction Lagrangian is proportional to scalar product of vectors of the field dyad, but they have their own proportionality coefficient in each sector:

$$L_{\text{int}} = -\frac{1}{2p_S}\,\mathrm{J}^\nu \mathrm{W}_\nu - \frac{1}{2p_T}\,\mathbf{J}^\nu \cdot \mathbf{W}_\nu - \frac{1}{2p_O}\mathfrak{J}^\nu \cdot \mathfrak{W}_\nu. \tag{5}$$

Sector coefficients p_S, p_T, p_O entering the form (2), will be named Weinberg's parameters.
Let us remind the reader that, according to the previous articles of this series [1] and [2], that the classical field theory, developed here, includes an unknown fundamental constant of length dimension r_0 (the estimate of its quantity is provided in [2]). This constant is taken for a length unit in all the formulas. Velocity of light c is also taken for a unit. In the process, currents and potentials have electric charge dimension, and the Lagrangian and action functional have dimension of electric charge square. Weinberg's sector parameters p_S, p_T, p_O are dimensionless constants, which numerical values are determined arbitrarily by a selected unit of measurement of an electric charge. It is convenient to select this unit in such a way so that to normalize for unit the sum of the square of Weinberg's parameters:

$$p_S^2 + p_T^2. + p_O^2 = 1 \tag{6}$$

Relation (6) allows to use two Weinberg angles, ψ and ϑ, instead of three Weinberg sector parameters p_S, p_T, p_O:
if we assume that

$$p_O = \sin\psi,\ \ p_T = \cos\psi\sin\vartheta,\ \ p_S = \cos\psi\cos\vartheta,$$

condition (6) will be transformed into an identity, and Weinberg angles ψ and ϑ are two fundamental empirical constants of the Standard Model.

The same unit of an electric charge which normalizes Weinberg parameters (6) is used for current and potential measurement, and, correspondingly, currents and potentials can be further considered dimensionless values.

- **The postulate of the current Lagrangian.**

The current Lagrangian in each sector is proportional to pseudo-Euclidean square of sector current (taking into account the multiplicity of a current). Sector proportionality coefficients for the singlet and triplet sector are introduced in [2]. The proportionality coefficient for the octuplet sector is determined by the rule of the "sector equality":

$$L_{cur} = -\frac{1}{8p_S^2}\,\mathrm{J}^\nu \mathrm{J}_\nu - \frac{1}{8p_T^2}\,\mathbf{J}^\nu \cdot \mathbf{J}_\nu - \frac{1}{8p_O^2}\mathfrak{J}^\nu \cdot \mathfrak{J}_\nu. \tag{7}$$

According to the ideas, expressed in the previous articles of this series [1], [2], each of the twelve currents of the Standard Model (one singlet current, three currents of YM-triplet of currents and eight currents of YM-octuplet of currents) is space-like. If we denote any of the twelve currents of the theory with a conventional symbol j^ν,

$$\mathrm{j}^\nu \mathrm{j}_\nu \leq 0. \tag{8}$$

The equality sign is reached in formula (8) at the three-dimensional outer boundary σ_j of the four-dimensional current zone Ωj filled with the given current j^ν. At this boundary, termed in [1] "pomerium", isotropization of current j^ν takes place. Beyond this boundary, current j^ν is missing (if within the framework of a specific problem, other current zones Ω'_j, which are separated from the considered zone, are not essential).

According to the ideas expressed in [1] and [2], none of the twelve currents of the theory can be unrestrictedly large by pseudo-Euclidean module. In each of the three sectors of physics there is a sector constant j^* which has a dimension of current density, such one that for any current j^ν in this sector the following inequality is satisfied:

$$\mathrm{j}^\nu \mathrm{j}_\nu \geq -\left(\mathrm{j}^*\right)^2. \tag{9}$$

The equality sign in formula (9) is reached at some inner boundaries of current zone Ω_j. These boundaries in [2] were named latens. The boundaries latens are outer boundaries for some cavitated zones (latebrae) inside current zone Ω_j. There is no current j^ν in the cavity of latebra, but there are potentials which match this current of the sector. The boundaries of pomerium and latens are not pre-set and must be constructed in the process of numerical solution of specific boundary-value problems of the Standard Model.

The classical approach to physics, developed in this series of articles, makes us operate with details of "elementary" particles' structure in the length range which are not available for experimental study (10^{-33} cm – 10^{-26} cm)[4]. The technical,

[4] This length range has been available only for one Experimenter, and probably only at the first moments of his laboratory- the Universe- coming into existence.

applied, usefulness of this approach is determined by the fact that it may allow to estimate the particles' masses [1], [2]. Some massive particles, in accord with [1], [2], are stationary one-current or multi-current states in one of the sectors of physics. The conceptual, philosophical usefulness of this approach is determined by the fact that by allowing us to reject the point particles as empirical (inexplicable and uninterpretable) protomaterial of physics, it gives us the possibility ***to construct particles*** as some of the intrinsic states of continual current fields, and thus it may bring us one step closer to understanding of fundamental principles of the structure of all things in existence – one step on the way which dates back to the times of Thales, Anaximander, and Heraclitus.

According to [1] and [2], we have to assume the existence of the states in which some current j^{ν} becomes isotropic in some 4-zone of Ω_{N} which has a non-zero 4-volume. This current was named in [1], [2] a ***neutrino current***, and zone Ω_{N} – a neutrino zone. In neutrino zone, the contribution of a corresponding neutrino current j^{ν} into the current Lagrangian is missing, but in this zone, we have to add a "penalty" term of the form $\lambda \mathrm{j}^{\nu}\mathrm{j}_{\nu}$ to the Lagrangian (7), where λ is undetermined Lagrange's multiplier. This term is a "penalty" for neutrino character of current. This "penalty" transforms base Lagrangian into some effective Lagrangian suitable for solution of neutrino problems. The examples of neutrino problems' solutions are provided in [1], [2].

- **The postulate of the field Lagrangian.**

The Lagrangian of the free fields L_f is included into each sector of physics in the form of the expression quadratic by sector tensor of field $\mathrm{W}^{\mu\nu}$ (singlet sector), $\mathbf{W}^{\mu\nu}$ (triplet sector), $\boldsymbol{\mathfrak{W}}^{\mu\nu}$ (octuplet sector). Contributions of all the three sectors enter into the Lagrangian L_f with the same weight:

$$L_f = -\frac{1}{16\pi}\left(\mathrm{W}^{\mu\nu}\mathrm{W}_{\mu\nu} + \mathbf{W}^{\mu\nu}\cdot\mathbf{W}_{\mu\nu} + \boldsymbol{\mathfrak{W}}^{\mu\nu}\cdot\boldsymbol{\mathfrak{W}}_{\mu\nu}\right). \tag{10}$$

Sector tensors of fields are determined as follows [2].

Singlet field tensor:

$$\mathrm{W}_{\mu\nu} = \partial_\mu \mathrm{W}_\nu - \partial_\nu \mathrm{W}_\mu. \tag{11}$$

Triplet field tensor:

$$\mathbf{W}^{\mu\nu} = \partial_\mu \mathbf{W}_\nu - \partial_\nu \mathbf{W}_\mu + p_T \mathbf{W}_\mu \times \mathbf{W}_\nu, \tag{12}$$

or, at the explicit indication of the triplet YM-indices,

$$\overset{\alpha}{\mathrm{W}}_{\mu\nu} = \partial_\mu \overset{\alpha}{\mathrm{W}}_\nu - \partial_\nu \overset{\alpha}{\mathrm{W}}_\mu + p_T \overset{\alpha\beta\gamma}{\varepsilon} \overset{\beta}{\mathrm{W}}_\mu \times \overset{\gamma}{\mathrm{W}}_\nu,$$

Octuplet field tensor:

$$\boldsymbol{\mathfrak{W}}_{\mu\nu} = \partial_\mu \boldsymbol{\mathfrak{W}}_\nu - \partial_\nu \boldsymbol{\mathfrak{W}}_\mu + p_O \boldsymbol{\mathfrak{W}}_\mu \times \boldsymbol{\mathfrak{W}}_\nu, \tag{13}$$

or, at the explicit indication of the octuplet YM-indices,

$$\overset{a}{\mathfrak{W}}_{\mu\nu} = \partial_\mu \overset{a}{\mathfrak{W}}_\nu - \partial_\nu \overset{a}{\mathfrak{W}}_\mu + p_O \overset{abc}{f} \overset{b}{\mathfrak{W}}_\mu \times \overset{c}{\mathfrak{W}}_\nu,$$

As it has been noted in [2], the choice of expressions (12) and (13) for YM- field tensors was in its time motivated by the considerations of SU (2) – and, correspondingly, SU (3) – the gauge invariance. However, within the framework of the ***classical*** field theory, developed in this series of articles, these field tensors can be interpreted just as the simplest antisymmetric Lorentz tensors of the second rank which can be constructed from potentials and their derivatives with regard to the algebra rules of the sector, within the framework of the corresponding sectors of the Standard Model. Sector coefficients p_T or p_O, preceding the last non-linear term in tensors (12) and (13) are determined by considerations of "derivability" of the equations of current conservation/transformation of sector currents from the sector field equations. This "derivability rule" can be formulated in the following way: the mode of sector field tensor should agree with the law of conservation / transformation of sector currents[5].

- **The postulate of Riemann geometry.**
The geometry of four-dimensional space-time continuum of the Standard Model is the Riemann geometry where Minkowski signature $(+ - - -)$ is the same for all points. Metric tensor of the Riemann space obeys Einstein equations, which state that the Ricci tensor, formed by metric tensor and its first and second derivatives, is proportional to the energy-momentum tensor. The coefficient of proportionality is determined by the gravitation constant.
The type of energy-momentum tensor is determined by the complete Lagrangian of the Standard Model, i.e. by the sum of the Lagrangians (5), (7) and (10).
Accounting of the Riemann curvature of space-time is essential for the problems of ***discrete*** states, i.e. of the states with finite current zone having inner and outer boundaries (see [1] and [2]). These states describe the internal structure of massive "elementary" particles. Accounting of the Riemann curvature may be less important for continual or ***wave*** states in which current zone boundaries and zones of large values of pseudo-Euclidean module of current or potential are missing.
While deriving all field equations of the Standard Model from the Lagrangian of the singlet-triplet-octuplet theory, it is convenient to disregard the problem of the Riemann curvature, deriving the equation in Minkowski coordinates (as we have already done it while writing field tensors (12) and (13)). As in the article [2], we will assume that the formal accounting of curvature in field equations can be conducted by Einstein's recipe described in [2].
Such approach to gravitation means that gravitation is removed from the framework of physics as some geometric background that has an effect on the field dyad physics. However, the characteristics of this background can not be pre-set; they are determined by physics of field dyads.
We can formulate the following basic distinction between physical fields and gravitation (geometry): physics is dyadic (described by the current/potential couple),

[5] Usually in the notation of field tensor determination (12) or (13), charge value appears instead of dimensionless Weinberg's coefficients. However, a charge is an integral characteristic of state and, correspondingly, appearance of this value in local formulas (12), (13) seems irrelevant.

geometry is monadic (described by one object – metric tensor), and there is nothing in nature that could be interpreted as a gravitational current. Gravitation is not a physical field (and, in fact, the very terms "gravitation" and "gravitational field" are archaic and redundant for theoretical physics). It is appropriate to complete the statement of the Standard Model postulates with the well-known Sancti Thomas Aquinas' maxim: ***et haec sunt credibilia*** – "and they are what is to believe". Anything else in the classical relativistic physics follows from these postulates.

The above postulates contain both ***standard*** interpretation of the Standard Model (let the reader excuse the tautological phrase) and non-standard deviations from it. The ***originality***, first of all, consists of accepting the idea of dyadic character of a field: currents and potentials are the primary continual variables of the theory; they are uninterpretable and inexpressible by something which is simpler – in particular, they have no mechanical interpretation.

Refusal from mechanical interpretation of electromagnetic field occurred in the XIXth century rather fast and required efforts of a single generation of theoretical physicists after Maxwell. Even in a century and a half after Maxwell there was no refusal from mechanical interpretation of current. Perhaps this refusal required some revolutionary, almost Copernican, change of the way of thinking, typical for theoretical physics. In mechanical interpretation, current is treated through mechanical motion of the point material carrier of some properties (mass, charge, strangeness, etc.). With this interpretation, current can be described only by a time-like vector.

In articles [1], [2] and in the present article, the continual, field interpretation of current is adopted. In this process, current is described by space-like vectors (in some states by isotropic vectors).

Adoption of continual interpretation of current, in a sense, completes the "field revolution" in classical physics which was initiated by Michael Faraday, J.C.Maxwell, and H.A. Lorentz. This continual interpretation allows to construct current Lagrangian (7) in a very simple form - but in the form which is deviating from the one, which is currently adopted in the Standard Model, too much. While adopting the continual interpretation of current, we unavoidably have to, as shown in article [1], take into account the Riemann curvature of space-time inside current zones and around them: high density of energy-momentum and significant deviations of geometry from the flat Minkowski's world correspond to the large values of current and potential.

It should be noted that the form of the current Lagrangian (7), suggested here, is the simplest possible form, and perhaps it is too much simple. The current Lagrangian (7) is quadratic by currents and does not contain any derivatives of current. (Derivatives of current could enter into the theory through current tensor, arranged similarly to the sector field-tensor). Missing of currents derivatives in the Lagrangian (7) makes Hamiltonian formulation of the theory impossible, and, therefore, blocks some ways of quantization of the theory, which were successfully used in due time in non-relativistic physics – for example, Schrodinger "leap" from de Broglie's waves through the classical Hamilton-Jacobi equation to Schrodingers wave equation.

2 Intersector Differential Constraints for Currents

Currents of the three sectors of the Standard Model obey the three inter-sector differential coupling equations:

$$\partial_\mu \mathrm{J}^\mu = 0; \tag{14}$$

$$\partial_\mu \mathbf{J}^\mu + p_T \mathbf{W}_\mu \times \mathbf{J}^\mu = 0; \tag{15}$$

$$\partial_\mu \mathfrak{J}^\mu + p_O\, \mathfrak{W}_\mu \times \mathfrak{J}^\mu = 0. \tag{16}$$

Equations (14), (15), (16) are the scalar Lorentz relations; their Yang-Mills multiplet dimension coincides with multiple dimension of the corresponding sector. Equation (14) expresses the singlet current conservation law. Differential constraint (15) for triplet sector currents already appeared in C.N. Yang, R.L. Mills' pioneer work of 1954 [4]. It conveys some rule of transmutation of currents of the triplet sector. For some of the triplet sector states, relation (15) is equivalent to the law of conservation of some YM-components of current and to orthogonally conditions of some YM-components of currents and potentials [2]. Equation (16) is the octuplet analogue of triplet equation (15). Intersector constraint equations (14), (15), (16) are constructed simultaneously with the expressions for sector field tensors (11), (12), (13) so that the equations of differential current constraints (14), (15), (16) were the result of the field equations which are based on the form of sector Lagrangians. This "derivation" of constraint equations from the sector field equations (Maxwell's equations in the singlet sector and Yang-Mills equations in triplet and octuplet sectors) means that coupling equations (14), (15), (16) specify ***natural couplings*** for the singlet-triplet-octuplet Lagrangian. These natural couplings do not cause any necessity for specific account of couplings by means of extension of the base Lagrangian, which additively includes the coupling conditions, multiplied by indeterminate Lagranges multipliers (see [2]).

3 Intersector and Cross-sector Algebraic Couplings between Currents

The base Lagrangian of the Standard Model is additive relative to sector fields. At the level of the base Lagrangian, the sectors of physics "do not notice" each other. There is also no direct interaction of YM-multiplet currents within the framework of one sector: each multiplet current interacts only with "its" potential. The integrity of the YM-multiplet is provided by inter-sector mixing of multiplet potentials due to availability of the term, non-linear by potentials, in tensor of YM- field.

However, the experience also shows a cross-sector mixing (different sectors of the Standard Model "notice" each other), and a direct interaction of currents within the multiplet. The terms, responsible for these phenomena, are missing in the base Lagrangian. In the construction of the singlet-triplet (electroweak) theory in article [2], to reflect such mixings, the algebraic couplings between currents, interpreted as some holonomic constraints imposed on the solution of the field equations of the theory, have been introduced into the theory. The cross-sector coupling between singlet current J^{ν} and the third component of YM-triplet of currents $\overset{3}{\mathrm{J}}{}^{\nu}$ has been introduced into the theory:

$$\overset{3}{\mathrm{J}}{}^{\nu}\left(\overset{3}{\mathrm{J}}_{\nu}-\mathrm{J}^{\nu}\right)=0. \tag{17}$$

It is this coupling that provides the existence of "Maxwell-Yang-Mills' neutrino" (mymino), a cross-sector object, described in article [2]. Relation (17) shows that the presence of singlet current J^{ν} violates the equality of the three currents of YM-triplet of currents: one of the three currents is distinguished by the coupling condition with the singlet current; YM-triplet space is not isotropic.

Besides cross-sector coupling of currents (17), the condition of inter-sector normalization of YM-triplet currents has also been introduced into the singlet-triplet theory [2]:

$$2\,\overset{1}{\mathrm{J}}{}^{\nu}\,\overset{2}{\mathrm{J}}_{\nu}=\overset{3}{\mathrm{J}}{}^{\nu}\,\overset{3}{\mathrm{J}}_{\nu}\,. \tag{18}$$

The symmetry of the triplet sector with respect to permutation of YM-indices $1 \leftrightarrow 2$ suggests one more inter-sector normalization condition, imposed on pseudo-Euclidean current modules 1 and 2 of the triplet sector:

$$\overset{1}{\mathrm{J}}{}^{\nu}\,\overset{1}{\mathrm{J}}_{\nu}=\overset{2}{\mathrm{J}}{}^{\nu}\,\overset{2}{\mathrm{J}}_{\nu}\,.^{6}$$

Within the framework of the original concept of article [2], and in accordance with the traditional mathematical methods of finding a conventional extremum of functionals, the algebraic couplings (17) and (18) were counted by adding "additional Lagrangian" L_{ad} to the base Lagrangian of the singlet-triplet theory:

$$l_{ad}=\eta\,\overset{3}{\mathrm{J}}{}^{\nu}\left(\overset{3}{\mathrm{J}}_{\nu}-\mathrm{J}^{\nu}\right)+\psi\left(2\,\overset{1}{\mathrm{J}}{}^{\nu}\,\overset{2}{\mathrm{J}}_{\nu}-\overset{3}{\mathrm{J}}{}^{\nu}\,\overset{3}{\mathrm{J}}_{\nu}\right). \tag{19}$$

In this additional Lagrangian, η and ψ are the Lagrange's multipliers, which must be determined at the simultaneous solving of field equations of the theory and holonomic constraints (17) and (18). Field equations of the theory are constructed on the basis of the ***effective Lagrangian***, which is equal to the sum of the base Lagrangian and the additional Lagrangian (19).

However, non-zero values of the Lagranges "penalty" multipliers η and ψ, absolutely innocent from the mathematical point of view, would be extremely overloading for the physical theory itself. They would mean the existence of two, external to the theory under consideration, "Higgs-like" physical fields, which affect the real physical currents in such a way that they make them obey the conditions (17) and (18). These "Higgs-like" fields η and ψ, per se, are deformed, they do not have a dyadic character, they do not contribute to the Lagrangian with the exception of (19) and, accordingly, they do not have explicit field equations that would control their behavior. The occurrence

[6] In article [2] this condition is not provided in the explicit form.

of such deformed objects in fundamental physical theory is totally unacceptable – it demonstrates incompleteness of the theory, its inability to adequately reflect the circle of physical phenomena which it claims to describe.

Based on these considerations ("anti-Higgs principle"), we must treat inter-sector and cross-sector algebraic couplings between the currents of the theory as additional ones to the base Lagrangian of the relation theory, which perform two functions simultaneously:

- They are ***natural couplings*** for a certain class of solutions of field equations of the theory – that is, accounting of these constraints does not require inclusion of additional terms of the form (19) into the Lagrangian of the theory; in other words, some solutions of field equations of the theory satisfy these conditions at zero values of the Lagrange multipliers.
- They express forbidding of use of other solutions of the field equations which do not satisfy these coupling equations. To sum it up, we must admit that no constraints that are not natural for the Lagrangian of the theory, can appear in the fundamental physical theory which claims to provide full description of reality.

In article [2], devoted to the singlet-triplet theory, there has not been constructed a formal proof of the ***naturalness*** of couplings (17) and (18) for this theory, but a number of partial solutions to the field equations, satisfying these couplings, have been provided.

Undoubtedly, we must take into account such natural couplings within the frame of the Standard Model. However, we have to admit that we have not managed to construct such couplings which include currents of the octuplet sector. Such couplings can be cross-sector or inter-sector. The cross-sector couplings should mix all or some of the currents of the octuplet sector with singlet current (without these couplings, we would be unable to assign the presence of electrical charge to quarks) and with triplet sector currents (without these couplings, we would be unable to describe weak decays of quarks). Inter-sector couplings should build inter-sector normalizations of octuplet currents (without such couplings, we would be unable to explain the availability of ***generation*** of quarks). We may expect any current couplings to be quadratic by currents, similarly to constraints (17) and (18). The matrices, specifying quadratic couplings, should in some form contain current mixing parameters which are already known in theoretical physics: N. Cabibbo's angle and other mixing angles, entering into M. Kobayashi–K. Maskawa matrix. However, Kobayashi–Maskawa 3×3-matrix is built for the existing six-quark version of the Standard Model and it mixes three generations of quarks. The eight-current Lagrangian of the octuplet sector of physics, constructed in this article, automatically presupposes the existence of eight sets of stationary one-current states, which are the ***classical*** quark models within the framework of our classical theory, or, of the four doublet generations of quarks, if it is in general acceptable to speak about "generations of quarks" within the framework of the classical theory. Consequently, we must expect appearance in the theory of some ***analogs*** of Kobayashi–Maskawa matrix with dimensions 4×4 and 4×3. Besides this, it should be noted that the existing Kobayashi–Maskawa matrix contains complex elements, which is absolutely unacceptable for any ***classical*** theory: all elements of the current coupling matrices of the classical theory must be real. While not having these mixing

conditions, we have no possibility to discuss any mixed cross-sector states that include octuplet currents. We have to confine ourselves to the research of pure one-sector octuplet states. No doubt, we may be sure of the existence of pure zero-current states (no current couplings affect zero-current states) and some one-current states. Consideration of multi-current states has a preliminary hypothetical character: some of them can be forbidden by unknown algebraic inter-sector or cross-sector current couplings.
Such "one-sector" narrowing of view has two unpleasant consequences: it is impossible to assign electrical charge to quarks as well as it is impossible to describe the processes of quarks' weak decays. But in this poor one-sector picture we manage to give a visual classical interpretation to such basic chromo-dynamic concepts as "flavor", "color" and "strangeness".

4 Getting Rid of Weinberg Parameter: Chromodynamical Lagrangian

By considering only pure octuplet states, we are getting rid of the necessity to use a symbol font for denoting currents and potentials of the octuplet sector, since currents and potentials from other sectors further do not appear.
By conducting, as previously in article [2], scale transformation of potentials and currents, we can get rid of Weinberg parameter p_O in the notation of octuplet field tensor and the octuplet Lagrangian.
Let us introduce a rescaled octuplet potential $\mathbf{A}^\nu$ through the relation:

$$\mathbf{A}^\nu = p_O\, \mathfrak{W}^\nu. \tag{20}$$

Let us also introduce a rescaled octuplet current $\mathbf{j}^\nu$:

$$\mathbf{j}^\nu = \frac{1}{2}\, \mathfrak{J}^\nu. \tag{21}$$

Within the framework of the rescaled variables, the octuplet Lagrangian L_O has the form:

$$L_O = \frac{1}{p_O^2}\, L_c, \tag{22}$$

where

$$L_c = \frac{1}{2}\, \mathbf{j}^\nu \cdot \mathbf{j}_\nu - \mathbf{j}^\nu \cdot \mathbf{A}_\nu - \frac{1}{16\pi}\, \mathbf{A}^{\mu\nu} \cdot \mathbf{A}_{\mu\nu}. \tag{23}$$

In formula (23) the rescaled octuplet field tensor $\mathbf{A}^{\mu\nu}$ has the form:

$$\mathbf{A}_{\mu\nu} = \partial_\mu \mathbf{A}_\nu - \partial_\nu \mathbf{A}_\mu + \mathbf{A}_\mu \times \mathbf{A}_\nu. \tag{24}$$

This tensor does not contain Weinberg parameter p_O. It is obvious that tensor $\mathbf{A}_{\mu\nu}$ is proportional to tensor :

$$\mathbf{A}_{\mu\nu} = p_O\, \mathfrak{W}_{\mu\nu}. \tag{25}$$

From formula (22) it is obvious that the octuplet Lagrangian L_O differs from the Lagrangian L_c, which does not contain Weinberg parameter p_O, only in insignificant scale

multiplier. By historical reasons it is appropriate to name L_c a ***chromodynamical Lagrangian***.
The one-sector chromodynamical Lagrangian (23) is the octuplet copy of the one-sector rescaled triplet "weak Lagrangian" L_w, presented in article [2], which also does not contain Weinberg sector parameter p_T. Considering the change of multiplet YM-dimension, while dealing with the Lagrangian (23) and field tensor (24), it should be taken into account that the eight-dimensional vector product in (24) is specified through a set of structural constants $\overset{abc}{f}$ (3) of the SU(3) group. An important distinction of the chromodynamical Lagrangian L_c from its triplet analog – the weak Lagrangian L_w – is the missing of an a priori requirement of some current's isotropy. Such requirement appears in the triplet sector because of one of triplet currents' coupling with singlet current. In the chromodynamical Lagrangian, all currents can be considered space-like. Isotropization of octuplet current takes place only in singular state of one-sector octuplet neutrino. Chromodynamical differential condition for currents (16) in these rescaled variables also does not contain Weinberg parameter p_O:

$$\partial_\nu \mathbf{j}^\nu + \mathbf{A}_\nu \times \mathbf{j}^\nu = 0.$$

By varying the Lagrangian (23) by currents and potentials, we obtain, as in the triplet sector, two systems of equations: 1) current equations, expressing the existence of linear algebraic coupling of currents and potentials; 2) Yang-Mills equations.

5 Charge Conjugation in the Octuplet Sector

Complete charge conjugation, i.e. a simultaneous reverse of sign for all currents and potentials, in the triplet sector of physics, as it has been showed in the previous article of this series [2], requires permutation of two indices of Yang-Mills triplet: $1 \leftrightarrow 2$.
But in octuplet sector of physics, ***complete*** charge conjugation is impossible.
Under complete charge conjugation, the first two terms in field tensor (24), linear by octuplet potential, reverse a sign. The last term in (24), an eight-dimensional vector product, is quadratic by potential $\mathbf{A}^\mu$. It does not reverse sign under complete charge conjugation. To change a sign of the vector product, it is necessary to permute eight YM-indices of YM-octuplet so that the signs of all non-trivial elements of structural symbol $\overset{abc}{f}$ (3) would be reversed.
Let us name such disordered set of three integral numbers a, b, c (in the range from 1 to 8), which any of non-trivial elements $\overset{abc}{f}$ corresponds to, a "regular triple".
In accordance with (3), there are nine of such sets. It is obvious that it is impossible to permute eight numbers within nine regular triples in such a way that all the nine elements $\overset{abc}{f}$ (3) would reverse a sign[7].

[7] A simple and elegant proof of this statement was suggested by Tatyana Kubovskaya. It will be presented in one of the subsequent articles of this series devoted to numerical research of octuplet waves.

Consequently, in the octuplet sector it is possible to provide only incomplete charge conjugation, leaving the signs of some currents and potentials, corresponding to these currents, irreversible.

If, under such incomplete charge conjugation, the signs of n currents and n potentials, corresponding to them ($1 \le n < 8$), are irreversible, we will mean that charge conjugation with n range defect is executed. Charge conjugation with the least defect of range 1 can be provided in the following way:

$$\mathbf{1} \to -\mathbf{1};\ \mathbf{2} \to -\mathbf{2};\ \mathbf{3} \to \mathbf{3};\ \mathbf{4} \to -\mathbf{7};\ \mathbf{5} \to -\mathbf{6};\ \mathbf{6} \to -\mathbf{5};\ \mathbf{7} \to -\mathbf{4};\ \mathbf{8} \to -\mathbf{8}. \qquad (26)$$

In formula (26) each number denotes a conventional form of the notation of current and potential with YM-index corresponding to this number.

Corresponding to formula (26) 8×8-matrix of the octuplet charge conjugation $\hat{C}_O$ with the defect of range 1, has the form:

$$\hat{C}_O = \begin{pmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{pmatrix}. \qquad (27)$$

In accordance with (26) and (27), under the charge conjugation in the octuplet sector, current **3** and potential **3** remain invariable, the other seven currents and seven potentials reverse sign under simultaneous permutation in two couples of YM-indices: $4 \leftrightarrow 7$; $5 \leftrightarrow 6$.

Octuplet charge conjugation matrix (27) reflects charge asymmetry of the octuplet world. While creating the octuplet world, the world of hadrons, God could assign a definite sign to current **3**. The other seven currents with the same sign form a matter in the world with arbitrarily chosen sign of current **3**; currents with the opposite signs correspond to antimatter in this world. If God had made another choice of sign for current **3**, the matter and antimatter would have changed over.

Charge conjugation in the triplet sector requires permutation of two indices of YM-triplet: $1 \leftrightarrow 2$ [2]. This permutation can be interpreted in empirically sensible terms as permutation of particles W^+ and W^-.

Permutations $4 \leftrightarrow 7$ and $5 \leftrightarrow 6$, imposed by matrix (27) under the octuplet charge conjugation, look rather shocking if we try to interpret them into the terms of experimental physics.

Stationary one-current states of the octuplet sector correspond to quarks (they are ***classical*** models of quarks). Permutations $4 \leftrightarrow 7$ and $5 \leftrightarrow 6$ imply the replacement of one quark by another quark, for example, turning of a strange quark s into a bottom quark of the third generation b and a charmed quark c into a top quark of the third generation t. Therefore, charge conjugation matrix (27) prescribes to admit that a ***true*** antiparticle for quark c is a quark which ***seems*** to be an antiparticle for quark b. But these quarks have different strangeness characteristics and different own weights (in the ranges where it is in general relevant to speak about own weight of a quark which does not exist in free form). It is not easy to put up with such picture, and we will stop its further discussion, similar to the authors of texts of the Council of Trent, "by cautiously preferring to avoid any unnecessary specifications" [5].

6 Coordinate Inversion in the Octuplet Sector

While conducting operation of inversion of 4-dimensional frame:

$$x_\nu \to -x_\nu, \tag{28}$$

in the octuplet sector, as in the triplet sector, it should be taken into account that occurring transformation of three-dimensional right spatial frame into the left one (or vise versa), requires a similar transformation in YM-space [2]. In the triplet sector of physics, as it has been shown in [2], it is enough to permute two YM-indices $1 \leftrightarrow 2$, ***without charge inversion***, which is nominally required according to the rules of any Lorentz vectors transformation under operation (28), or, if you wish, under double charge inversion, within the framework of the three-way combined coordinate inversion described in [2]:

(1) Inversion of signs x_ν (28), accompanied by the sign inversion of all currents and potentials of the triplet sector.
(2) Permutation of YM-indices $1 \leftrightarrow 2$.
(3) Repeated sign inversion of all currents and potentials of the triplet sector.

Coordinate inversion per se (28) is not a correctly determined procedure in the triplet sector of physics (so called "law of parity nonconservation in weak interactions" [2]).
Finally, 3×3-matrix $\hat{D}_T$, specifying transformation of currents and potentials of the triplet sector under performing of coordinate inversion (28), has the form:

$$\hat{D}_T = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}.$$

This matrix differs from triplet matrix of charge conjugation $\hat{C}_T$ only in sign.
In the octuplet sector, with regard to a more complex procedure of octuplet charge conjugation, we can describe a similar three-way operation of combined coordinate inversion:

(1) Inversion of coordinate signs (28), accompanied by the sign inversion of ***all*** currents and potentials of the octuplet sector.
(2) YM-indices permutation in pairs $4 \leftrightarrow 7$ and $5 \leftrightarrow 6$.
(3) Repeated sign inversion of all currents and potentials, with exception of current **3** and potential **3**.

Finally, 8×8-matrix $\hat{D}_O$, specifying currents and potentials transformation, which the octuplet sector variables should be subjected to for insuring the chromo-dynamical Lagrangian invariance relative to coordinate inversion (28), differs from matrix of the octuplet charge inversion $\hat{C}_O$ only in sign (27):

$$\hat{D}_O = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}. \qquad (29)$$

The coordinate inversion per se (28) is not a correctly determined operation in the octuplet sector of physics. This assertion can be interpreted as the "law of parity non-conservation in strong interactions". The opposite assertion about parity conservation in strong interactions, cited by many authors, is incorrect, or, to be precise, boundedly correct – in case of experimenting with the systems that contain only ***currents*** **1** and **2** (i.e. the lightest quarks u and d). Permutation of ***potentials***, required in the process by matrix $\hat{D}_O$, and the sign reversal of ***potential*** **3**, result in quark's ***color*** change (i.e. the current zone field shell, see p.9); while the color is not an observable variable.

Coordinate inversion for the system which includes ***all*** currents of the octuplet sector, in accordance with (28), seems to be impracticable even for the Omnipotent: in order to see the mirror image of some experiment, it is necessary to move to the other Universe, with different current sign**3**. In this other Universe, matter and antimatter change over. Further, we have to make an experiment with the matter of our Universe, which is the antimatter in this other Universe, simultaneously permuting the two pairs of strange quarks[8]

[8] Undoubtedly, giving this description, the author has violated the cited above "rule of the Tridentine circumspection".

7 Classification of the Octuplet Sector States

As in the triplet sector, in the octuplet sector of physics, a state can be categorized primarily by the number of currents that form this state. But in the octuplet sector there is a possibility for one more additional classification – by the composition of octuplet potentials accompanying this current set of state. The possible existence of different sets of octuplet potentials at a specified current composition of the state is related to the fact that in the eight-dimensional space of YM-vectors of octuplet there are three-dimensional and four-dimensional subspaces which are closed relative to vector multiplication. In the three-dimensional space of YM-vectors of the triplet sector there are no such closed subspaces, and therefore any current composition of the triplet state is accompanied by a complete set of triplet potentials.

We shall represent the states of the octuplet sector in the form of a bracket symbol:

$$\langle a,\, \ldots |a,\, b,\, c,\, \ldots\rangle. \tag{30}$$

To the left of the vertical dividing line, there are symbols denoting currents of the state, to the right – there are symbols that represent potentials of the state (at least three potentials).

If current a is presented in this state, potential a, conjugated with it, is sure to be presented in this state.

Zero-current state will be denoted by a one-sided bracket symbol containing only a list of potentials of states:

$$|a,\, b,\, c,\, \ldots\rangle.^{9} \tag{31}$$

Zero-current states describe Yang- Mills free waves in the octuplet sector of physics. These waves are the ***classical*** models of gluons. Gluon waves, similarly to the triplet sector waves, can be classified by the type of wave vector: the waves with time-like wave vector (actually gluons) and the objects which are cognate to triplet object terriculum [2] with space-like wave vector.

The states that have at least one current, can be classified into discrete and wave states [2]. In discrete states, the three-dimensional zone, occupied by currents at each instant of time, has a finite volume. The outer boundary of this three-dimensional current zone is pomerium – the surface of current isotropization. Within the current zone, there are voids containing no currents (latebrae). On the outer boundary of these cavitated zones (latens), the negative square of pseudo-Euclidean module of space-like current takes its limiting value (9).

The major subtype of discrete states is the ***stationary states***. For each stationary state there is such a frame of reference in which all currents and potentials do not depend on time. Geometry of stationary states is substantially non-planar and obeys Einstein gravitation equations.

Wave current states do not have current boundaries of pomerium and latens. Current

[9] This convenient octuplet bracket symbolism is not an absolute copy of the quantum $\langle bra|$ – and – $|cket\rangle$ Dirac's symbolism: $\langle bra|$ – ***states (currents without potentials) do not exist***.

zone fills the whole four-dimensional space – time. Wave states with not very high energy density of the wave can be described as waves in Minkowskis flat world. Wave current states, as well as zero-current states, can have both time-like and space-like wave vector. Among one-current wave states we can identify specific ***neutrino states*** (octuplet neutrinos). In the neutrino state, current is isotropic everywhere.
Current states with the same bracket formula (30) are available in two varieties – the stationary state and the wave state. This doubling of states arouses some concern. What corresponds to this doubling from the point of view of experimental physics? (The same question naturally arises both in the singlet and triplet sectors of physics). Undoubtedly, stationary one-current states in the octuplet sector correspond to quarks (they are classical models of quarks)[10]. But do their wave one-current "doubles" correspond to any particle? Perhaps these one-current wave states of the octuplet sector ("flavored gluons"), as well as "heavy photon" described in the article [1], correspond to enormously massive bosons with the rest energy of the Planck range, that can hardly be seen in the laboratory experiment.

8 Zero-current States (gluons)

In the octuplet sector there are eight kinds of zero-current states that differ in composition of potentials states.

- ***Five triplet zero-current states***:

$$|\mathbf{1},\,\mathbf{2},\,\mathbf{3}\rangle,\ |\mathbf{1},\,\mathbf{4},\,\mathbf{7}\rangle,\ |\mathbf{1},\,\mathbf{6},\,\mathbf{5}\rangle,\ |\mathbf{2},\,\mathbf{4},\,\mathbf{6}\rangle,\ |\mathbf{2},\,\mathbf{5},\,\mathbf{7}\rangle. \tag{32}$$

  These five triplets are composed of the potentials, which form three-dimensional subspaces of YM-octuplet, closed relative to vector multiplication specified in the eight-dimensional YM-space by equations (2) and (3).
  Mathematical description of the wave state $|\mathbf{1},\,\mathbf{2},\,\mathbf{3},\rangle$ totally coincides with the description of free YM-wave in the triplet sector. Detailed description of wave states of the triplet sector is presented in the previous article of this series [2]. Mathematical description of other triplet waves from the list (32) is reduced to wave description $|\mathbf{1},\,\mathbf{2},\,\mathbf{3},\rangle$ by means of re-scaling of potentials and / or time in the intrinsic system of the wave.

- ***Two quartuplet zero-current states***:

$$|\mathbf{3},\,\mathbf{4},\,\mathbf{5},\,\mathbf{8}\rangle,\ |\mathbf{3},\,\mathbf{6},\,\mathbf{7},\,\mathbf{8}\rangle. \tag{33}$$

  These quartuplets consist of potentials which form four-dimensional subspaces of YM-octuplet, closed relative to the cross product.
  For quartuplet $|\mathbf{3},\,\mathbf{4},\,\mathbf{5},\,\mathbf{8}\rangle$, it is convenient to introduce a combined potential $\overset{+}{\mathbf{V}}$

[10] Stationary one-current states in the octuplet sector are not normalized by energy due to "bad behavior" of the stationary potential triplet "at infinity", far away from the pomerium. This fact is doubtless (free quarks are not observed), but it obviously has no formal proof.

which is a superposition of potentials **3** and **8**:

$$\overset{+}{\mathbf{V}} = \frac{1}{2}\left(\mathbf{3} + \sqrt{3}\cdot\mathbf{8}\right). \tag{34}$$

When using YM-vector (34), the mathematical description of quartuplet wave $|\mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8}\rangle$ can be reduced to a description of the triplet wave with the formula $|\ \overset{+}{\mathbf{V}},\ \mathbf{4},\ \mathbf{5}\rangle$. Besides the energy integral, the wave $|\mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8}\rangle$ has one more integral which is linear by potentials. In this wave the components **3** and **8** can grow unboundedly, despite the oscillations of vector $\overset{+}{\mathbf{V}}$ which are finite by amplitude. This growth arouses certain problems in interpretation of the wave $|\mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8}\rangle$.

For quartuplet $|\mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8}\rangle$ it is convenient to introduce a combined potential $\overset{-}{\mathbf{V}}$:

$$\overset{-}{\mathbf{V}} = \frac{1}{2}\left(\mathbf{3} - \sqrt{3}\cdot\mathbf{8}\right). \tag{35}$$

When using YM-vector (35), mathematical description of the quartuplet wave $|\mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8}\rangle$ can be reduced to a description of the triplet wave $|\ \overset{-}{\mathbf{V}},\ \mathbf{6},\ \mathbf{7}\rangle$. For this quartuplet, there also occurs a problem of physical interpretation of unbounded growth of potentials **3** and **8** under the bounded oscillations of their linear combination (35).

- ***One complete octuplet zero-current state*:**

$$|\mathbf{1},\ \mathbf{2},\ \mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8}\rangle. \tag{36}$$

A plane wave with time-like wave vector, corresponding to complete octuplet zero-current state (36), in the intrinsic wave system can be described by a set of eight three-dimensional vectors. Yang-Mills equations for this set of values are a system of 24 ordinary differential equations of the second order with cubic nonlinearities. Perhaps, this is one of the most complex and multi-dimensional test subjects in the theory of nonlinear dynamical systems[11].

Here we do not provide the explicit form of Yang - Mills wave equations (36), having an intention to present them in one of the subsequent articles of this series which is devoted to numerical investigation of the octuplet waves. The reader, who is already familiar with the technique of mathematical description of plane triplet YM-waves from the previous articles of this series [2], may independently derive these equations from the field octuplet Lagrangian. The most significant difference of the octuplet sector algebra is the lack of a simple formula for the four-index convolution $\overset{abde}{F}$ of the two structural symbols $\overset{abc}{f}$:

$$\overset{abde}{F} = \overset{abc}{f}\ \overset{dec}{f}\ . \tag{37}$$

Through convolution (37), which forms a double cross product in the octuplet, we can calculate Yang-Mills inertia tensor for the octuplet sector, enter an explicit form

[11] The numerical investigation of dynamics of this subject will be presented in one of the subsequent articles of this series.

of the equations for the plane wave dynamics and construct the energy integral for these waves. Symbol (37) has 2^{12} elements, but only 364 of its elements are non-zero and can be reduced to one of the five values: $^1/_4$, $^{\sqrt{3}}/_4$, $^1/_2$, $^3/_4$, 1[12].

Each of the eight states (32), (33) and (36) is a ***classical*** model of gluon. A set of potentials, entering the description of these zero-current states, should be interpreted as a ***color*** of gluon (eight colors).

Flat zero-current waves can have a time-like wave vector. Accordingly, we must assume that gluons have nonzero rest mass. A wide-spread idea of the gluon's masslessness is incorrect.

In the octuplet sector, as well as in the triplet sector, the chirality problem arises. The method for its solution for the triplet sector is described in article [2]. For gluon waves, the same procedure of "soft chiralization" as for the wave triplet sector can be applied. However, in the octuplet sector, the chiral determinacy of a solution is controlled by signs of the nine chiral determinants CD, but not of one CD as for the triplet waves. The components of potentials that form each CD are determined by a set of "normal triples", mentioned above in p. 5.

9 One-current States (flavored gluons and quarks)

The octuplet sector algebra rules allow the existence of eight sets of one-current states that differ in YM-number of the current which enters the state. Let us name a complete set of one-current states for a given current, *the flavor*. One-current states within the range of one flavor vary in a set of YM-potentials that enter into the bracket formula of the state. This set of potentials must belong to a three-or four-dimensional subspace, closed under the octuplet vector multiplication (2), (3). The set of potentials, appearing in the bracket formula of one-current state, will be named *the color* of this state. Flavor **8** is dichromatic; the other seven flavors are trichromatic. The full list of bracketed formulas of one-current states, varying in flavor and color, is presented in Table 1.

[12] We do not know any compact formula for (37). The explicit notation of the massive (37) in the form of a set of 64th square matrices 8×8, convenient for obtaining complete octuplet wave equations (36), will be presented in one of the subsequent articles of this series. The elements of massive were calculated by Tatyana Kubovskaya by means of the packet of Wolfram Mathematica 8.0.

Table 1 Bracket formulas of one-current states, varying in flavor and color

Flavor \ Color	I	II	III
1	$\langle \mathbf{1} \,|\, \mathbf{1},\ \mathbf{2},\ \mathbf{3} \rangle$	$\langle \mathbf{1} \,|\, \mathbf{1},\ \mathbf{4},\ \mathbf{7} \rangle$	$\langle \mathbf{1} \,|\, \mathbf{1},\ \mathbf{6},\ \mathbf{5} \rangle$
2	$\langle \mathbf{2} \,|\, \mathbf{1},\ \mathbf{2},\ \mathbf{3} \rangle$	$\langle \mathbf{2} \,|\, \mathbf{2},\ \mathbf{4},\ \mathbf{6} \rangle$	$\langle \mathbf{2} \,|\, \mathbf{2},\ \mathbf{5},\ \mathbf{7} \rangle$
4	$\langle \mathbf{4} \,|\, \mathbf{1},\ \mathbf{4},\ \mathbf{7} \rangle$	$\langle \mathbf{4} \,|\, \mathbf{2},\ \mathbf{4},\ \mathbf{6} \rangle$	$\langle \mathbf{4} \,|\, \mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8} \rangle$
5	$\langle \mathbf{5} \,|\, \mathbf{1},\ \mathbf{6},\ \mathbf{5} \rangle$	$\langle \mathbf{5} \,|\, \mathbf{2},\ \mathbf{5},\ \mathbf{7} \rangle$	$\langle \mathbf{5} \,|\, \mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8} \rangle$
6	$\langle \mathbf{6} \,|\, \mathbf{1},\ \mathbf{6},\ \mathbf{5} \rangle$	$\langle \mathbf{6} \,|\, \mathbf{2},\ \mathbf{4},\ \mathbf{6} \rangle$	$\langle \mathbf{6} \,|\, \mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8} \rangle$
7	$\langle \mathbf{7} \,|\, \mathbf{1},\ \mathbf{4},\ \mathbf{7} \rangle$	$\langle \mathbf{7} \,|\, \mathbf{2},\ \mathbf{5},\ \mathbf{7} \rangle$	$\langle \mathbf{7} \,|\, \mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8} \rangle$
3	$\langle \mathbf{3} \,|\, \mathbf{1},\ \mathbf{2},\ \mathbf{3} \rangle$	$\langle \mathbf{3} \,|\, \mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8} \rangle$	$\langle \mathbf{3} \,|\, \mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8} \rangle$
8	—	$\langle \mathbf{8} \,|\, \mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8} \rangle$	$\langle \mathbf{8} \,|\, \mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8} \rangle$

Let us name the color, consisting of three potentials, ***the ordinary color***, but the color, consisting of four potential – ***the strange color***. There are two strange colors and five ordinary ones. Let us name the flavor that has only ordinary colors, ***the ordinary flavor***; the flavor, containing only one strange color – ***the strange flavor***; the flavor, containing two strange colors – ***the special flavor***. According to Table 1, there are two ordinary flavors – flavor **1** and flavor **2**; there are four strange flavors – **4**, **5**, **6**, **7**; there are two special flavors **3** and **8**.

Each one-current state can exist both in the form of a wave without current boundaries (let us name this wave the ***flavored gluon***), and in the form of a stationary state. A certain particle with a finite three-dimensional volume of the current zone corresponds to a stationary state. Undoubtedly, we have to identify these stationary states with quarks, or more prudently: each stationary one-current state of the octuplet sector is a classical model of a quantum object – quark. Each quark is characterized not only by flavor and color, but also by two integral numbers – the pomerium connectivity and the number of inner current-free zones latebrae. With this flavor and color there can be several quarks varying in these two integer-valued characteristics[13].

The above description and Table 1 provide a simple and obvious classical interpretation of the abstract phenomenological property "quark color". ***Color – is a set of three or four potentials, which form Yang-Mills field shell of the current zone*** (***and influencing the current distribution within the current zone***). Within the framework of octuplet algebra, this interpretation is natural and, in a sense, it makes the very term "color" redundant and archaic. The classical interpretation of phenomenological concept "***strangeness***", suggested above, is quite natural within the framework of octuplet algebra. This interpretation is based on distribution of the three-current and

[13] The equality of the number of flavors and the number of quarks is an empirical fact. Probably, the "topologically excited" or "multi-compendent" quarks of each flavor, acceptable within the framework of our classical YM-theory, are excessively massive and inaccessible for modern experiments.

four-current colors in the octuplet scheme of flavors and colors in Table 1.

The two ordinary flavors from Table 1, flavor **1** and flavor **2**, should be, undoubtedly, identified with the flavors of the lightest quarks **u** and **d**. The four strange flavors – **4**, **5**, **6**, **7** – should be identified with the four strange quarks **s**, **c**, **b**, **t**. While discussing the charge conjugation (p.5) and the coordinate inversion (p.6) above, we mentioned a close coupling in couples (**4**, **7**) and (**5**, **6**), caused by the necessity for YM-indices permutation in these couples under the charge conjugation and coordinate inversion. Probably, this implies that the flavors in these couples agree with the same magnitude electric charges[14]. Consequently, the flavors of couple **4** and **7** both have to be either ***upper or lower***. These terms – ***upper quarks*** and ***lower quarks*** – do not have support in the octuplet algebra. We should treat them as uninterpretable phenomenological terms which indicate the existence of certain inter-sector current couplings in the octuplet sector. These couplings form doublet generations of quarks. In octuplet algebra per se there is no evidence for existence of quark generations.

Nothing in phenomenological physics of particles of the six-quark Standard Model corresponds to special flavors **3** and **8**, presented in Table 1. This "non-observability" of the fourth generation of quarks can have three possible versions of explanation:

a) Stationary one-current states with currents **3** and **8** do not exist, and the corresponding "non-existence theorem" can be proved in the framework of mathematics of the octuplet sector without additional involvement of current couplings[15].

b) Stationary one-current states with currents **3** and **8** do not exist due to yet unknown cross-sector or inter-sector current couplings.

c) Stationary one-current states with currents **3** and **8** exist, but the quarks, corresponding to them, are too massive and the hadrons, containing these quarks, are not generated under the available accelerator energy.

If we keep to the last "optimistic" version of the explanation, with naive extrapolation of masses of the three known generations of quarks, we can estimate the quarks' masses of the fourth generation as 200 – 500 GeV (bottom quark) and 10 – 20 TeV (top quark).

Not being able to distinguish between the upper and lower YM-quarks within the framework of the octuplet algebra, we can establish a hypothetical correspondence between Yang-Mills and phenomenological quarks in a few different methods. One of the possible variants of this correspondence is demonstrated in Table 2. We are going to use this variant for further interpretations of multi-current states.

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[14] An appeal to the electric charge quantity moves us beyond the frames of the octuplet sector. Not including into consideration cross-sector couplings between the currents, we are, in fact, discussing here the one-sector models of quarks which are devoid of the electric charge.

[15] We do not currently have a theorem of the stationary states existence in any of the three sectors of physics. Perhaps a mathematician exists somewhere else who is capable to get interested in this problem of existence.

Table 2 The Table of possible correspondences between Yang-Mills (**1**, **2**, **4**, **5**, **6**, **7**) and phenomenological quarks (**u**, **d**, **s**, **c**, **b**, **t**)

Number of generation	1	2	3	4
Upper quarks	**u** **1**	**c** **5**	**t** **6**	? **8**
Lower quarks	**d** **2**	**s** **4**	**b** **7**	? **3**
Type of quarks	Ordinary quarks	Strange quarks		Special quarks

10 Two-current States (biflavored gluons and dions)

The state, in which two different octuplet currents exist at each time point in each point of some finite or infinite three-dimensional volume, will be named the two-current state. By this definition we exclude from consideration, for example, the proton that has a quark formula uud or, in YM-notations adopted here, the proton that has a compound current formula of the two currents $\mathbf{1}+\mathbf{2}$. Within the framework of the classical field theory, a proton is a compound state containing two currents, but it is not a two-current state. Classical proton should be considered as a non-stationary system of three interacting quasi-stationary one-current objects. Within the framework of the ***classical*** field theory, such system would probably have to lose energy in the form of gluon waves. Numerical investigation of such system would, of course, be a mathematical adventure, no less exciting than the three-body problem in celestial mechanics, but now we have to put up with the fact that such familiar objects of particle physics as baryons may not allow the adequate description within the classical theory. But other objects – gluons, quarks, pions ... – allow such description.

Two-current states have a common bracket formula of the form:

$$\langle a,\, b \,|\, a,\, b,\, c\rangle \text{ or } \langle a,\, b \,|\, a,\, b,\, c,\, d\rangle, \tag{38}$$

i.e. they contain two different currents and a triplet or quartuplet of potentials which form an octuplet subspace closed relative to the cross product (2), (3). A two-current state with YM-field triplet will be called the ordinary state, and the state with quartuplet of fields – the strange state.

Two-current states (38) can be divided into the wave states (the state with infinite current zone, which has no pomerium) and the discrete states (the states in which the current zone has an outer boundary of pomerium, common for the two currents). The most important of the discrete states are the stationary states. Stationary states are classical models of some of the particles.

Wave two-current states will be named biflavor gluons. Mathematical description of these waves is similar to the description of two-current waves of the triplet sector, presented in the previous article [2]. Perhaps, these waves are available in the gluon sea of baryon along with gluons and flavor gluons.

Stationary two-current states will be named dions. These objects can probably be interpreted as the classical models of some of the charged and neutral mesons (but not all mesons)[16].

While forming tables of dions, we will use the table of correspondence of currents and quarks (Table 2), and will assign to YM-quarks the standard quantities of electric charges of phenomenological quarks: $\pm{}^2/_3$ (upper quarks), and $\pm{}^1/_3$ (lower quarks). This "assignment" has no explanation within the framework of the classical one-sector theory, but it is convenient to classify dions.

Dions can be divided into two classes: the charged and neutral dions. Charged dions consist of a mixture of the upper current and lower anti-current (or vice versa). They correspond to the charged pions and other charged mesons. Neutral dions can be divided into two classes: the upper neutral dions and the lower neutral dions. The upper neutral dions consist of two different upper currents of the table of correspondence (Table 2), to be precise – of current and anticurrent. The lower neutral dions are formed by two different lower currents, to be precise – by current and anticurrent.

Table 3 demonstrates the bracket formulas of charged dions. For some dions, the real mesons, which hypothetically correspond to them, are indicated. Strange diones are marked with an asterisk (*). Perhaps, the ordinary and strange dions may have different physics.

There are 16 couples of charged dions with a charge ± 1. Dion with the current formula $\langle \mathbf{2},\, \mathbf{8}\,|\, \ldots \rangle$ is prohibited by the rules of octuplet algebra. Dion with current formula $\langle \mathbf{3},\, \mathbf{8}\,|\, \ldots \rangle$ has two variants of the allowed field shells. Charged dions exist in the form of doublets[17].

Dion's mass $\langle \mathbf{5},\, \mathbf{7}\,|\, \mathbf{2},\, \mathbf{5},\, \mathbf{7} \rangle$ is determined by the mass of quark b and can be estimated as ~ 7 GeV. Dions' masses $\langle \mathbf{2},\, \mathbf{6}\,|\, \mathbf{2},\, \mathbf{4},\, \mathbf{6} \rangle$, $\langle \mathbf{4},\, \mathbf{6}\,|\, \mathbf{2},\, \mathbf{4},\, \mathbf{6} \rangle$ and $\langle \mathbf{6},\, \mathbf{7}\,|\, \mathbf{3},\, \mathbf{6},\, \mathbf{7},\, \mathbf{8} \rangle$ are determined by the mass of quark t and can be estimated as 175 – 180 GeV. The author does not know whether there are such mesons, but we can hardly doubt their existence.

[16] Nevertheless, it is possible that dions, which, in accordance with (38), have a colored shell, are also unobservable in the free form, similarly to quarks. However, they have common current formulas with mesons.

[17] A wide-spread treatment of the family of pions as a triplet $\left(\pi^+,\, \pi^0,\, \pi^-\right)$ is incorrect within the framework of our classical models. A neutral pion is not a dion, it does not belong to the class of two-current systems within the definition which has been given above. A classical neutral pion should be treated as a non-stationary compound system.

Table 3 The table of charged dions

Lower currents / Upper currents	**1**	**5**	**6**	**8**
2	$\langle \mathbf{1,2}\vert\mathbf{1,2,3}\rangle$ $\pi^{\pm}$	$\langle \mathbf{2,5}\vert\mathbf{2,5,7}\rangle$ $D^{\pm}$	$\langle \mathbf{2,6}\vert\mathbf{2,4,6}\rangle$	—
4	$\langle \mathbf{1,4}\vert\mathbf{1,4,7}\rangle$ $K^{\pm}$	$\langle \mathbf{4,5}\vert\mathbf{3,4,5,8}\rangle^{*}$ $D_s^{\pm}$	$\langle \mathbf{4,6}\vert\mathbf{2,4,6}\rangle$	$\langle \mathbf{4,8}\vert\mathbf{3,4,5,\ 8}\rangle^{*}$
7	$\langle \mathbf{1,7}\vert\mathbf{1,4,7}\rangle$ $B^{\pm}$	$\langle \mathbf{5,7}\vert\mathbf{2,5,7}\rangle$	$\langle \mathbf{6,7}\vert\mathbf{3,6,7,8}\rangle^{*}$	$\langle \mathbf{7,8}\vert\mathbf{3,6,7,8}\rangle^{*}$
3	$\langle \mathbf{1,3}\vert\mathbf{1,\ 2,\ 3}\rangle$	$\langle \mathbf{3,5}\vert\mathbf{3,4,5,8}\rangle^{*}$	$\langle \mathbf{3,6}\vert\mathbf{3,6,7,8}\rangle^{*}$	$\langle \mathbf{3,8}\vert\mathbf{3,4,5,8}\rangle^{*}$ $\langle \mathbf{3,8}\vert\mathbf{3,6,7,8}\rangle^{*}$

Table 3 also includes more questionable objects – dions containing currents of the fourth generation. Since the quarks of the fourth generation have not been revealed, the masses of these dions are difficult to estimate with some reliability. Masses of the dions, which contain the lower current of the fourth generation, are estimated by the mass of the fourth lower quark and can be of 350 – 700 GeV. Masses of the dions, containing the upper current of the fourth generation may be 10 – 20 TeV. Detection of such massive mesons would be the evidence for existence of the fourth generation of quarks.

Tables 4 and 5 provide bracket formulas of the upper and lower neutral dions. For some dions, there are presented real mesons, hypothetically corresponding to them.

Table 4 The table of the upper neutral dions

Currents	**1**	**5**	**6**
5	$\langle \mathbf{1,5}\vert\mathbf{1,6,5}\rangle$ D^{0}		
6	$\langle \mathbf{1,6}\vert\mathbf{1,\ 6,\ 5}\rangle$	$\langle \mathbf{5,6}\vert\mathbf{1,6,\ 5}\rangle$	
8	—	$\langle \mathbf{5,8}\vert\mathbf{3,\ 4,\ 5,\ 8}\rangle^{*}$	$\langle \mathbf{6,8}\vert\mathbf{3,\ 6,\ 7,\ 8}\rangle^{*}$

Table 5 The table of the lower neutral dions

Currents	**2**	**4**	**7**
4	$\langle \mathbf{2}, \mathbf{4} \vert \mathbf{2}, \mathbf{4}, \mathbf{6} \rangle$ K_L^0		
7	$\langle \mathbf{2}, \mathbf{7} \vert \mathbf{2},\ \mathbf{5},\ \mathbf{7} \rangle$ B^0	$\langle \mathbf{4}, \mathbf{7} \vert \mathbf{1}, \mathbf{4},\ \mathbf{7} \rangle$ B_s^0	
3	$\langle \mathbf{2}, \mathbf{3} \vert \mathbf{1},\ \mathbf{2},\ \mathbf{3} \rangle$	$\langle \mathbf{3}, \mathbf{4} \vert \mathbf{3}, \mathbf{4},\ \mathbf{5},\ \mathbf{8} \rangle^*$	$\langle \mathbf{3}, \mathbf{7} \vert \mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8} \rangle^*$

There are five upper neutral dions (dion with the current formula $\langle \mathbf{1},\ \mathbf{8} \,\vert\, \ldots \rangle$ is prohibited by the rules of octuplet algebra). There are six lower neutral dions. Dion masses $\langle \mathbf{1},\ \mathbf{6} \,\vert\, \mathbf{1},\ \mathbf{6},\ \mathbf{5} \rangle$ and $\langle \mathbf{5},\ \mathbf{6} \,\vert\, \mathbf{1},\ \mathbf{6},\ \mathbf{5} \rangle$ are determined by quark t mass and can be 175 – 180 GeV.

The masses of the three lower neutral dions, containing current **3**, are determined by the mass of the undiscovered lower quark of the fourth generation and can be 350 – 700 GeV. The masses of the two upper neutral dions, containing current **8**, are determined by the mass of undiscovered upper quark and can be 10 – 20 TeV.

Objects, such as neutral pion or charmonium, should be treated as a non-stationary system of two interacting one-current particles, both of which have its own pomerium. The adequate numerical modeling of such systems within the framework of the classical field theory is hardly possible.

Each stationary dion, as well as any stationary particle with pomerium in any of the three branches of physics – is characterized not only by the bracket formula, but by a couple of integral numbers: pomerium connectivity and the number of inner current-free cavities. In other words, if a stationary two-current problem has a spectrum of solutions with different boundary topology[18], each dion, besides its basic state, can have such "topologically excited states", which exceed the masses of the known mesons by 2-3 orders.

11 Three-current States (triflavored gluons and trions)

The state, in which three different currents coexist at each time point in each point of some finite or infinite three-dimensional volume, will be named the three-current state. Three-current states have a bracket formula of the form

$$\langle a,\, b,\, c \,\vert\, a,\, b,\, c \rangle \text{ or } \langle a,\, b,\, c \,\vert\, a,\, b,\, c,\, d \rangle. \tag{39}$$

Potentials of the three-current state (39) must form a subspace of the eight-dimensional YM-space that is closed under the eight-dimensional cross product.

[18] And if this problem in general has a solution, it should be added by the "Tridentine circumspection rule".

Wave three-current states will be named the triflavored gluons. Stationary three-current states with common outer boundary (pomerium) for all three currents will be named trions[19].

Trions is a family of fermions with charges 0; ±1; ±2. Each member of the family is a doublet of particle and antiparticle. Both members of the doublet have the same bracket formula, but they differ in inessential for bracket formula signs of all three currents. For charged trions it means the opposite signs of the electric charge of the particle and antiparticle. In the doublets of neutral trions, the particles and antiparticles coincide.

Neutral trions have one upper and two lower currents in the current formula. Trions with charge ±1 have two upper currents and one lower current in the current formula. Existence of trions with three lower quarks is prohibited by the rules of octuplet algebra (in any case, if we use table 2 to establish the correspondence between Yang-Mills and the phenomenological quarks). Trions with charge ±2 are formed by three upper currents.

Altogether, the rules of octuplet vector algebra allow the existence of thirteen trion doublets. If we roughly estimate the masses of trions by the masses of quarks corresponding to the trion currents, trions can be divided into the lightest, the massive and supermassive ones.

The two lightest trions are neutral. They have bracket formulas of the form $\langle \mathbf{1}, \mathbf{4}, \mathbf{7} | \mathbf{1}, \mathbf{4}, \mathbf{7} \rangle$ (with the mass of about 5 GeV) and $\langle \mathbf{2}, \mathbf{5}, \mathbf{7} | \mathbf{2}, \mathbf{5}, \mathbf{7} \rangle$ (with the mass of about 7 GeV). We do not know how it could be possible to distinguish these trions from strange hyperons which have the same current composition – usb and dcb, respectively. Baryons (from the classical point of view) are rather friable formations, in which the compact one-current particles, quarks, having dimensions of the order of fundamental length $r_0 \propto 10^{-26}$ cm [2], swim in the huge gluon sea with a typical dimension of $\propto 10^{-13}$ cm. But trions have to be[20] the compact objects with dimension of the order r_0.

However, we do not have any dynamical theory, which would be able to predict how this structural distinction affects the lifetime and decay schemes.

There are five average mass trions (in the range of hundreds of GeV). For two of them, which do not contain "questionable" currents of the fourth generation, mass can be predicted with some certainty. This mass is determined by the mass of quark t, and can be estimated as 175 – 180 GeV. This is a neutral trion with bracket formula $\langle \mathbf{2}, \mathbf{4}, \mathbf{6} | \mathbf{2}, \mathbf{4}, \mathbf{6} \rangle$ and a trion doublet with charge ±2 which has bracket formula $\langle \mathbf{1}, \mathbf{5}, \mathbf{6} | \mathbf{1}, \mathbf{5}, \mathbf{6} \rangle$. A charged trion may be somewhat more massive than a neutral trion.

The lower current of the fourth generation **3** contains three more neutral average mass trions. Their masses may belong to the range of 200 – 700 GeV. They are the trions with bracket formulas $\langle \mathbf{1}, \mathbf{2}, \mathbf{3} | \mathbf{1}, \mathbf{2}, \mathbf{3} \rangle$, $\langle \mathbf{3}, \mathbf{4}, \mathbf{5} | \mathbf{3}, \mathbf{4}, \mathbf{5}, \mathbf{8} \rangle$ and $\langle \mathbf{3}, \mathbf{6}, \mathbf{7} | \mathbf{3}, \mathbf{6}, \mathbf{7}, \mathbf{8} \rangle$. Octuplet alge-

[19] We can not assert that trions exist. To make such assertion we must have the theorem of existence of the solution to some boundary-value problem in a zone with unknown boundaries for the system of equations in partial derivatives, describing the trion structure. (This system includes Yang-Mills' octuplet equations and Einstein's gravity equations). We do not have such theorem of existence. We are just considering such three-current states, the existence of which is ***not prohibited*** by the rules of octuplet vector algebra. This notice concerns all stationary states in all sectors of the theory.

[20] If they exist.

bra also allows the existence of such trions, which current formula includes the upper current of the fourth generation **8**. They are probably the supermassive objects with a mass of 10 – 20 TeV. Two of them are neutral: $\langle \mathbf{3}, \mathbf{4}, \mathbf{8} | \mathbf{3}, \mathbf{4}, \mathbf{5}, \mathbf{8} \rangle$ and $\langle \mathbf{3}, \mathbf{6}, \mathbf{8} | \mathbf{3}, \mathbf{6}, \mathbf{7}, \mathbf{8} \rangle$. Four of these super-massive trions have the charge ± 1: $\langle \mathbf{4}, \mathbf{5}, \mathbf{8} | \mathbf{3}, \mathbf{4}, \mathbf{5}, \mathbf{8} \rangle$, $\langle \mathbf{6}, \mathbf{7}, \mathbf{8} | \mathbf{3}, \mathbf{6}, \mathbf{7}, \mathbf{8} \rangle$, $\langle \mathbf{3}, \mathbf{6}, \mathbf{8} | \mathbf{3}, \mathbf{6}, \mathbf{7}, \mathbf{8} \rangle$ and $\langle \mathbf{3},\ \mathbf{5},\ \mathbf{8}\,|\,\mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8} \rangle$.

All of the "allowed" trions can be depicted on the "trion chessboard" (Fig. 1). The field numbers on this board vertically and horizontally correspond to YM-numbers of the two currents entering into the three-current formula of a trion: the numbers in the cells correspond to YM-number of the third current. Each state is represented only once, above the diagonal directed from the left bottom corner to the right top corner.

It should be noted that the current list of each trion state is determined only by the rules of octuplet algebra. The assignment of masses and charges to trions is based not only on the rules of octuplet algebra, but also on the table of correspondence of currents and quarks (Table 2) and, therefore, contains an element of arbitrariness.

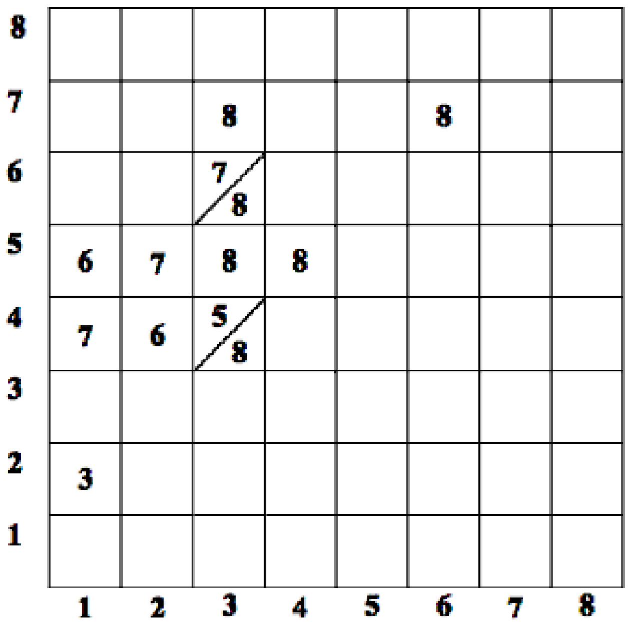

Fig. 1 Trion currents chessboard

12 Four-current States (tetraflavored gluons and tetrons)

The state, in which four different currents coexist at each time point in each point of some finite or infinite three-dimensional volume, will be named the four-current state. In accordance with (33), only two bracket formulas of the four-current states are algebraically allowed:

$$\langle \mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8}\,|\,\mathbf{3},\ \mathbf{4},\ \mathbf{5},\ \mathbf{8} \rangle \text{ and } \langle \mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8}\,|\,\mathbf{3},\ \mathbf{6},\ \mathbf{7},\ \mathbf{8} \rangle. \quad (40)$$

States (40) can exist in the form of the waves which will be named tetraflavored states and as stationary states, which will be named ***tetrons***.
Tetrons[21] are bosons, which mass is determined by the properties of current **8** and can make 10-20 TeV. Each of the two bracket formulas (40) corresponds to one charged doublet particle / antiparticle with the charge ±2 and two different doublets of neutral particles in which the particle is the same as the antiparticle.

13 Total Eight-current State (octoflavored gluons and octons)

The state, in which all eight octuplet currents coexist at each time point in each point of some finite or infinite three-dimensional volume, will be named the compound eight-current state. Bracket formula of this state has the following form:

$$\langle \mathbf{1},\, \mathbf{2},\, \mathbf{3},\, \mathbf{4},\, \mathbf{5},\, \mathbf{6},\, \mathbf{7},\, \mathbf{8} \,|\, \mathbf{1},\, \mathbf{2},\, \mathbf{3},\, \mathbf{4},\, \mathbf{5},\, \mathbf{6},\, \mathbf{7},\, \mathbf{8} \rangle. \tag{41}$$

The wave form of the state (41) will be named the octoflavored gluon. Any stationary state (41) with a single pomerium, common for all currents, will be called ***octon***. Octons[22] form a large family of super-massive bosons with the mass determined by current **8** (10 – 20 TeV). Due to the same current formula, all members of this family can have almost the same masses.
Considering all the possible combinations of quark charges, corresponding to each current, and separating from them those that provide integral total charge of the octon, we can find that amongst octons there is one doublet particle / antiparticle with the charge ±4, 16 different doublets with the charge ±2, and 22 different doublets of neutral particles[23].
One-current systems with fractional charge can form dions with integral charge. If we assume by analogy that octons with the "wrong" combination of currents, creating a fractional charge, may be combined into double octuplets (dioctons) with integral charge, the number of such dioctons can also be measured in many dozens.
Therefore, if energy of the accelerators ever falls into the area of dozens of TeV, the experimenters can expect a breakthrough in physics of the fourth generation of quarks, which abounds with many particles.
It is appropriate to bring together all the cited and implied reservations: "if this fourth generation exists", "if current couplings and constraints do not prevent the occurrence of these massive particles", and finally, if these stationary states exist – at least as mathematical objects of the classical theory of the octuplet field with continuum currents.

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[21] If they exist.
[22] If they exist.
[23] In these calculations the fact of invariability of the charge sign for current **3** is ignored, i.e. the fact of missing of antiparticle for quark **3** (see p.6). If this is taken into account, the number of possible octons, tetrons, trions and dions decreases (for some particles, antiparticles vanish).

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