ON CONSTRUCTION METHODS OF THE STRONG GRAVITATION THEORY

Valery Koryukin

vmkoryukin@gmail.com

1.

The question: can be describe strong interaction particles with the use of the Einstein gravitational theory?

Answer: no.   **The question**: why?

Answer: The Riemannian space of the Einstein gravitational theory does not have the torsion $S_{ij}^{k} = \Gamma_{ij}^{k} - \Gamma_{ji}^{k}$ of the connection $\Gamma_{ij}^{k}(x)$. The torsion must describe the coherent states of strong interaction particles.

The question: can be use the Lie local groups for the description of strong interaction particles?

Answer: no.   **The question**: why?

Answer: The instability of strong interaction particles can be characterize only the Lie local loops for which is absent the associative property.

The principle of the theoretical notions adequacy to experimental data must be put in the base of the serious physical theory. It is precisely therefore we attach the fundamental importance to symmetries which's reflecting the matter properties in the condensed (pithy) form. For this in the elementary particle physics is used the scattering matrix which allows to guess a form of transition operators if only for linear approximation. Because we must forecast results of future experiments, the description of physical systems states will proceeds by use of smooth functions, which it is desirable to obtain as solutions of differential equations. It is precisely therefore we shall approximate the transition operators by differential operators using the variation formalism. We note that the presence of the Universe neutrino background with the finite Fermi energy ε_F is the catalytic agent of stochastic processes, but the large value of this energy causes to the determinancy of physical processes. Specifically we connect the large value of the Fermi energy and the low temperature of the Universe neutrino background with the stability (or if only with the metastability) of elementary particles.

In the degenerate state background fermions of Universe, generating Fermi and Bose liquids, are weakly-interacting particles, but it is not excluded by the interaction with hadrons their exhibition as color fermions – ghosts. We do not exclude also the possibility, that in the state of the Fermi liquid they must be considered as right neutrinos and left antineutrinos with the sufficiently high Fermi energy ε_F ("sterile" neutrinos and "sterile" antineutrinos [1];

$$\varepsilon_F = \sqrt[3]{\frac{6\pi^2}{2S+1} \cdot \frac{N}{V}} \, ,$$

S is the spin of particles, N/V is their density; we shall use the system of units $h/(2\pi) = c = 1$, where h is the Planck constant and c is the velocity of light). It must be exhibited in the absence of these particles by decays attributed to weak interactions of low energies (a mirror asymmetry). Note, that the transition to the classical physics proceeds by use of $N \to \infty$ or $\varepsilon_F \to \infty$.

Thus for example, it can be interpreted a lepton production upon a charged pion decay as a freezing-out of color degrees of freedom what is expressed in the form of the spontaneous breaking of the $SU(3)$ symmetry characterizing the interaction of color quarks to the $SU(2) \times U(1)$ symmetry characterizing the electroweak interactions of leptons.

$$(U(n) = \left\{ T \in M_n(C) \,|\, T^+ \cdot T = T \cdot T^+ = E \right\}, \qquad SU(n) = \left\{ T \in U(n) \,|\, \det T = 1 \right\},$$

the top index "+" is the symbol of the Hermitian conjugation).

2. Let the action has the form as the following integral

$$A = \int_{\Omega_n} \Lambda \, d_n V = \int_{\Omega_n} \kappa \overline{X}(\Psi) \rho X(\Psi) d_n V. \qquad (1)$$

(we shall name Λ as a Lagrangian also as in the field theory). Here and further κ is a constant; $\rho = \rho(x)$ is the density matrix (tr $\rho = 1$, $\rho^+ = \rho$) and the bar means the generalized Dirac conjugation which must coincide with the standard one in particular case that is to be the superposition of Hermitian conjugation and the spatial inversion of the space-time M_4. We shall name solutions $\Psi(x)$ of differential equations, which are being produced by the requirement of the minimality of the integral (1), as the maximum plausible realizations of Lie local loops [2] and we shall use for the construction of the all set of functions $\{\Psi(x)\}$ (generated by the help of the transition operators).

Let E_{n+N} is the vector fiber space with the base M_n and the projection π_N, $\Psi(x)$ is the arbitrary section of fibre bundle E_{n+N}, ∂_i is the partial derivative symbol. Let us to consider the infinitesimal substitutions defining the vector space mapping of the neighbour points x and $x + \delta x$ ($x \in U$, $x + \delta x \in U$, $U \subset M_n$) and conserving the possible linear dependence between vectors. We demand that the action A was the invariant one with respect to the infinitesimal substitutions

$$x^i \to x^i + \delta x^i = x^i + \delta \omega^a(x) \xi_a^i(x), \tag{2}$$

$$\Psi^A(x) \to \Psi^A(x) + \delta \omega^a(x) T_{aB}^A(x) \Psi^B(x), \tag{3}$$

of the local Lie loop $G_r(x)$ conserving the type of geometrical objects.

By this the components $C_{ab}{}^c(x)$, alternating on down indices of the structural tensor, must satisfy to the generalized Jacobi identities [3]

$$C_{[ab}^d C_{c]d}^e - \xi_{[a}^i \nabla_{|i|} C_{bc]}^e + \xi_{[a}^i \xi_b^j R_{|ij|c}{}^e = 0 \qquad (4)$$

($R_{ijc}{}^e(x)$ are the curvature tensor components of the connection $\Gamma_{ia}^b(x)$;. here and further x^i are the co-ordinates of the point x; $x^i + \delta x^i$ are the co-ordinates of the point $x + \delta x$; $\Psi^A(x)$ are the components of the vector field $\Psi(x)$; $\delta\omega^a(x)$ are the components of the infinitesimal vector field $\delta\omega(x)$ being the section of the vector fibre bundle E_{n+r} with the base M_n and with the projection π_r; Latin indices a, b, c, d, e will run the values of integers from 1 to r; Latin indices $i, j, k, ...$ will run the values of integers from 1 to n; Latin capital indices A, B, C, D, E will run the values of integers from 1 to N).

That the appearance of stringent restrictions can be excluded on a Lagrangian we introduce its dependence on additional fields $B(x)$, the changes of which's contain the covariant derivatives of infinitesimal parameters $\nabla_i \delta\omega^a(x)$, in consequence of this they are named as gauge fields. Let

$$BB^+ = \rho\,\mathrm{tr}\left(BB^+\right) \tag{5}$$

in the Lagrangian (1). Further fields $\Psi(x)$ we shall name as prime ones. We denote the components of the gauge fields $B(x)$ as: $B_a^c(x)$. Probably the rank of the density matrix ρ equals n, but it is impossible to eliminate that the given equality is satisfied only approximately when some components of a density matrix can be neglected.

In any case we shall consider that among fields B_a^b the mixtures Π_a^i were formed with non-zero vacuum means h_a^i which determine differentiable vector fields $\xi_a^i(x)$ for considered domain Ω_n as:

$$\Pi_a^i = B_a^b \, \xi_b^i \tag{6}$$

(spontaneous breaking of symmetry, fields $\xi_a^i(x)$ determine a differential of a projection $d\pi$ from $\Omega_r \subset M_r$ in $\Omega_n \subset M_n$). It allows defining a Riemannian space M_n°, the basic tensor $g_{ij}(x)$ of which we shall introduce through a reduced density matrix $\rho'(x)$ [3]. As a result it can be "to hide" a part of fields by a non-trivial geometrical structure. So let components ρ_i^j of a reduced density matrix $\rho'(x)$ are determined by the way:

$$\rho_i^j = \xi^{+a}{}_i \, \rho_a^b \, \xi_b^j \Big/ \left(\xi^{+c}{}_k \, \rho_c^d \, \xi_d^k \right) = \Pi^{+a}{}_i \, \Pi_a^j \Big/ \left(\Pi^{+b}{}_k \, \Pi_b^k \right). \tag{7}$$

Let us note the integral (1) in the following manner

$$A_t = \int\limits_{\Omega_n} \Lambda_t d_n V = \int\limits_{\Omega_n} [\Lambda_\circ + \Lambda_1(\Psi) + \Lambda_2(B)] d_n V \ , \tag{8}$$

where $\Lambda_\circ$ is the constant which is connected with the normalization and

$$\Lambda_1 = \kappa \overline{X^b}(\Psi) \rho_b^a X_a(\Psi) = \kappa \overline{D^a \Psi} D_a \Psi \Big/ \left(B^{+c}_{\ \ b} B^b_c \right), \tag{9}$$

$$D_a \Psi = -B_a^c X_c(\Psi) = B_a^c \left(\xi_c^i \nabla_i \Psi - L_c \Psi \right). \tag{10}$$

Since the action (8) must be invariant by infinitesimal substitutions of the Lie local loop G_r, then the Lagrangian $\Lambda_2(B)$ must depend on the gauge [4] (boson) fields $B(x)$ by intensities $F_{ab}^c(B)$, having the form

$$F_{ab}^c = \Theta_d^c\left(\Pi_a^i\nabla_iB_b^d - \Pi_b^i\nabla_iB_a^d + \Xi_{ab}^d\right),$$

(11)

where

$$\Theta_b^c = \delta_b^c - \xi_b^i\Pi_i^a\left(B_a^c - \beta_a^c\right), \qquad \Xi_{ab}^e = B_d^e\left(B_a^cL_{cb}^d - B_b^cL_{ca}^d\right) - B_a^cB_b^dC_{cd}^e.$$

(12)

Hereinafter a selection of fields Π_i^a and β_c^a are limited by the relations:

$$\Pi_j^a\Pi_a^i = \delta_j^i, \qquad \beta_c^a\xi_a^i = h_c^i.$$

(13)

3. Further it is convenient to use the following Lagrangian:

$$\Lambda_2 = \frac{\kappa'_\circ}{4} F^c_{ab} F^d_{ge} \left[t^{ag} \left(s^e_c s^b_d - \upsilon s^b_c s^e_d \right) + t^{be} \left(s^a_d s^g_c - \upsilon s^a_c s^g_d \right) + u_{cd} \left(t^{ag} t^{be} - \upsilon t^{ab} t^{ge} \right) \right], \quad (14)$$

($\kappa'_\circ$, υ are constants) [4]. If $s^b_a = \delta^b_a$, $t^{ab} = \eta^{ab}$, $u_{ab} = \eta_{ab}$ (η_{ab} are metric tensor components of the flat space and η^{ab} are tensor components of a converse to basic one) then the given Lagrangian is most suitable one at the description of the symmetry matter (all matter states are equally likely), because it is most symmetrical one concerning intensities of the gauge fields F^c_{ab}. What is more we shall require the realization of the correlations:

$$L^a_{cd} \eta^{db} + L^b_{cd} \eta^{da} = 0, \quad (15)$$

that the transition operators L^b_{ac} generate the symmetry which follows from the made assumptions.

The transition to the stage of the matter evolution of the observable region of the space for which one it is possible to suspect that the presence of cluster states of weakly interacting particles will be expressed in following formula for tensors s_a^b, t^{ab}, u_{ab} and h_i^a:

$$s_a^b = s\,\xi_a^i h_i^b + \xi_a^{\underline{c}}\varepsilon_{\underline{c}}^b, \quad t^{ab} = t\,\varepsilon_{(l)}^a \varepsilon_{(k)}^b \eta^{(l)(k)} + \varepsilon_{\underline{c}}^a \varepsilon_{\underline{d}}^b \eta^{\underline{cd}}, \quad u_{ab} = u\,\xi_a^i \xi_b^j h_i^c h_j^d \eta_{cd} + \xi_a^{\underline{c}}\xi_b^{\underline{d}}\eta_{\underline{cd}},$$

$$h_i^a = h_i^{(k)}\varepsilon_{(k)}^a. \tag{16}$$

$((i),(j),(k),(l),... = 1,2,...,n; \underline{a},\underline{b},\underline{c},\underline{d},\underline{e} = n+1, n+2,...,n+\underline{r}; \ \underline{r}/r \ll 1)$, where fields $h_i^{(j)}(x)$, taking into account the relations (16), are determined uniquely from equations: $h_k^a h_a^i = \delta_k^i$. Similarly tensors $\eta^{(i)(j)}$, $\eta^{\underline{ab}}$ are determined from equations: $\eta^{(i)(k)}\eta_{(j)(k)} = \delta_{(j)}^{(i)}$, $\eta^{\underline{ab}}\eta_{\underline{cb}} = \delta_{\underline{c}}^{\underline{a}}$, while tensors $\eta_{(i)(j)}$, $\eta_{\underline{ab}}$ are determined as follows: $\eta_{(i)(k)} = \eta_{ab}\,\varepsilon_{(i)}^a \varepsilon_{(k)}^b$, $\eta_{\underline{ab}} = \eta_{cd}\,\varepsilon_{\underline{a}}^c \varepsilon_{\underline{b}}^d$.

We shall connect constants $\varepsilon^a_{(i)}$, $\varepsilon^a_{\underline{b}}$ with a selection of the gauge fields $\Pi^a_i(x)$ recording them by in the form

$$\Pi^a_i = \varepsilon^a_{(k)}\Phi^{(k)}_i + \varepsilon^a_{\underline{b}}P^{\underline{b}}_i \qquad (17)$$

and let $\varepsilon^a_{\underline{b}} = 0$. Besides we shall apply the decomposition of fields $B^a_b(x)$ in the form

$$B^a_c = \zeta^a_i\Pi^i_c + \zeta^a_{\underline{b}}A^{\underline{b}}_c \ , \qquad (18)$$

where

$$A^{\underline{b}}_c = \xi^{\underline{b}}_a B^a_c \ .$$

Note that we decompose the physical system described by fields $B_b^a(x)$ on two subsystems. One of them described by fields $\Pi_a^i(x)$, will play the role of the slow subsystem. In addition components of intermediate tensor fields $\xi_a^i(x)$, $\xi_{\underline{a}}^b(x)$, $\zeta_i^a(x)$, $\zeta_{\underline{b}}^a(x)$ should be connected by the relations: $\zeta_i^a \xi_a^j = \delta_i^j$, $\zeta_i^a \xi_{\underline{a}}^b = 0$, $\zeta_{\underline{b}}^a \xi_a^j = 0$, $\zeta_{\underline{b}}^a \xi_{\underline{a}}^c = \delta_{\underline{b}}^c$. So, considering the indistinguishability of physical states of weakly interacting particles we shall use the reduced set of fields $\left\{\Pi_c^i(x), A_c^b(x)\right\}$ instead of the full set $\left\{B_c^a(x)\right\}$.

Of course, taking into account the absence of a bijection between the real world and the mathematical one, we can construction the maximum plausible physical theory only. It allows using an elemental description, if only for a local domain.

We shall use that smooth manifolds are locally diffeomorphic ones to the Euclidean space or to the pseudo-Euclidean space in a certain neighborhood of any point. Therefore we shall choose the connection components $\Gamma_{ia}^{\ b}(x)$ equal to zero in the region under consideration. Since stable states or metastable states are characterized the specific symmetries, then giving the parameter dependence of structural tensor components C_{ab}^{c}, we can describe decay processes of elementary particles if only approximately. Specifically, we shall consider that the process of the spontaneous symmetry breaking is characterized the quasi-group structure (we take account of the presence of the Universe neutrino background which is the catalytic agent of stochastic processes, including decays of elementary particles). In consequence of this it is logically connect the stability of differential equations (4) solutions with the stability of elementary particles. As a result functions $C_{ab}^{c}(x)$ must describe the process of spontaneous breaking of symmetry at hadrons decay.

If the Lie local loop $Q_r(x)$ operates in the space of the affine connection as transitively so and effectively ($n = r$), then it can choose the components ξ_a^k of the intermediate tensor field equaled to the Kronecker symbols δ_a^k in a neighborhood of a point ω. As a result we must test the solution stability of differential equations

$$C_{[ab}^d C_{c]d}^e - \partial_{[a} C_{bc]}^e = 0 \tag{19}$$

Specifically, when $n = r = 8$, it allows to do not increase the count of gauge fields beyond 8 as in the grand unified theory. Thereby we consider that gluons are present in the space domain where intermediate vector bosons are absent and on the contrary intermediate vector bosons are present in the space domain where gluons are absent.

Note that in more general cases, when the connection components $\Gamma_{ia}^{\ b}(x)$ are not equal to zero and the Lie local loop $G_r(x)$ operates in the space of the affine connection as transitively so and effectively, then the correlations (4) become in the Ricci identity ($C_{ab}^c = 2S_{ab}^c$). Because the symmetry, characterizing the physical system, is selected in terms of experimental data, the geometrical structure is only the maximum plausible one. Hence it follows that it is desirable to use the spaces of the affine connection with the torsion for the description of particles. What is more precisely the torsion must depend on a rest mass of a particle.

The assumption on the "sea" of quarks in the ground state allows using the Landau theory of the Fermi liquid considering observable particles as quasi-particles on the background of "sterile" neutrinos and "sterile" antineutrinos. The properties of the latter's must define the geometrical and topological properties of the space-time M_n. We note that the transition to the description of the slow subsystem with the help of the space-time manifold is carried when the Fermi energy ε_F of "sterile" neutrinos tends to infinity. In this case the quotation-marks in the words "sterile" neutrinos can be discarded, because these neutrinos will not collide with the other particles even at very high energies of the latter.

4. At present veritable elementary observable particles are considered charged leptons. Besides stable leptons are only electrons and positrons. We shell consider them excited states of "sterile" neutrinos and antineutrinos, which's are in the ground state under the temperature $T_{\circ}$ (the temperature of the cosmic microwave background may be its estimation) and the Fermi energy ε_F (the open resonance (126 GeV) at LHC may be its estimation) in the boundary layer of Fermi sphere. The stability condition for the electron is written as

$$3\alpha T_{\circ}\, \varepsilon_F^2 \approx m_e^3 \qquad (20)$$

($m_e \approx 0.5 \cdot 10^{-3}\ GeV$ is the electron mass, α is fine structure constant;). Here we took into account the Lie algebra dimension of Lie group $SU(2)$, which characterizes the properties of the lepton interior space, and also the equality of the pressure and the temperature for the electron and "sterile" neutrinos.

The crude estimation shows ($\alpha \sim 10^{-2}$, $T_\circ \sim 10^{-13} \, GeV$, $\varepsilon_F \sim 10^2 \, GeV$), that the relationship (20) is satisfied. For arbitrary charged leptons the relationship (20) need be rewritten in the form:

$$3\alpha T_\circ \, \varepsilon_F^2 \leq m_l^3 \qquad (21)$$

(m_l is the lepton mass). If we shell consider hadrons, then it need take into account, that the properties of their interior space (in specifically, for the stable proton ($m \approx 1 \, GeV$)) are characterized by group $SU(3)$ (the space dimension n is equal to 8). As a result the stability condition (20) for the proton is rewritten in the form:

$$8\alpha T_\circ \, \varepsilon_F^7 \approx m_p^8 . \qquad (22)$$

What is more, considering so named "black holes" as hadrons with the large baryon number [5], we can use the relationship (22) as the stability condition of theirs. By this it is inexpediently the study of the gravitation ignoring the torsion of the space M_n.

5. We suggested considering "black holes" as hadrons with very large baryonic charges [5]. It allows simulating similar objects in laboratory conditions (at high energy accelerators). Naturally, that we connect the use necessity of the quantum chromodynamics in the cosmology with the chance of the processes explanation which's go in quasars and nuclei of Seyfert galaxies with the very large energy release. The Einstein theory cannot apply for this as in it the substantial object – the space-time torsion is absent by the gravitation geometrization (the space-time torsion is the locally diffeomorphic one to the corresponding structural tensor field of the Lie local loop characterizing the symmetry of the quantum system). What is more, in the Hawking process of the "black holes" quantum evaporation is violated the conservation low of the baryonic charge, accumulated the massive collapsing star. If we shall apply this process for the description to two-photon decay of pseudo-scalar neutral mesons (this low takes place), then we receive a discrepancy with experimental data (instead the increase of the particles lifetime it is reducing with the growth of their masses).

6. References

[1] V.M. Koryukin, *The confinement and the dark matter of the Universe*, in proceedings of *the XIX International Baldin Seminar on High Energy Physics Problems: Relativistic Nuclear Physics and Quantum Chromodynamics*, JINR, Dubna 2008, V. 1, XVI, p. 61.

[2] A.I. Mal'tsev, *Analiticheskie lupy*, *Matematicheskij sbornik*, **36** [3] (1955) 569.

[3] V. Koryukin, *Gravitational Fields and Early Universe*, in proceedins of *the XXIV Workshop on High Energy Physics and Field Theory: Fundamental Problems of High Energy Physics and Field Theory*, Editor V.A. Petrov, State Research Center of Russia, Institute for High Energy Physics, Protvino 2001, p. 157.

[4] V. Koryukin. *In Proceedings of the XXV international workshop on the fundamental problems of high energy physics and field theory "Geometrical and Topological Ideas in Modern Physics"* (Ed. V A Petrov) (Protvino: IHEP, 2002). p. 56.

[5] V.M. Koryukin. Proceedings of International Scientific Meeting "Physical Interpretations of Relativity Theory - 2013" (PIRT-2013) (Moscow, BMSTU, 1 – 4 July 2013). Edited by M.C. Duffy, V.O. Gladyshev, A.N. Morozov, P. Rowlands. Moscow: BMSTU, 2013. P. 163-169.

Thank you for your attention