Gravitational Fields and Early Universe

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There is the prevailing opinion in the theoretical physics, that gravitational interactions can be neglected on the microscopic level. In consequence of this gravitational fields are not being enlisted for the description of the interaction of elemental particles. We shall consider that even in the case if it can neglect the gradients of the gravitational fields on account of their possible homogeneity but this fields it is not allowed to neglect in consequence of quantum effects what is showed in the presence of the spins and the masses of elemental particles. Extending the concepts of A.A. Logunov [1] we shall consider that the Riemannian space–time M_n is the effective one, postulating the metric tensor on the base of the reduced density matrix ρ' of the gravitational fields $\Phi(x)$. We shall define those mixtures $\Phi(x)$ of the gauge fields $B(x)$ which have the non-zero vacuum averages as the gravitational fields even if the space–time M_n is not the Riemannian manifold. Besides we shall consider that the dimensionality n of the space–time is the rank of the density matrix ρ of the gauge fields $B(x)$ in the ground (vacuum) state, assuming that General Relativity are the condensed description of the gravitational phenomena.

1. The gauge fields

Let's assume that the physical fields must be described by not one field $\Psi(x)$ being the cross sections of the vector fiber bundle E_{n+N} with the base M_n (a point $x \in M_n$, M_n is the Riemannian differentiable manifold), but by the class of the equivalence $\{\Psi(x)\}$ in which the relation of the equivalence is determined by the infinitesimal transformations having the form:

$$\Psi \to \Psi + \delta\Psi = \Psi + \delta\omega^a \; T_a \Psi, \tag{1.1}$$

where $a, b, c, d, e = 1, 2, ..., r$; $\delta\omega^a(x)$ are infinitesimal parameters; $T_a(x)$ are $N \times N$ matrices depending on charges of particles being quanta of fields $\Psi(x)$. Using of approximate symmetries by a description of interactions made it possible to unite non-degenerate fields (in a general case) in multiplets or in supermultiplets, in consequence of what a number N (in an abstract theory) is not concretized.

Since it is impossible to be fully confident that there is a strict border between internal symmetries and external ones, then it is necessary to consider both transformations of fields $\Psi(x)$ and transformations of points x in the form:

$$x^i \to x^i + \delta x^i = x^i + \delta\omega^a \; \xi^i_a(x), \tag{1.2}$$

(x^i are coordinates of a point $x \in M_n$; $i, j, k, l, ... = 1, 2, ..., n$). In consequence of this it might be worthwhile to resolve $\delta\Psi$ into summands as follows

$$\delta\Psi = \delta_0\Psi + \delta\omega^a \; \xi^i_a \; \partial_i\Psi \tag{1.3}$$

($\partial_i \Psi$ are the partial derivatives of fields $\Psi(x)$), selecting the changes $\delta_\circ \Psi$ of fields $\Psi(x)$ in the point x. Writing down $\delta_0 \Psi$ as

$$\delta_0 \Psi = \delta\omega^a \; X_a(\Psi) = \delta\omega^a \; (T_a \Psi - \xi^i_a \; \partial_i \Psi), \tag{1.4}$$

we shall regard $X_a(\Psi)$ the generators of the Lie local loop $G_r(x)$ [2] (we refuse the associativity property which is inherent to the Lie local groups). Precisely the structure of the Lie local loop will characterize the degree of the coherence considered by us the quantum system. By this the maximal degree is being reached for the Lie simple group and the minimal degree is being reached for the Abelian one. In the last case we shall have the not coherent mixture of the wave-functions, it's unlikely which can describe the unspreading wave packet that is being confirmed by the absence of the fundamental scalar particles, if hipothetical particles are not being taken into account (in experiments only the mesons, composed from the quarks, are being observed and which are not being considered the fundamental one). Note that the "soft" structure of the Lie local loop by contrast to the Lie group allow to use it by the description of the symmetry both the phase transition (there is the time dependence) and the compact objects (there is the space dependence) especially. Here and further the geometrical objects $T_a(x)$ and $\xi^i_a(x)$ satisfy to the following relations:

$$\xi^i_a \; \partial_i \xi^k_b - \xi^i_b \; \partial_i \xi^k_a = -C^c_{ab} \; \xi^k_c, \tag{1.5}$$

$$T_a T_b - T_b T_a - \xi^i_a \; \partial_i T_a + \xi^i_b \; \partial_i T_a = C^c_{ab} \; T_c. \tag{1.6}$$

The components $C^c_{ab}(x)$ of the structural tensor field of the Lie local loop $G_r(x)$ must satisfy to the identities:

$$C^c_{ab} + C^c_{ba} = 0, \quad C^d_{[ab} \; C^e_{c]d} + \xi^i_{[a} \; \partial_{|i|} C^e_{bc]} = 0. \tag{1.7}$$

We construct the differentiable manifold M_n, not interpreting it by physically. Of course we would like to consider the manifold M_n as the space-time M_4. At the same time it is impossible to take into account the possibility of the phase transition of a system as a result of which it can expect the appearance of the coherent states. In consequence of this it is convenient do not fix the dimensionality of the manifold M_n. It can consider that the macroscopic system reach the precisely such state by the collapse. As a result we have the classical analog of the coherent state of the quantum system. Besides there is the enough developed apparatus — the dimensional regularization using the spaces with the changing dimensionality and representing if only on the microscopic level.

Consider the following integral

$$\mathcal{A} = \int\limits_{\Omega_n} \mathcal{L} d_n V = \int\limits_{\Omega_n} \kappa \overline{X^b}(\Psi) \rho^a_b X_a(\Psi) d_n V, \tag{1.8}$$

being the analogue of the fields $\Psi(x)$ variance in the domain Ω_n at issue, which we shall call the action, and $\mathcal{L}$ we shall call the Lagrangian. Here and further $\rho^b_a(x)$ are the components of the density matrix $\rho(x)$ and the bar means the Dirac conjugation which is the superposition of the Hermitian conjugation and the space inversion. Solutions $\Psi(x)$ (and even one solution) of equations, which are being produced by the requirement of the minimality of the integral (1.8) can be used for the constraction of the all set of the functions $\{\Psi(x)\}$ (generated by the transition operator), describing the wave packet.

Of course for this purpose we can use the analog of the largest plausibility method employed in the mathematical statistics. Note that according to the Feynman's hypothesis the probability amplitude of the system transition from the state $\Psi(x)$ in the state $\Psi'(x')$ equal to the following integral

$$\int\limits_{\Omega(\Psi,\Psi')} \exp{(i\mathcal{A})} \, \mathcal{D}\Psi = \lim_{N\to\infty} I_N \int d\Psi_1 ... \int d\Psi_k ... \int d\Psi_{N-1} \exp\left(i \sum_{k=1}^{N-1} \mathcal{L}(\Psi(x_k)) \triangle_n V_k \right) \tag{1.9}$$

(it is used the system of units $h/(2\pi) = c = 1$, where h is the Planck's constant and c is the light speed; $i^2 = -1$; the constant I_N is choosed so that the limit is existing). Therefore the functions $\Psi(x)$ obtained from the requirement of the minimality of the action $\mathcal{A}$ are olso the largest plausibility ones for the description of the quantum system.

It is naturally to demand the invariance of the integral (1.8) relatively the transformations (1.1) and (1.2), in consequence of what it is necessary to introduce the additional fields $B(x)$ with the transformation law in point $x \in \delta\Omega_n$ in the form

$$\delta_o B \cong \delta\omega^a Y_a(B) + \partial_i \delta\omega^a Z_a^i(B), \tag{1.10}$$

and which we shall name the gauge ones. Make it in the standard manner defining them by the density matrix $\rho(x)$ as

$$B_\gamma^b \overline{B_a^\gamma} = \rho_a^b (B_\gamma^c \overline{B_c^\gamma}). \tag{1.11}$$

by this the factorization of the gauge fields $B(x)$ on equivalence classes is allowed for the writing of the indexes of their components $B_\alpha^a(x)$. Note, that $B_\alpha^a(x)$ can be both Utiyama gauge fields [3] and Kibble gauge fields [4]. Following for Utiyama [3] we shall not concretize significances which are adopted by the Greek indexes.

Further we shall assume that the density matrix $\rho(x)$ defines the dimensionality of manifold M_n, using even if for this the corresponding generalized (singular) functions in consequence of what the rank of the density matrix $\rho(x)$ must be equal to n, and the formula (1.8) can be rewritten in the form

$$\mathcal{A} = \int\limits_{\Omega_r} \mathcal{L} d_r V = \int\limits_{\Omega_r} \kappa \overline{X^b}(\Psi) \rho_b^a X_a(\Psi) d_r V, \tag{1.12}$$

We should connect the rank n of the density matrix ρ with the nonzero vacuum average β_α^b of the gauge fields B_α^a.

In consequence of (1.8) and (1.11) it can consider that the Lagrangian $\mathcal{L}$ depend on the gauge fields B by

$$D_\beta \Psi = -B_\beta^a X_a(\Psi), \tag{1.13}$$

We see by this formula, that the particles charges define the form of the generators $X_a(\Psi)$ and the components $C_{ab}^c(x)$ of the structural tensor field of the Lie local loop $G_r(x)$, and hence it follows the dependence of the symmetries on the particles charges as and in the Utiyama formalism [3]. Let the fields

$$\Phi_\beta^i = B_\beta^a \ \xi_a^i, \tag{1.14}$$

are those mixtures of the gauge fields $B(x)$ which have the non-zero vacuum averages and ρ' is the reduced density matrix of the fields $\Phi(x)$ which have the rank n by definition. Naturally that the components ρ_i^j of the reduced density matrix ρ' will be defined from the following relations

$$\Phi_\gamma^j \overline{\Phi_i^\gamma} = \rho_i^j (\Phi_\gamma^k \overline{\Phi_k^\gamma}). \tag{1.15}$$

Let us introduce the metric in the differentiable manifold M_n which will be cosidered the Riemannian space-time, using the reduced density matrix $\rho'(x)$. Let the fields

$$g^{ij} = \eta^{k(i} \rho_k^{j)} (\eta_{lm} g^{lm}) \tag{1.16}$$

(where η_{ij} are the covariant components of the metric tensor of the tangent space to M_n and η^{ij} are defined as the solutions of the following equations: $\eta^{ij}\eta_{kj} = \delta_k^i$) are the components of the tensor inverse to the fundamental one g_{ij} of the space-time M_n ($g^{ij} g_{kj} = \delta_k^i$) in consequence of what we shall have relations

$$\nabla_k g_{ij} = 0, \quad \nabla_k g^{ij} = 0 \tag{1.17}$$

(∇_i are covariant derivatives).

If now we shall have "spread" the gauge fields but retaining the terms T_i responsible for the vacuum oscillation, then the Lagrangian $\mathcal{L}$ will have been rewritten in the form

$$\mathcal{L} = k(\partial_i\overline{\Psi} - \overline{T_i\Psi})\eta^{ij}(\partial_j\Psi - T_j\Psi). \tag{1.18}$$

In particular by $n = 4$ and considering the CPT–degeneracy

$$\Psi = \begin{pmatrix} \psi_L \\ \psi_R \end{pmatrix}, \quad \psi_L = \frac{1}{2}(I - \gamma_5)\psi, \quad \psi_R = \frac{1}{2}(I + \gamma_5)\psi, \quad \psi = \begin{pmatrix} \psi_1 \\ \psi_2 \\ \psi_3 \\ \psi_4 \end{pmatrix}, \tag{1.19}$$

$$T_A = -T_A^+ = i\frac{\omega_o}{2}\Sigma_A \otimes \begin{pmatrix} I - \gamma_4 & 0 \\ 0 & I + \gamma_4 \end{pmatrix}, \quad \Sigma_A = \begin{pmatrix} \sigma_A & 0 \\ 0 & \sigma_A \end{pmatrix}, \tag{1.20}$$

$$T_4 = -T_4^+ = i\frac{\omega_o}{2}\gamma_4 \otimes \begin{pmatrix} I - 3\gamma_4 & 0 \\ 0 & I + 3\gamma_4 \end{pmatrix} \tag{1.21}$$

($i^2 = -1$; I is the unit matrix; $\gamma_5 = -i\gamma_1\gamma_2\gamma_3\gamma_4$; $\gamma_1, \gamma_2, \gamma_3, \gamma_4$ are the Dirac matrices; σ_A are the Pauli matrices; $A, B = 1, 2, 3$; η^{ij} are the contravariant components of the metric tensor of the Minkowski space; ω_o is a constant) it can obtain the Lagrangian $\mathcal{L}$ of the neutrinos fields in the standard form ($\omega_o = 1/k$)

$$\mathcal{L} = -ik\frac{\omega_o}{2}[\eta^{AB}(\partial_A\overline{\psi}\gamma_B\psi - \overline{\psi}\gamma_A\partial_B\psi) - \partial_4\overline{\psi}\gamma_4\psi + \overline{\psi}\gamma_4\partial_4\psi)] \tag{1.22}$$

If now we turn on the mixing of the fields with the different polarization, it is possible substituting L_4 (the formula (1.21)) in the following form

$$T_4 = -T_4^+ = i\frac{\omega_o}{2}\gamma_4 \otimes \begin{pmatrix} (I - 3\gamma_4) & 2I\omega_1/\omega_o \\ 2I\omega_1/\omega_o & (I + 3\gamma_4) \end{pmatrix}, \tag{1.23}$$

then the fields $\Psi(x)$ will describe the particles with the nonzero rest masses. Of course this mixing is the detector of the vacuum frequency change, which is induced by the presence of the added fields (in particular, by the presence of the electromagnetic field).

Now one may proceed to a construction of the covariant gauge formalism considering that the manifold M_n is the Riemannian space-time. For this it is necessary to find a law of a transformation of the fields $B(x)$. Let the fields $D_\alpha\Psi$ change analogously to the fields $\Psi(x)$ in a point $x \in M_n$, then is

$$\delta_0 D_\alpha\Psi = \delta\omega^b\ (T_b D_\alpha\Psi - T_{b\alpha}^{\ \beta}\ D_\beta\Psi - \xi_b^i\ \partial_i D_\alpha\Psi). \tag{1.24}$$

As a result $\delta_0 B_\alpha^a$ are written down in the form:

$$\delta_0 B_\alpha^d = \delta\omega^b\ (C_{cb}^d\ B_\alpha^c - T_{b\alpha}^{\ \beta}\ B_\beta^d - \xi_b^i\ \partial_i B_\alpha^d) + \Phi_\alpha^i\ \partial_i\delta\omega^d. \tag{1.25}$$

Since the action

$$\mathcal{A}_t = \int\limits_{\Omega_n} \mathcal{L}_t\ d_nV = \int\limits_{\Omega_n} \mathcal{L}_t\ \eta\ dx^1dx^2...dx^n \tag{1.26}$$

(Ω_n is a region of the space-time M_n and $\eta(x)$ is the base density of the same) must be invariant against infinitesimal transformations of the Lie local loop $G_r(x)$, then the total Lagrangian $\mathcal{L}_t$ depending on fields $\Psi(x)$, $B(x)$ and also their derivatives of the first order is unable to be selected arbitrarily. The following Lagrangian $\mathcal{L}_t(\Psi; D_\alpha\Psi; F^c_{\alpha\beta})$ satisfy to this demand, where the components $F^c_{\alpha\beta}(x)$ of the intensities of the gauge fields $B(x)$ have the form:

$$F^c_{\alpha\beta} = [\delta^c_b - \xi^i_b\ \Phi^\gamma_i\ (B^c_\gamma - \beta^c_\gamma)]\ [\Phi^j_\alpha\ \partial_j B^b_\beta - \Phi^j_\beta\ \partial_j B^b_\alpha - \\ B^e_\alpha\ B^d_\beta\ C^b_{ed} + (B^e_\alpha\ T_{e\beta}{}^\delta - B^e_\beta\ T_{e\alpha}{}^\delta)\ B^b_\delta]. \tag{1.27}$$

Note that the fields $\Phi^\alpha_i(x)$ are defined from the equations

$$\Phi^i_\alpha\ \Phi^\alpha_j = \delta^i_j \tag{1.28}$$

(δ^j_i and δ^b_a are the Kronecker delta symbols). In consequence of $\beta^b_\alpha \neq 0$ the matrixes T_i in the formula (1.18) proved to be the non-zero ones.

Rewrite the equations

$$\Phi^i_\alpha\ \left(\frac{\mathcal{L}_t}{\eta}\ \frac{\partial\eta}{\partial B^b_\alpha} + \frac{\partial\mathcal{L}_t}{\partial B^b_\alpha} - \nabla_j\left(\frac{\partial\mathcal{L}_t}{\partial(\partial_j B^b_\alpha)}\right)\right) = 0 \tag{1.29}$$

of gauge fields in the quasi-maxwell form:

$$\nabla_j H^{ji}_a = I^i_a, \tag{1.30}$$

where

$$H^{ij}_a = -\Phi^i_\beta\ \frac{\partial\mathcal{L}_t}{\partial(\partial_j B^a_\beta)} = \Phi^j_\beta\ \frac{\partial\mathcal{L}_t}{\partial(\partial_i B^a_\beta)}, \tag{1.31}$$

$$I^i_a = -\mathcal{L}_t\xi^i_a - \frac{\partial\mathcal{L}_t}{\partial(\partial_i\Psi)}\ X_a(\Psi) - \frac{\partial\mathcal{L}_t}{\partial(\partial_i B^b_\beta)}\ Y^b_{a\beta}(B), \tag{1.32}$$

$$Y^b_{a\gamma}(B) = C^b_{ca}\ B^c_\gamma - T_{b\alpha}{}^\beta\ B^d_\beta - \xi^i_a\ \partial_i B^b_\gamma. \tag{1.33}$$

Besides let

$$\Phi^k_\alpha \frac{\partial\eta}{\partial B^b_\alpha} + \eta\xi^k_b = 0. \tag{1.34}$$

We pick out from the equations of gauge fields folding them with $B^b_\alpha\ \Phi^\alpha_l$ those which can will be called the equations of fields $\Phi^i_\alpha(x)$ and which must substitute for Einstein gravitational equations.

2. The gravitational fields equations

The construction of the differentiable manifold M_4 can be connected with the finding of the equations solutions of the gauge fields $\Phi^i_\beta = B^a_\beta\xi^i_a$ received from the demand of the minimality of the total action (1.26), where

$$\mathcal{L}_t = \mathcal{L}(\Psi, D_\alpha\Psi) + \mathcal{L}_1(F^a_{\alpha\beta}) = \mathcal{L}(\Psi, D_\alpha\Psi) + \kappa_1\overline{F^{\beta\delta}_d}\rho_1{}^{d}_{\beta\delta b}{}^{\alpha\gamma}F^b_{\alpha\gamma}. \tag{2.1}$$

Further for a simplification of a calculation we shall consider that the Lie transitiv local loop $G_r(x)$ act effectively in the considered domain of the space-time M_n, in consequence of this $r = n$ and let

$$T_{c\alpha}{}^\beta = 0, \tag{2.2}$$

Let, moreover, $n = 4$; the Greek indexes take the values $1, 2, 3, 4$; $\eta_{\alpha\beta}$ are the covariant components and $\eta^{\alpha\beta}$ are the contravariant components of the metric tensor of the Minkowski space. As a result the formula (1.33) is rewritten as

$$Y^b_{a\gamma}(B) \longmapsto Y^k_{i\gamma} = -\nabla_i\Phi^k_\gamma. \tag{2.3}$$

Write down the Lagrangian $\mathcal{L}_1$ in the form

$$\mathcal{L}_1 = \kappa_1 \eta^{\alpha\beta} Y^i_{j\beta}(\Phi) Y^j_{i\alpha}(\Phi), \tag{2.4}$$

considering that the fields $\Phi(x)$ satisfy the Lorentz conditions:

$$\nabla_i \Phi^i_\alpha = 0 \tag{2.5}$$

and $\eta^{\alpha\beta}$ are the contravariant components of the metric tensor of the Minkowski space. In this case the Lagrangian $\mathcal{L}_1$ is distinguished only the constant factor $(-\kappa_1)$ from the scalar curvature $R = g^{ij}R_{ij}$ where $R_{ij} = R_{kij}{}^k$ are the components of the Ricci tensor. It can note that in this case the gauge fields equations are written down as the Einstein equations, namely

$$I^j_k = \kappa_1(2g^{jl}R_{kl} - \delta^j_k R). \tag{2.6}$$

where the energy-momentum tensor of the everybody fields (excluding the fields Φ^i_α) has the form

$$I^j_k = -\delta^j_k \mathcal{L} + \frac{\partial \mathcal{L}}{\partial \Phi^k_\alpha} \Phi^j_\alpha. \tag{2.7}$$

If we do not wish to use the Lorentz' conditions (2.5), then it can take the following Lagrangian $\mathcal{L}_1$

$$\mathcal{L}_1 = \frac{1}{2}\kappa_1 \eta^{\alpha\beta} \eta_{ijpq} \eta^{klpq} Y^i_{k\beta}(\Phi) Y^j_{l\alpha}(\Phi), \tag{2.8}$$

where η^{klpq} is the base 4-vector of the manifold M_4 and η_{ijpq} is the mutual one to η^{klpq}. As a result

$$\mathcal{L}_1 = \kappa_1 \eta^{\alpha\beta}(\nabla_j \Phi^i_\beta \nabla_i \Phi^j_\alpha - \nabla_i \Phi^i_\beta \nabla_j \Phi^j_\alpha). \tag{2.9}$$

It can rewrite this Lagrangian (2.9) also in the form

$$\mathcal{L}_1 = \frac{1}{4}\kappa_1 \eta^{\alpha\beta}(F^\delta_{\gamma\beta} F^\nu_{\mu\alpha} \eta^{\gamma\mu} \eta_{\delta\nu} + 2F^\delta_{\gamma\beta} F^\gamma_{\delta\alpha} - 4F^\gamma_{\gamma\beta} F^\delta_{\delta\alpha}), \tag{2.10}$$

where the components $F^\nu_{\mu\alpha}$ of the intensities of the gauge fields $\Phi(x)$ can be got from the intensities (1.27) as

$$F^\nu_{\alpha\beta} = \Phi^\nu_k(\Phi^i_\alpha \nabla_i \Phi^k_\beta - \Phi^i_\beta \nabla_i \Phi^k_\alpha). \tag{2.11}$$

In the more general case, when $r \geq 4$, it ought to use the following total Lagrangian $\mathcal{L}_t$

$$\mathcal{L}_t = F^a_{\alpha\beta} F^b_{\gamma\delta} \eta^{\beta\delta} [\kappa_1 \xi^i_a \xi^j_b (\eta^{\alpha\gamma} \eta_{\varepsilon\theta} h^\varepsilon_i h^\theta_j + 2h^\gamma_i h^\alpha_j - 4h^\alpha_i h^\gamma_j) +$$

$$\kappa_2 \eta_{cd} \eta^{\alpha\gamma} (\delta^c_a - \xi^i_a h^\varepsilon_i \beta^c_\varepsilon)(\delta^d_b - \xi^j_b h^\theta_j \beta^d_\theta)]/4 + \mathcal{L}(\Psi, D_\alpha \Psi), \tag{2.12}$$

where

$$h^i_\alpha = \beta^a_\alpha \xi^i_a, \quad \eta_{ab} = \eta_{ba} \tag{2.13}$$

and the geometrical objects $h^\alpha_i(x)$ are defined as the solutions of the equations

$$h^\alpha_k h^i_\alpha = \delta^i_k. \tag{2.14}$$

Now the Einstein equations, got from the gauge ones

$$\Phi^j_\alpha \left(\frac{\mathcal{L}_t}{\eta} \frac{\partial \eta}{\partial B^b_\alpha} + \frac{\partial \mathcal{L}_t}{\partial B^b_\alpha} - \nabla_i \left(\frac{\partial \mathcal{L}_t}{\partial(\partial_i B^b_\alpha)} \right) \right) B^b_\beta \Phi^\beta_k = 0, \tag{2.15}$$

are written as

$$g^{ji}R_{ki} - \frac{1}{2}\delta^j_k R = \frac{1}{2\kappa_1}[D^{ij}_a E^a_{ik} - \frac{1}{4}\delta^j_k D^{il}_a E^a_{il} + P^j \Psi D_k \Psi - \delta^j_k \mathcal{L}(\Psi, D_i\Psi)], \tag{2.16}$$

where

$$D_i\Psi = \Phi^\alpha_i D_\alpha \Psi = \partial_i \Psi - B^a_i T_a \Psi, \tag{2.17}$$

$$P^k\Psi = \frac{\partial \mathcal{L}}{\partial D_k \Psi} = \Phi^k_\alpha \frac{\partial \mathcal{L}}{\partial D_\alpha \Psi}, \tag{2.18}$$

$$B^a_i = \Phi^\alpha_i B^a_\alpha, \tag{2.19}$$

$$E^a_{ij} = (\delta^a_b - \xi^k_b B^a_k)(\nabla_i B^b_j - \nabla_j B^b_i + B^c_i B^d_j C^b_{cd}), \tag{2.20}$$

$$D^{ij}_a = \kappa_2 g^{ik} g^{jl} \eta_{cd}(\delta^c_a - \xi^p_a h^\varepsilon_p \beta^c_\varepsilon)(\delta^d_b - \xi^q_b h^\theta_q \beta^d_\theta) E^b_{kl}. \tag{2.21}$$

By this it can rewrite the total Lagrangian $\mathcal{L}_t$ (2.12) as

$$\mathcal{L}_t = (H^{ij}_k F^k_{ij} + D^{ij}_a E^a_{ij})/4 + \mathcal{L}(\Psi, D_\alpha \Psi), \tag{2.22}$$

where

$$F^k_{ij} = -\Phi^k_\alpha(\nabla_i \Phi^\alpha_j - \nabla_j \Phi^\alpha_i) \tag{2.23}$$

and

$$H^{ij}_k = \kappa_1(g_{kl}F^l_{pq}g^{ip}g^{jq} + F^i_{kl}g^{jl} + g^{il}F^j_{lk} + 2g^{ip}\delta^j_k F^l_{lp} + 2\delta^i_k g^{jp} F^l_{pl}). \tag{2.24}$$

In the general case the condition (2.2) it is necessary to abolish (by this, $T^\beta_{c\alpha} \neq \xi^i_c T^\beta_{i\alpha}$) so that the intensities F^k_{ij} of the fields $\Phi(x)$ will have the following form

$$F^k_{ij} = \nabla_i \Phi^k_\beta \Phi^\beta_j - \nabla_j \Phi^k_\beta \Phi^\beta_i + \Phi^k_\gamma T^\gamma_{a\beta}(B^a_i \Phi^\beta_j - B^a_j \Phi^\beta_i). \tag{2.25}$$

Already because of this the masses of the vector bosons (being the quanta of the gauge fields) can be the non-zero ones. Thus the interactions of the elemental particles with fields Φ^i_α which are describing the vacuum oscilations and which are connected with the gravitational interactions can lead to the appearance of the masses both of the fermions and of the vector bosons.

3. The symmetry breaking

From the recent experimental data (see for example [5]) it is followed that only 5% of the all Universe matter has the baryon natture, 33% is the dark matter and 62% exists in the vacuumly similar state ($p = -\rho$, where p is the pressure, ρ is the energy density) which is connected with the Λ-term. In cousequence of this it is expedient to divide the Universe matter into the rapid and slow subsystems considering that all known particles (ignoring neutrinos) fall into the rapid subsystem and using the fields $\Phi(x)$ with the non-zero vacuum averages for the condensed description of the slow subsystem. Thus the elemental particles can be cosidered as the coherent structures in the open systems characterized if only the quasigroup symmetries [6]. As a result it is necessary to return to concepts of Hoyle and Narlikar [7] in which the masses of the elemental particles depend on the time that allows to consider the Universe evolution even in the space without the curvature.

Naturally, that the assumption about fields are filling the Universe and determining the geometric structure of the space–time manifold, allows us to introduce the connection of the fundamental tensor of this manifold with such a statistical characteristic as the entropy defining it in a standard manner via the reduced density matrix $\rho'(x)$ in the form

$$S = -\rho^j_i \ln \rho^i_j. \tag{3.1}$$

As a result, the transition from the singular state of the Universe to the modern one can be connected with increasing of the entropy S defined here. As $1 < n < r$, we can consider that the gauge fields $B^a_\beta(x)$ became the owners of the nonzero vacuum averages breaking their symmetry in consequence of the Universe evolution. The presence of the nonzero vacuum averages lead to that the fields equations (2.15) are not converted to zero identically by freezing of the excitations being the quanta of the fields $\Phi^i_\alpha(x)$ but they convert to the Einstein equations or to their generalizations [6].

Let us to consider that the symmetry breaking was the phase transition by the formation of the Cooper pairs in the medium consisting of primary fermions. Of course by this we rely on the known data: the formation the Cooper pairs in ^3He [8] and the spin-fluctuation high T_c superconductivity mechanism [9]. Before the start of the phase transition in the early Universe it is necessary to neglect the non-zero vacuum averages $\beta^c_\alpha(x)$ of the gauge fields $B^c_\alpha(x)$ ($\beta^c_\alpha = 0$) that lead to the absence ($\xi^k_c[\delta^c_b - \xi^i_b\ \Phi^\gamma_i\ (B^c_\gamma - \beta^c_\gamma)] = 0$) of the intensities

$$F^i_{\alpha\beta} = \xi^i_c F^c_{\alpha\beta} \tag{3.2}$$

of the fields Φ^i_α. In the absence of the fields Φ^i_α and the fields Ψ the Lagrangian form (3.2) is becoming the most symmetric one ($\mathcal{L}_t \propto B^4$). Thus the formation of primary fermions ($\Psi \neq 0$) from primary bosons is the necessary condition of the Universe transition to the modern stage of the development although and the not sufficient one. Only the Bose — Einstein condensation of the Cooper pairs (the quantity of whiches increased beyond all bounds) from the fermions of the some class (various types of neutrinos) caused to the large growth of the rest masses of those vector bosons (W^+, W^-, Z^o) whiches interact with fermions of this class. In our opinion so the neutrinos and the weak interactions occupied the particular place in the Universe evolution. In parallel to it the rest masses of other particles grew too, although and not all (the photon has not the rest mass as it do not interact with neutrinos immediately).

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