SUPERGRAVITY AND NATURE'S GRAND UNIFIED FIELD MODELS

Melibaev Muxtardjan
Associate Professors of the Kokand State University, Uzbekistan
email: melibaev1950@ gmail.com

ANNOTATION

Supergravity and nature's grand unified field models are considered.

Abstract: Supergravity and nature's grand unified field models are considered.

Key words: Supergravity, unifying the fundamental forces, Higgs mechanism, . Planck energy, Grand Unification Model, symmetry breaking, quantization of the metric tensor, supermultiplet

The idea of unifying the fundamental forces of nature, including electromagnetism, Fermi weak forces, nuclear force and gravity, into a single force, belongs to A. Einstein, and he worked in this direction until the end of his life. Maxwell remains the first historical figure to unify the electric and magnetic forces (fields) into a single equation. If we look at this equation, although the electric and magnetic fields are symmetrical, the absence of magnetic charge in nature makes the equation asymmetrical.

$$\left.\begin{aligned} div\vec{E} &= \frac{1}{\varepsilon_0}\rho \\ div\vec{B} &= 0 \end{aligned}\right\} \qquad (1)$$

In this equation, it is clearly seen that the magnetic field "charge" is zero. Dirac tried to correct this shortcoming by inventing his own magnetic monopole. However, the presence or absence of a magnetic monopole in nature has not been observed in any world-famous laboratory.

Einstein's failure was followed by the discovery of a model based on the spontaneous breaking of symmetry of the local gauge invariance of Abelian fields and the Higgs mechanism, based on the formation of massless bosons and massive bosons.This model has the following symmetry

$$SU(3)_c x\ SU(2)_v\ U(1) \qquad (2)$$

where (2) is a direct multiplication of simple groups.

Here SU(3)c is a 3-dimensional singular unimodular Yang–Mils–no Abelian group containing colored quarks. SU(3) contains quantum chromodynamics.
SU(2) is a 3-generator field containing local gauge intermediate bosons. This group contains the electroweak interaction. U(1) is a unitary one-generator group

corresponding to the electromagnetic field, forming the U(1)–Abelian group. Supergravity is Einstein's quantum theory of gravitational field, generalized to the electroweak strong interaction. This energy range occurs at energies above E= 10^{19}GeV, i.e. Planck energy and correspondingly mass.
A model that combines the Grand Unification Model with quantum gravity can be called supergravity.

It is certainly not an easy task to compare the spontaneous symmetry breaking with the experimental one. The drawback of this theory is the creation of many fundamental bosons and the problem of their interpretation.

To illustrate the above points, one can see that for the case N=8 one can see that it leads to a quantized theory of gravity. Supergravity leads to the quantization of natural gravity. Indeed, if the symmetry transformation is mixed with the fields of other particles, it is not necessary to quantize all the fields and discard the metric tensor. In the simplest supergravity theory, the quantization of the Rarity–Schwinger field should be accompanied by the quantization of the metric tensor.

From the global concept of supersymmetry, it is known that a massless (Majoran) spiral particle **λ** =±3/2 can be generated in a supermultiplet by the bosons **λ** =±2, **λ** =±1. The first group direction supergravity is expressed by the (±2, ±3/2) free Lagrangian

$$G^0 = G^0_{en}(\lambda_{\mu\nu}) - \frac{1}{2}\varepsilon^{\mu\nu g ъ}\overline{\psi}_\mu \gamma_5 \gamma_\nu \partial_g \psi_a$$

where $G^0_{en}(\lambda_{\mu\nu})$ is the Lagrangian of the linearized Einstein

$$g_{\mu\nu} = \eta_{\mu\nu} + \chi h_{\mu\nu}$$

The Lagrangian is invariant under the transformation of two distinct abelian forms

$$\delta h_{\mu\nu} = \partial_\mu \xi_\nu + \partial_\nu \xi_\mu, \quad \delta\psi_\mu = \partial_\mu \alpha$$

and to the global supersymmetry transformation

$$\delta h_{\mu\nu} = \bar{\varepsilon}\gamma_\mu \psi_\nu + \bar{\varepsilon}\gamma_\nu \psi_\mu$$

$$\delta\psi_\mu = \partial_\mu h_{\mu\sigma} g^{g\sigma}\varepsilon$$

An alternative option (±3/2, ±1) becomes the free Lagrangian state.

$$G^1 = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} - \frac{1}{2}\varepsilon^{\mu\nu g\sigma}\overline{\psi}_\mu \gamma_5 \gamma_\nu \delta_g \sigma$$

The Lagrangian is invariant with respect to two distinct abelian gauge transformations

$$\delta A_\mu = \partial_\mu \wedge, \quad \delta\psi_\mu = \partial_\mu \alpha \left(F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu\right)$$

Global superammetric shape transformation

$$\delta A_\mu = \bar{\varepsilon}\psi_\mu, \delta\psi_\mu = \sigma_{g\tau}\gamma_\mu F^{g\tau}\varepsilon$$

The possibility of introducing the gravitino into a supermultiplet is G^0, G^1 twofold. If ε=ε (x), then the supersymmetry transformation is local. In this case, introducing a new limit into the Lagrangian consists of multiplying the field by the current $\chi\overline{\psi}_{\mu d} J^{\mu\alpha}$.

$$\partial^{\mu} J_{\mu\alpha}(x) = 0$$

is appropriate. This implies a Noetherian coupling. In the supershape transformation, the system goes into the energy-momentum tensor in spin-vector current supersymmetry. Therefore, we can associate $\chi\overline{\psi}_{\mu} J^{\mu}$ with $\chi\overline{\psi}_{\mu\nu} J^{\mu\nu}$.

The resulting supergravity Lagrangian is as follows

$$G_{SG} = -\frac{1}{2\chi^2}\sqrt{-g}R(g_{\mu\nu}) - \frac{1}{2}\varepsilon^{\mu\nu g\sigma}$$

$$\overline{\psi}_{\mu}\gamma_5\gamma_{\nu}D_g\sigma - \frac{e}{32}\chi^2\left[\left(\overline{\psi}^{\mu}\gamma^{\nu}\psi^{g}\right)\right.$$

$$\left.(\overline{\psi}_{\mu}\gamma_{\nu}\psi_{g} + 2\overline{\psi}_{\nu}\gamma_{\mu}\psi_{g}) - 4(\overline{\psi}_{\mu}\gamma\psi)^2\right]$$

where $g_{\mu\nu} = e_{\mu}^{a} e_{\nu a}$ and - $e_{\mu a}$ in the tetrad.

Here, the Laograngian G_{SG}–Noabelian gauge is invariant under deformation.

$$\varepsilon=\varepsilon(x)$$

$$\delta e_{\mu a} = \chi\overline{\varepsilon}\gamma_a\psi_{\mu}$$

$$\delta\psi_{\mu} = \frac{2}{\chi}D_{\mu}\varepsilon + \frac{1}{4}\chi\sigma^{a,b}\varepsilon\left(2\overline{\psi}_{\mu}\gamma_a\psi_b + \overline{\psi}_a\gamma_{\mu}\psi_b\right)$$

where D_{μ} is the covariant differentiation given by the Christoffel connection. Thus the free $\chi = 0$ state has two abelian transformations and one global transformation. The effect is a single-valued abelian gauge transformation at the Lagrangian level. The curvature limits $\delta\psi_{\mu} = \frac{2}{\chi}\tilde{D}_{\mu}\varepsilon$ $(\tilde{D}_{\mu} = D_{\mu} +$ to appreciability) lead to gauge transformations of potentials such as the Yang-Mills field.

$$\delta A_{\mu}^{a} = D_{\mu}\wedge^{a} = \partial_{\mu}\wedge^{a} - f^{abc}\wedge^{b}\wedge_{\mu}^{c}$$

In supergravity, spin dependence ω_{μ}^{ab} is a nonlinear function of the fields.

In supersymmetric theory, particles and their corresponding fields are combined into a supermultiplet. A supermultiplet of fields consists of fields with different spins and statistics, and internal symmetry. Majorana subalgebra stability condition

$$\left\{O_{\alpha}^{i} Q_{\beta}^{i}\right\} = \delta_{\alpha\beta}\delta^{ij}$$

$$\alpha,\beta=1\ldots4, \qquad I,j=1\ldots N$$

Using a two-component Weyl spinor

$$\left\{O_{\alpha}^{i}\overline{Q}_{\beta}^{i}\right\} = \delta_{\alpha\beta}\delta^{ij}$$

$$\left\{O_{\alpha}^{i}Q_{\beta}^{i}\right\} = 0 \qquad \alpha,\beta=1,2$$

$O_{\alpha}^{i}Q_{\beta}^{i}$ - 2N satisfies the algebra of fermi operators

References

1. Ferrara S. Phys.Rev.Lett 37, 1669 (1976).
2. Salem A. Nuch.Phys. B76, 477, 1974.
3. Манин Ю. Сборник статей. Геометрические идеи в физике. М. Мир. 1983.
4. РЯ, Расулов ВР, et al. "по диссертации Муроди Халимджон Гафурзода на тему «Физические основы управления временных характеристик в непрерывно действующих лазерах с насыщающимся поглотителем внутри резонатора», представленной на соискание ученой степени доктора физико-математических наук по специальности: 01.04. 07-физика конденсированного." *Известия вузов. Физика* 65 (2022).
5. Xursanboyevich, Qo'Chqorov Mavzurjon. "OLIY TA'LIMDA ANIQ VA TABIIY FANLARNING ZAMONAVIY, INNOVATSION RIVOJLANISHI." *Science and innovation* 3.Special Issue 57 (2024): 327-329.
6. Rasulov, Rustam Y., et al. "Spectral and Temperature Dynamics of Photon Absorption in Monatomic Transition Metal Dichalcogenides." *East European Journal of Physics* 2 (2025): 231-236.
7. Muxtardjan, Muxtardjan Melibaev. "FAZO JUFTLIGINI TAU LEPTONLI SISTEMALARDA SAQLANMASLIK EFFEKTLARI." *Confrencea* 11.1 (2023): 218-226.
8. MELIBAEV, MUXTARDJAN. "УЧЕНЫЕ ЗАПИСКИ ХУДЖАНДСКОГО ГОСУДАРСТВЕННОГО УНИВЕРСИТЕТА ИМ. АКАДЕМИКА Б. ГАФУРОВА. СЕРИЯ: ЕСТЕСТВЕННЫЕ И ЭКОНОМИЧЕСКИЕ НАУКИ." *УЧЕНЫЕ ЗАПИСКИ ХУДЖАНДСКОГО ГОСУДАРСТВЕННОГО УНИВЕРСИТЕТА ИМ. АКАДЕМИКА Б. ГАФУРОВА. СЕРИЯ: ЕСТЕСТВЕННЫЕ И ЭКОНОМИЧЕСКИЕ НАУКИ Учредители: Худжандский государственный университет им. академика Б. Гафурова* 55.4 (2020): 14-16.