

Massless Spin 3/2 Field, Spherical Solutions, Exclusion of the Gauge Degree of Freedom

A. V. Ivashkevich (Foreign) ¹,

E. M. Ovsiyuk (Foreign) ²,

V. V. Kisel ³,

V. M. Red'kov (Foreign) ⁴

2021

^{1, 4} Foreign (Институт физики НАН Беларуси, г. Минск, Республика Беларусь)

² Foreign (кафедра общей физики и методики преподавания физики Мозырского государственного университета имени И. П. Шамякина, г. Мозырь, Беларусь)

³ Кафедра физики, Белорусский государственный университет информатики и радиоэлектроники, г. Минск, Республика Беларусь

Keywords: Spin 3/2, massless field, gauge symmetry, tetrad formalism, Minkowski space, spherical coordinates, Wigner D-functions, exact solutions, exclusion of the gauge degrees of freedom.

Abstract: Covariant relativistic system for vector-bispinor describing a massless spin 3/2 field is studied in spherical coordinates and tetrad of Minkowski space. Presentation of the equation with the use of covariant Levi-Civita tensor exhibits existence of gauge solutions in the form of

the covariant 4-gradient over arbitrary bispinor. Substitution for the main vector-bispinor assumes diagonalization of four operators: of energy, square and third projection of the total angular momentum, and space reflection. After separation of the variables, we derive radial system for eight independent functions. General structure of the spherical gauge solutions is specified, and it is demonstrated that the gauge 8 radial functions satisfy the derived system of 8 equations. It is proved that the general system reduces to two couples of independent 2-nd order and nonhomogeneous differential equations, their particular solutions may be found with the use of the gauge solutions of special form. The corresponding homogeneous equations turn out to have one the same form, and have three regular singularities and one irregular of the rank 2. Frobeniustypes solutions for this equation have been specified, and the structure in involved power series is studied. Six remaining radial functions may be straightforwardly found through the use of simple algebraic relations. By this method we have been constructed two types of solutions for the massless spin 3/2 field which do not contain gauge constituents.

Источник публикации: Massless Spin 3/2 Field, Spherical Solutions, Exclusion of the Gauge Degree of Freedom / A. V. Ivashkevich [et al] // Nonlinear Dynamics and Applications. – 2021. – Vol. 27. – P. 384-399.