Spin 3/2 Particle in the Presence of Magnetic Field: Tetrad Formalism and Fedorov-Gronskiy Method

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2023

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Keywords: spin 3/2 particle, Rarita – Schwinger equation, tetrad formalism, uniform magnetic field, cylindrical symmetry, projective operators, exact solutions, energy spectra, anomalous solutions.

Abstract: A spin 3/2 particle is considered in the presence of an external uniform magnetic field. The covariant representation of the Rarita – Schwinger first order equation for vector-bispinor wave function in cylindrical coordinates and tetrad is used. On searching solutions we diagonalize the operators of the energy, the third projection of the linear momentum, and the third projection of the total angular momentum, as a result we derive the system of 16 first order differential equations in the variable r. To resolve this system of equations we apply the Fedorov–Gronskiy method which is based on the use of the projective operators related to 16-dimensional generator J12 for vector-bispinor. Within this approach we decompose the complete wave function into the sum of four projective constituents, each of them is determined by only one corresponding function fi(r), i = 1, 2, 3, 4. For these four basic functions we have constructed the exact solutions in terms of confluent hypergeometric

functions. In accordance with the general Fedorov–Gronskiy approach we transform the differential first order system of 16 equations into algebraic homogenous system. From vanishing its determinant we derive and algebraic equation of the fourth order with respect to the squared energy, its solutions give possible values for the energy of the particle. In this way, we find 4 series of real-valued and physically interpretable energy spectra, all remaining ones provide us with complex-valued energies and they should be ignored (they are the so called anomalous solutions).

Источник публикации: Spin 3/2 Particle in the Presence of Magnetic Field: Tetrad Formalism and Fedorov-Gronskiy Method / A. V. Ivashkevich [et al.] // Nonlinear Phenomena in Complex Systems. – 2023. – Vol. 26, no. 3. – P. 257–272.