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Recent progress on the description of relativistic spin: vector model of spinning particle and rotating body with gravimagnetic moment in general relativity. (English) Zbl 1401.83004

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Summary: We review the recent results on development of vector models of spin and apply them to study the influence of spin-field interaction on the trajectory and precession of a spinning particle in external gravitational and electromagnetic fields. The formalism is developed starting from the Lagrangian variational problem, which implies both equations of motion and constraints which should be presented in a model of spinning particle. We present a detailed analysis of the resulting theory and show that it has reasonable properties on both classical and quantum level. We describe a number of applications and show how the vector model clarifies some issues presented in theoretical description of a relativistic spin: (A) one-particle relativistic quantum mechanics with positive energies and its relation with the Dirac equation and with relativistic *Zitterbewegung*; (B) spin-induced noncommutativity and the problem of covariant formalism; (C) three-dimensional acceleration consistent with coordinate-independence of the speed of light in general relativity and rainbow geometry seen by spinning particle; (D) paradoxical behavior of the Mathisson-Papapetrou-Tulczyjew-Dixon equations of a rotating body in ultrarelativistic limit, and equations with improved behavior.

MSC:

83C10 Equations of motion in general relativity and gravitational theory
81S10 Geometry and quantization, symplectic methods
83C60 Spinor and twistor methods in general relativity and gravitational theory; Newman-Penrose formalism

Keywords:

relativistic spin; rotating body; general relativity; relativistic quantum mechanics

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