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Spinning particles, Dirac-type operators on curved spaces and the role of Killing-Yano tensors

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ABSTRACT

We review the geodesic motion of pseudo-classical spinning particles in curved spaces. Investigating the generalized Killing equations for spinning spaces, we express the constants of motion in terms of Killing-Yano tensors. Passing from the spinning spaces to the Dirac equation in curved backgrounds we point out the role of the Killing-Yano tensors in the construction of the Dirac-type operators. The general results are applied to the case of the four-dimensional Euclidean Taub-Newman-Unti-Tamburino space. From the covariantly constant Killing-Yano tensors of this space we construct three new Dirac-type operators which are equivalent with the standard Dirac operator. Finally the Runge-Lenz operator for the Dirac equation in this background is expressed in terms of the forth Killing-Yano tensor which is not covariantly constant.

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