

Einstein-aether theory: Dynamics of relativistic particles with spin or polarization in a Gödel-type universe

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Abstract

© 2017 IOP Publishing Ltd and Sissa Medialab srl . In the framework of the Einstein-aether theory we consider a cosmological model, which describes the evolution of the unit dynamic vector field with activated rotational degree of freedom. We discuss exact solutions of the Einstein-aether theory, for which the space-time is of the Gödel-type, the velocity four-vector of the aether motion is characterized by a non-vanishing vorticity, thus the rotational vectorial modes can be associated with the source of the universe rotation. The main goal of our paper is to study the motion of test relativistic particles with a vectorial internal degree of freedom (spin or polarization), which is coupled to the unit dynamic vector field. The particles are considered as the test ones in the given space-time background of the Gödel-type; the spin (polarization) coupling to the unit dynamic vector field is modeled using exact solutions of three types. The first exact solution describes the aether with arbitrary Jacobson's coupling constants; the second one relates to the case, when the Jacobson's constant responsible for the vorticity is vanishing; the third exact solution is obtained using three constraints for the coupling constants. The analysis of the exact expressions, which are obtained for the particle momentum and for the spin (polarization) four-vector components, shows that the interaction of the spin (polarization) with the unit vector field induces a rotation, which is additional to the geodesic precession of the spin (polarization) associated with the universe rotation as a whole.

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Keywords

modified gravity, particle physics-cosmology connection

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