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Weyl-invariant Einstein-Cartan gravity: unifying the strong CP and hierarchy puzzles

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Abstract. It is well-known since the works of Utiyama and Kibble that the gravitational force can be obtained by gauging the Lorentz group, which puts gravity on the same footing as the Standard Model fields. The resulting theory - Einstein-Cartan gravity - happens to be very interesting. I will overview the construction of this theory and discuss its applications in particle physics and cosmology. In particular, the minimal Weyl-invariant Einstein-Cartan gravity in combination with the Standard Model of particle physics contains just one extra scalar degree of freedom (in addition to the graviton and the Standard Model fields) with the properties of an axion-like particle which can solve the strong CP-problem. The smallness of this particle's mass as well as of the cosmological constant is ensured by tiny values of the gauge coupling constants of the local Lorentz group. The tree value of the Higgs boson mass and that of Majorana leptons (if added to the Standard Model to solve the neutrino mass, baryogenesis and dark matter problems) are very small or vanishing, opening the possibility of their computability in terms of the fundamental parameters of the theory due to nonperturbative effects.

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