

Limits for Spin-Dependent Short-Range Interaction of Axion-Like Particles

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A possible solution to the strong CP problem is a light pseudoscalar boson, the so-called axion. The axion would cause a new spin-dependent short-range interaction. Of interest here is the search for an axion mediated short range interaction between a fermion and the spin of another fermion. To search for this effect, co-located, nuclear spin polarized ^3He and ^{129}Xe gas is used to become independent of magnetic field drifts. The new approach is to measure the free nuclear spin precession frequencies in a homogeneous magnetic guiding field of about 350 nT using LTc SQUID detectors. The whole setup is housed in a magnetically shielded room at the Physikalisch Technische Bundesanstalt (PTB) in Berlin. With this setup long nuclear-spin coherence times of several hours for both gases can be achieved.

In this talk we present results which improve the present upper limits on the scalar-pseudoscalar coupling of axion-like particles in the axion-mass window from $10^{(-2)}$ eV to $10^{(-6)}$ eV by up to four orders of magnitude [1].

[1] K. Tullney et al., Phys. Rev. Lett. 111, 100801 (2013).

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