Measurement of the Electric Dipole Moment of the ^{129}Xe Atom

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Precision measurements of fundamental symmetry violations in atoms can be used as a test of the Standard Model of elementary particles and to search for new physics beyond it. Electric Dipole Moments (EDMs) of fundamental or composite particles are excellent candidates to look for new sources of violation of CP symmetry. We describe a setup to measure the CP violating permanent EDM of the neutral ^{129}Xe atom. Our goal is to improve the present experimental limit ($d_{Xe} < 3 \cdot 10^{-27}$ ecm [1]). The experimental approach is based on the free precession of nuclear spin polarized ^{3}He and ^{129}Xe atoms in a homogeneous magnetic guiding field of about 400 nT [2, 3]. A finite EDM is indicated by a change in the precession frequency as an electric field is periodically reversed with respect to the magnetic guiding field. To render the experiment insensitive to fluctuations and drifts of the magnetic guiding field, the principle of co-magnetometry is used: Two different spin species are located in the same volume (hyperpolarized ^{129}Xe and ^{3}He gas in the same measurement cell). The experiment benefits strongly from long spin-coherence times of several hours [4]. We discuss the methods of data evaluation and analyze different sources of noise and systematic effects, and the sensitivity of the ^{129}Xe EDM to underlying sources of CP violation on the level of elementary particle interactions. We report on technical improvements and first experimental results achieved within the MIXed collaboration.

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