

Search for Electric Dipole Moments at Storage Rings

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An electric dipole moment (EDM) aligned with the spin of a fundamental particle violates both parity conservation and time reversal invariance, or, via the presumed CPT conservation, CP invariance. Standard Model predictions are much below current or anticipated experimental sensitivity levels; an observation within the next generation of searches will represent a new signature of CP violation and possibly contribute to our understanding of the matter-antimatter asymmetry of the universe.

This presentation outlines the possibility to use an electromagnetic storage ring to directly probe charged particles for an EDM at a sensitivity level approaching 10^{-29} e.cm. Every sensitive electric dipole moment measurement proceeds in three steps: preparation of an intense highly polarized ensemble of particles; interaction of the EDM with a strong electric field for as long as possible; measurement of the spin evolution. For the storage ring technique, a polarized beam is accelerated and injected into the storage ring. Here the polarization is rotated to point along the momentum of the particles. While circling the ring the particles interact with a combination of a vertically oriented magnetic field and a radially oriented electric field. With a carefully controlled combination of electric and magnetic field strengths, the precession of the polarization caused by the interaction of the magnetic moment can be halted. The interaction between the EDM and the electric field causes the polarization to develop a vertical component, out of the ring plane.

The setup, status and R&D efforts of several experimental EDM searches based on the storage ring technique will be discussed, including those on the muon, proton and deuteron.

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