

Search for Electric Dipole Moments and Axions/ALPS of Charged Particles using Storage Rings.

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An electric dipole aligned along the spin axis of a fundamental particle, nucleus, or atomic system violates both parity conservation and time reversal invariance. The observation of such a phenomenon would, at present or proposed levels of experimental sensitivity, signal new physics beyond the Standard Model.

The usual method for identifying an electric dipole moment (EDM) in such searches is to observe the rotation of the spin axis or polarization under the influence of a strong electric field. The use of a storage ring opens the search to charged, polarized particles that would otherwise not be manageable in such a field. The best procedure begins with the alignment of the beam polarization along the velocity of the beam followed by the observation of any slow rotation of that polarization into the vertical direction perpendicular to the ring. Electric ring fields of the right strength or the correct combination of electric and magnetic ring fields are needed to ensure that the polarization does not rotate relative to the velocity ("frozen" spin).

Dedicated studies performed in the past decade at the COSY Storage Ring at FZ-Juelich culminated with a first upper limit for the static and the oscillating EDM of the deuteron. The oscillating EDM can indeed be accessed by exploiting the same methodology of the static one and it is of interest as it might be coupled to the possible axion field in the galaxy.

This presentation is meant to provide a general introduction to the EDM search by means of polarized beams in storage rings, to highlight the developments at the COSY ring and to address the next steps of the research.

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