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Search for the electric dipole moment of charged particles using storage rings

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The search for Electric Dipole Moments (EDMs) of elementary particles is a powerful tool to probe physics beyond the Standard Model (SM) of Particle Physics. Since a permanent EDM violates CP symmetry, an EDM measurement of a fundamental particle is a potential source of CP -violation that could, e.g., explain the matter-antimatter asymmetry in the universe. Moreover, a rotating polarized beam used in EDM searches is sensitive to oscillating EDM caused by axions or axion-like particles (ALPs), the candidates for the dark matter.

Storage rings make it possible to measure EDMs of charged particles by observing the effect of the EDM on the particle's spin motion in the ring. The Cooler Synchrotron COSY at the Forschungszentrum Jülich provides polarized protons and deuterons with momenta up to 3.7 GeV/s, which is an ideal testing ground and starting point for such an experimental program. The analysis of the first direct (precursor) measurement of the deuteron EDM in COSY is currently ongoing. Due to the complexity of storage rings, this study requires demanding precision in measurements and a thorough understanding of systematics. Beyond that, the design report of the prototype EDM storage ring is the next milestone of the JEDI (Jülich Electric Dipole moment Investigations) research program.

In this talk, I will present the current status of the JEDI program for the measurement of proton and deuteron EDMs, discuss the various technical developments, and show recent results. In particular, I will present a first result of our oscillation EDM measurement with polarized deuteron beams at COSY and its impact for Dark Matter searches.

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