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The search for proton and deuteron Electric Dipole Moments using storage rings

The Standard Model (SM) of Particle Physics is not capable to account for the apparent matter-antimatter asymmetry of our Universe. Physics beyond the SM is required and is either probed by employing highest energies (e.g., at LHC), or by striving for ultimate precision and sensitivity (e.g., in the search for electric dipole moments). Permanent electric dipole moments (EDMs) of particles violate both time reversal (T) and parity (P) invariance, and are via the CPT-theorem also CP-violating. Finding a non-zero EDM would be a strong indication for physics beyond the SM, and pushing upper limits further provides crucial tests for any corresponding theoretical model. Up to now, EDM searches focused on neutral systems (neutrons, atoms, and molecules). Storage rings, however, offer the possibility to measure EDMs of charged particles by observing the influence of the EDM on the spin motion in the ring. Direct searches of proton and deuteron EDMs bear the potential to reach sensitivities beyond 1E-29 e cm.

Since the Cooler Synchrotron COSY at the Forschungszentrum Jülich provides polarized protons and deuterons up to momenta of 3.7 GeV/c, it constitutes an ideal testing ground and starting point for such an experimental program. The collaboration is presently aiming at a first direct (precursor) measurement of the deuteron EDM in COSY, using an RF Wien filter that was specifically designed for that purpose. Beyond that, the technical design of a prototype EDM storage ring constitutes the next major milestone of the JEDI research program, which shall be addressed together with CERN in the framework of a newly formed CPEDM collaboration (Charged Particle Electric Dipole Moment collaboration).

The talk will present the JEDI plans for the measurement of proton and deuteron EDMs, and discuss the various technical developments, and also show recent results.
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