Search for electric dipole moments using storage rings

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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 searched for by (i) employing highest energies (e.g., at LHC), and (ii) striving for ultimate precision and sensitivity (e.g., in the search for electric dipole moments (EDMs)). Permanent EDMs of particles violate both time reversal (T) and parity (P) invariance, and are via the CPT-theorem also CP-violating. Finding an EDM would be a strong indication for physics beyond the SM, and pushing upper limits further provides crucial tests for any corresponding theoretical model, e.g., SUSY.

Direct searches of proton and deuteron EDMs bear the potential to reach sensitivities beyond 10^{-29} e·cm. As will be discussed in the presentation, this goal can be pursued either with an all-electric proton storage ring, or by an approach using a combined electric-magnetic lattice which shall allow access to the EDMs of proton, deuteron, and ^{3}He in one-and-the-same machine.

As a proof of principle experiment, the JEDI collaboration is currently preparing for a first direct measurements of the EDM of the proton and the deuteron using the conventional magnetic storage ring COSY. To open up the possibility for an EDM measurement, this experiment will employ a novel waveguide RF Wien filter, whereby the spins of protons or deuterons can be manipulated at frequencies of about 0.1 to 2 MHz.

The talk will highlight recent achievements from the JEDI R&D program at COSY, and emphasize one of the most spectacular possibilities in modern science: Finding a signal for new physics beyond the Standard Model through the detection of a permanent electric dipole moment using a storage ring.

[1] http://collaborations.fz-juelich.de/ikp/jedi/