

Working Group #2

Measurement of Electric Dipole Moments in Storage Rings

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Permanent Electric Dipole Moments (EDMs) of subatomic particles violate both time invariance and parity. Assuming the CPT theorem, the violation of time invariance implies CP violation. The CP violation of the Standard Model is orders of magnitude too small to be observed experimentally in EDMs in the foreseeable future. Since it is also too small to explain the observed excess of matter over antimatter in our universe, other mechanisms beyond the realm of the Standard Model must be at play. High precision measurements of EDMs therefore provide a valuable means to search for physics beyond the Standard Model such as supersymmetry or multi-Higgs models, for instance [1,2].

EDM experiments with charged hadrons are proposed at storage rings where polarized particles are exposed to a radial electric field [3]. If an electric dipole moment exists, the spin vector will experience a torque resulting in a change of the original spin direction which can be determined using elastic scattering of the beam particles on a carbon target. Although the principle of the measurement is simple, the smallness of the expected effect makes this a challenging experiment requiring new developments in various experimental areas.

In this working group the spin motion for a first direct EDM measurement with a polarized deuteron beam in the Cooler Synchrotron COSY utilizing an RF Wien filter will be worked out [4]. One important ingredient is the required spin coherence time necessary to reach a certain statistical sensitivity: A particle ensemble with perfectly aligned spin vectors will decohere after a certain time. This time scale is described by the spin coherence time. Another important quantity is the so called spin tune. As in an NMR experiment spin vectors precess in the magnetic field of the accelerator. The number of spin rotations per particle revolution is defined as the spin tune. Finally the students should understand the relevance of charged particle EDMs and the basic principles of a measurement at storage rings.

References

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