EDM Measurements in Storage Rings

February 1, 2021 | Maximilian Vitz

RWTH AACHEN UNIVERSITY

JEDI

JÜLICH Forschungszentrum

Member of the Helmholtz Association

Physics case

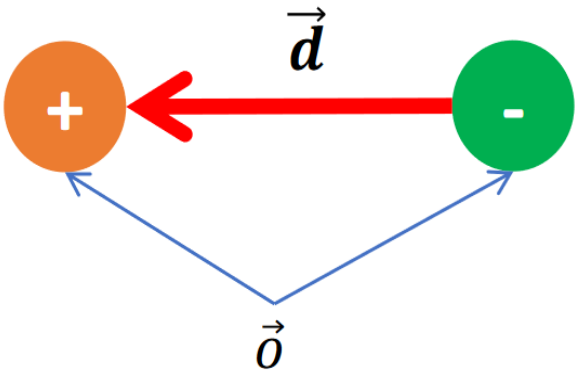
- Asymmetry between matter and antimatter $\Rightarrow$ Sakharov: Source of CP-Violation $\Rightarrow$ EDM

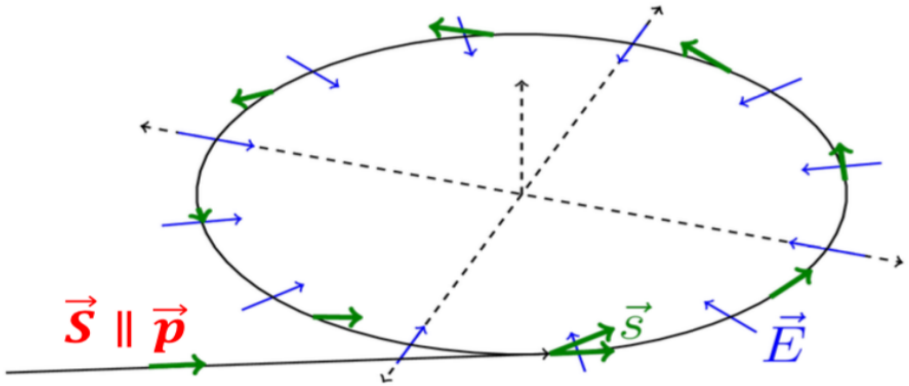
EDM:

- permanent separation of charges
- closely connected to the spin
- predicted by the SM but unmeasurable small

Measuring method:

- use a storage ring as a charged particle trap
- inject particles with spin and momentum aligned
- apply radial electric field and measure build-up of vertical polarization





Spin Coherence Time

- to reach statistical sensitivity ⇒ keep spins aligned as long as possible (1000 s)
- Coherent particle bunch is needed ⇒ SCT ⇒ time until the total polarization falls below 1/e

Spin Decoherence:

- Particles are off-momentum
- Particles do not see identical fields
- Particles are not on same orbit
- Spin resonances

Solution:

- Bunching and cooling of the beam
- Change system parameters
  ⇒ Chromaticity: $\xi = \Delta Q / \Delta p$