Search for Axion-Like Particles with Polarized Beams at Storage Rings

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Polarized hadron beams provide a powerful tool for exploring interactions that are unobservable with unpolarized beams, particular for testing symmetry violations. Axions are leading particle candidates for dark matter. They were originally introduced to solve the strong CP problem and have also appeared in various extensions to the Standard Model (SM). At low axion masses, axion/axion-like-particle (ALP) dark matter behaves as a classical field, affecting spin motion in storage rings and potentially creating an observable signal when the ALPs field frequency resonates with the beam's spin precession frequency.
The JEDI collaboration conducted the first proof-of-principle experiment using the polarized deuteron beam at the Cooler Synchrotron (COSY). While no ALP signal was detected, the experiment established upper limits on the oscillating electric dipole moment (oEDM) due to ALPs.
In this presentation, measurements at COSY and possible future experiments that can be performed at existing GSI/FAIR accelerators with polarized hadron beams or targets will be discussed. The working principle of axion searches in storage rings will be explained. Additionally, the latest simulation results will be presented, with a focus on the accelerator lattice optimization of the Spin Coherence Time (SCT).

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