Storage ring as an ALP antenna – experimental proof of principle

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Axions or axionlike particles (ALPs) would couple to the spin of nucleons and nuclei, either directly through the axion-wind effect, or indirectly, inducing an oscillating electric dipole moment in nucleons. If ALPs are a part the cold dark matter in our Galaxy, they can be treated as a classical field. A beam of in-plane polarized hadrons cinrculating in a storage ring can therefore be used as an ALP antenna. At the resonance between the frequency of an ALP field and the spin-precession frequency of the beam, a buildup of the vertical polarization component should appear as a signal of the ALP presence. As the ALP mass and frequency are unknown, the beam momentum, which is directly related to its spin-precession frequency, needs to be ramped in a search for resonance crossing.
The JEDI collaboration conducted a proof-of-principle experiment demonstrating this new method using the deuteron beam of the COSY synchrotron. An ALP mass range of 0.495-0.502 neV/c^2 was scanned. No ALP signal was observed, but a 90% confidence upper limit on the oscillating electric dipole moment of 6.4×10^{-23} e.cm was obtained. The experimental method was successfully tested through injection into the ring of a fake ALP signal generated using a radio-frequency Wien filter.
In my talk, I will discuss the method, necessary preparatory work and developments, the experiment and its subtleties, and the results.