

The Search for Electric Dipole Moments of Charged Particles in Storage Rings

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Electric dipole moments (EDMs) are probes of physics beyond the Standard Model and are closely related to the search for new sources of CP violation required to explain the matter-antimatter asymmetry of the universe. Permanent EDMs violate time-reversal and parity symmetries and, assuming the CPT theorem, imply CP violation. In addition, axions and axion-like particles (ALPs), proposed to solve the strong CP problem and as candidates for dark matter, are predicted to induce oscillating EDMs.

The COoler SYnchrotron (COSY) at Forschungszentrum Jülich provided polarized deuteron beams and was an ideal starting point for the JEDI Collaboration to develop storage-ring-based EDM searches. Over recent years, several milestones were achieved at COSY, including high-precision spin-tune measurements, spin-coherence times exceeding 1000 s, and operation of radio-frequency (rf) devices for spin manipulation. These achievements enabled the first direct measurement of the deuteron's permanent EDM in a storage ring and the first search for oscillating EDMs, both observed through the build-up of vertical polarization. This presentation summarizes the experimental results obtained and discusses upcoming steps toward high-precision storage-ring EDM measurements.