

Storing muons in a compact frozen-spin trap to search for an electric dipole moment

Thursday 4 September 2025 16:40 (25 minutes)

A dedicated search for the muon electric dipole moment using the frozen-spin technique [1] promises to extend our reach towards physics beyond the Standard Model incorporating additional sources of CP violation. The muEDM Collaboration is developing a compact frozen-spin trap [2] to enable a first demonstration of this technique, with a target sensitivity of 6×10^{-23} ecm, more than a factor of 1000 beyond the current limit [3]. Polarized muons of 28 MeV/c from a high intensity muon beamline at the Paul Scherrer Institute will be injected off-axis into a 3 T superconducting solenoid and stored at its centre with an orbital radius of 30 mm. A fast kicker magnet will reduce axial momentum and permit confinement within a weakly-focusing magnetic field.

The hallmark of the frozen-spin technique is the cancellation of the spin precession induced by the anomalous magnetic moment ($g - 2$) by precisely tuning a radial electric field. This enhances sensitivity by permitting only the precession out of the orbital plane as would arise due to a non-zero EDM. The parity-violating muon decay allows spin-tracking of an ensemble by reconstructing trajectories of emitted positrons using an array of scintillating fibres. With systematic effects controlled [4], an EDM would be apparent from the measured rate of change in asymmetry of positron emitted up- and downstream of the orbital plane. This talk will outline the developments undertaken by the Collaboration and preparations for the upcoming demonstration of core systems. In particular, the efforts in developing a fast kicker magnet and optimisation of the storage dynamics will be presented.

[1] F.J.M. Farley *et al.*, *Phys. Rev. Lett.* **93**, 052001 (2004).

[2] A. Adelmann *et al.*, *Eur. Phys. J. C* **85**, 622 (2025).

[3] G.W. Bennett *et al.*, *Phys. Rev. D* **80**, 052008 (2009).

[4] G. Cavoto *et al.*, *Eur. Phys. J. C* **84**, 262 (2024).

Authors: Dr SCHMIDT-WELLENBURG, Philipp; HUME, Timothy (Paul Scherrer Institute)

Presenter: HUME, Timothy (Paul Scherrer Institute)

Session Classification: WG4+WG6

Track Classification: NuFACT 2025: WG4 - Muon Physics