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Development of the muEDM Muon Trigger Detector

The muEDM experiment at the Paul Scherrer Institut (PSI) aims to measure the muon electric dipole moment (EDM) with unprecedented sensitivity, targeting sigma;(dμ)=6×10^{−23} e · cm, a three-order-of-magnitude improvement over the current limit established by the BNL muon g−2 experiment. Central to this effort is the muon trigger detector (TrigDet), positioned at the solenoid entrance, which provides rapid and precise identification of muons within the solenoid’s storage acceptance. This trigger initiates a pulsed magnetic field to direct muons into stable orbits, where a radial electric field enables the frozen-spin technique for isolating EDM-induced spin precession.

The TrigDet utilizes plastic scintillators read out by silicon photomultipliers (SiPMs) and consists of two subsystems: a sub-millimeter-thick Gate detector for minimally invasive muon detection, an Active Aperture detector to veto non-storable muons via anti-coincidence logic.

By operating in anti-coincidence, the system ensures selective triggering on storable muons while suppressing background events. A prototype TrigDet was validated at the PSI πE1 beamline using surface muons, with performance assessed through comparative analysis of experimental data and Geant4-based simulations. We present key design principles, prototype test results (including detector response and electronic timing performance), and progress toward achieving the muEDM experiment’s transformative sensitivity goals.

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