

First test beam of an all-silicon polarimeter demonstrator for proton EDM searches (in-person)

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Permanent EDM (Electric Dipole Moments) of elementary particles are prime candidates for finding new physics beyond the Standard Model. Permanent EDM of charged particles can be measured in innovative storage rings by observing a polarisation change caused by interaction between a particles spin vector and stable electric fields.

The cpEDM (charged particle EDM) Collaboration aims to design an all-electric storage ring for proton EDM studies that could be either hosted at CERN or COSY (Cooler Synchrotron). To address this challenging project, the cpEDM Collaboration assumes a staged approach. The prototype ring stage, which serves as a proof-of-principle, uses protons with 30-45 MeV kinetic energy necessitating a low material budget polarimeter.

This contribution presents an all-silicon polarimeter for proton EDM searches. The polarimeter is comprised of one 100 μm layer of HV-CMOS (High Voltage-CMOS) sensors for high spatial resolution, surrounded by two layers of LGAD (Low Gain Avalanche Detectors) in a time of flight configuration to provide high energy resolution by means of picosecond timing resolution. The HV-CMOS layers will be used to accurately determine the scattered direction of the protons and for track reconstruction. Geant4 simulations have showed that such a system meets the energy resolution necessary for the experiment (less than 3%) whilst retaining a short time of flight length (less than 1 m).

We have designed a polarimeter demonstrator based on a prototype LGAD (USFD2), with 200 μm strip pitch. The polarimeter is read out using a TRB3 board featuring four FPGA-based TDCs (Time-to-Digital Converters) with <20 ps RMS (Root Mean Square) time precision between two individual channels. The positions of the timing layers can be reconfigured remotely to test the energy resolution obtained with different time of flight lengths. The application for pEDM studies, design and test beam evaluation at a medical proton therapy centre are presented.

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