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A silicon pixel detector prototype for μ SR

Muon spin rotation (μ SR) is a powerful technique for studying the magnetic and superconducting properties of materials by utilizing positive muons as highly sensitive local magnetic probes. Traditional μ SR experiments use scintillators as detectors, which limit sensitivity to subtle magnetic dynamics due to pile-up issues. Employing silicon pixel sensors with superior spatial and temporal resolution enables precise tracking of muon stopping positions and clear identification of decay positrons through vertex reconstruction. This integration not only allows for much higher muon beam rates but also facilitates smaller sample sizes, longer data gate lengths, and broader depth penetration, thereby opening up new possibilities for exploring novel research directions and subtle effects in magnetic and superconducting systems.

High-Voltage Monolithic Active Pixel Sensors (HV-MAPS), originally designed with an extremely low material budget for low-energy electron tracking in the Mu3e experiment, are well-suited for μ SR measurements. To showcase the potential of this technology, a prototype telescope equipped with four layers, each comprising 2x2 MuPix11 sensors, is currently under development, aiming to demonstrate the practical application of silicon pixel sensors in μ SR experiments.

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