

# Development of Silicon Photo-Multiplier (SiPM) Detectors for Muon Scattering Tomography

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Muon tomography exploits the natural flux of cosmic-ray muons to probe dense and shielded structures non-invasively. Using the scattering and absorption of muons, material properties and arrangements can be identified. Precise reconstruction of muon trajectories, and hence scattering angles, serves as the basis for muon scattering tomography. Achieving high spatial resolution in such systems requires precise tracking detectors and fast, reliable data acquisition.

We present the development of a Silicon Photo-Multiplier (SiPM) strip detector prototype designed as a potential building block of a hybrid muon tomography stack. The detector modules employ plastic scintillator strips read out by SiPMs, offering compact geometry, high light yield, and scalability. A dedicated FPGA-based data acquisition (DAQ) system has been used to handle multi-channel operation and is compatible with both gaseous and scintillator detector layers. The system integrates NINO ASIC front-end electronics for fast signal shaping and discrimination, followed by direct LVDS processing on an Altera MAX-10 FPGA with 500 MHz sampling capability. This architecture enables high precision in timing and signal processing across multiple detector channels, enhancing the tracking accuracy.

Preliminary results from characterization and efficiency studies of the SiPM modules demonstrate promising performance, validating the design choices. The presentation will discuss detector optimization, DAQ integration, and system-level performance, highlighting the potential of this approach for building efficient, scalable muon scattering tomography setups.

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