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A Silicon Strip Telescope for Prototype Sensor Characterisation Using Particle Beam and Cosmic Rays

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We present the design and the performance of a silicon strip telescope that we have built and recently used as reference tracking system for prototype sensor characterisation. The telescope was operated on beam at the CERN SPS and also using cosmic rays in the laboratory. We will describe the data acquisition system, based on a custom electronic board that we have developed, and the online monitoring system to control the quality of the data in real time.

Summary

We have designed and built a tracking system capable to operate on particle beam and also using cosmic rays in laboratory. The telescope consists of 8 layers of single-sided silicon strip detectors with 512 strips each and is used as reference tracking system for the characterisation of prototype silicon sensors. The detectors are read out using Beetle chips, custom ASICs developed for the LHCb experiment, which provide the measurement of the hit position and pulse height of 128 channels. The detector size is about 10 cm x 10 cm and the strip pitch is 183 um. The maximum trigger rate accepted when operated on beam is 1.1 MHz while cosmic rays in laboratory are detected at a rate of about 1 Hz. The data acquisition system is based on a custom electronic board equipped with Xilinx-7 FPGA, providing the digitalisation of the analog signals, zero suppression and managing the data flow. For the signal digitalisation, multichannel 12-bit ADCs with high speed serial outputs are used. A TDC with sub-ns resolution is implemented in FPGA to measure the time interval between the triggers received by the Beetle chip and the sampling time. This feature is useful in order to determine the TDC value for optimal signal over noise ratio. A user friendly GUI was developed to configure and run the data acquisition system and monitor the quality of the data in real time.

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