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Real time tracking with a silicon telescope prototype using the "artificial retina"algorithm

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We developed a prototype of a silicon tracker with real time tracking capabilities. The working principle is based on the 'artificial retina'algorithm, based on extensive parallelisation of data distribution and pattern recognition.
The algorithm, inspired by neurobiology, has been implemented on custom data acquisition boards based on FPGAs Xilinx Kintex 7 lx160 in three main logic modules: a switch for the routing of the detector hits, a pool of engines for the digital processing of the hits, and a block for the calculation of the track parameters. The architecture is fully pipelined and allows the reconstruction of real-time tracks with a latency below 100 clock cycles, corresponding to 0.25 microsecond at 400 MHz clock.
The silicon telescope consists of 8 layers of single-sided silicon strip detectors with 512 strips each. The detector size is about 10 cm x 10 cm and the strip pitch is 183 um. The detectors are read out by Beetle chips, custom ASICs developed for the LHCb experiment, which provide the measurement of the hit position and pulse height of 128 channels.
We report on the first results of the fast tracking device and compare with simulations.

Collaboration

On behalf of the RETINA Collaboration. The RETINA project is funded by CSN5 of INFN. The members of the RETINA Collaboration are affiliated with Università di Milano, Politecnico di Milano, Università di Pisa, Scuola Normale Superiore di Pisa, Fermilab (USA) and INFN, Italy.

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