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A novel 4D fast track finding system using precise space and time information of the hit

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We propose a novel fast track finding system capable of reconstructing four dimensional particle trajectories in real time using precise space and time information of the hits. The fast track finding device that we are proposing is based on a massively parallel algorithm to be implemented in commercial field-programmable gate array using a pipelined architecture. We will present studies of expected tracking performance and first results based on a hardware prototype.

Summary

The use of the precise space and time information is crucial for the HL-LHC experiments since it allows the suppression of background hits not compatible with the time of passage of the particle and the determination of its time evolution. Recent developments in silicon pixel detectors achieved 30 ps time resolution and intense R&D is in progress.
We describe a 4D algorithm for a tracking system prototype based on 12 planes of silicon pixel sensors, providing precise space and time information, as a case study. In particular, the tracking planes are considered as 6 pairs and "stubs" are constructed linking two measured space points. According to simulations the time information of the hits is effective to reduce fake tracks combinations while improving real-time track reconstruction at high rates. The system provides offline-like tracks with a short latency of order one microsecond. A sector of a pixel detector with HL-LHC conditions has been simulated on a prototype hardware device. First results based on simulated data will be shown.

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