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Design and development of micro-strip stacked module prototypes for tracking at S-LHC

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Experience at high luminosity hadrons collider experiments shows that tracking
information enhances the trigger rejection capabilities while retaining high efficiency for interesting physics events. The design of a tracking based trigger for Super LHC (S-LHC), the already envisaged high luminosity upgrade of the LHC collider, is an extremely challenging task, and requires the identification of high-momentum particle tracks as a part of the Level 1 Trigger. Simulation studies show that this can be achieved by correlating hits on two closely spaced silicon strip sensors. The progresses on the design and development of micro-strip stacked prototype modules and the performance of few prototype detectors will be presented. The prototypes have been built with the silicon sensors and electronics used to equip the present CMS Tracker. Correlation of signals collected from sensors are processed off detector.Preliminary results in terms of signal over noise and tracking performance with cosmic rays will also be shown.

Summary

Tracking detectors at future hadron colliders will operate in extreme experimental conditions: the increase of the collider luminosity in order to extend the physics
reach and the sensitivity to discoveries will imply the study of more complex events, collected with a very high collision rate. Under these conditions is mandatory to keep the trigger rate under control without loosing sensitivity to interesting physics phenomena. The present LHC experiments, such as CMS, make use of tracking information as part of the higher level trigger, in order to select interesting physics events among those accepted by the Level-1 trigger.
The increased luminosity of the S-LHC collider will imply a revision of the trigger strategy: the most appealing and promising solution considered today is to incorporate the tracker information at the Level-1 selection. The design of a tracking based trigger for SLHC is an extremely challenging task, and requires the measurement of the charged particle momentum by a fast evaluation of the track direction of flight. The timing constraints for a Level-1 trigger decision will imply that trigger capability should be a feature of the detectors used in the next generation trackers. In particular the capability to process higher levels of information by the use of correlations in space, should be intrinsically introduced in the sensors as well as in the read-out electronics, thus increasing the
complexity of the detector design. This work is a preliminary approach on how to exploit charged particle cluster properties to produce trigger information. The research focuses on the design and development of module prototypes made of two silicon micro-strip sensors stacked one on top of the other. By measuring the hit positions in the stacked planes it is possible to have a fast evaluation of the direction of flight of the particle that can be used for trigger decisions. The effectiveness of the method has been evaluated using real collision data. We will discuss the technical challenges in the construction of stacked modules and the performance of the produced prototypes.

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