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The LHCb Silicon Tracker: Running experience

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The LHCb Silicon Tracker is part of the main tracking system of the LHCb detector at the LHC. It measures very precisely the particle trajectories coming from the interaction point in the region of high occupancies around the beam axis.

After presenting our production and comissioning issues in TWEPP 2008, we report on our running experience. Focusing on electronic and hardware issues as well as operation and maintenance adversities, we describe the lessons learned and the pitfalls encountered after three years of successful operation.

Summary

The LHCb Silicon Tracker is part of the main LHCb tracking system and provides data for the region of high track densities. For the tracking station TT in front of the main dipole magnet, the Silicon Tracker covers the full acceptance angle of the experiment, while for the stations T1-T3 after the magnet, the Silicon Tracker only covers the region directly around the beam pipe. The Silicon Tracker covers a sensitive are of 12 mˆ2 using silicon micro-strip sensors with very long readout strips. The analogue hit information of the silicon strip detectors, which is amplified by the Beetle readout chip, is transmitted via copper cables to Services Boxes which are located outside the acceptance area. The Service Boxes hold Digitizer Boards, on which the analogue signals from the Beetle front-end chips are digitized and encoded into a Gigabit data stream for transmission via VCSEL diodes and 120 m of multi-ribbon optical fibre to the counting house. In the counting house, the optical ribbons can be directly connected to TELL1 preprocessor boards equipped with two multi-channel optical receiver cards.

Final results from the production of the detector modules and the readout electronic boards, as well as some other issues encountered during early commissioning, were already presented in TWEPP 2008. After taking data successfully for three years, we report on the running experience of the Silicon Tracker and the lessons learned through its operation.
We report on new hardware and electronic issues, due mainly to aging and human intervention, but also to design misconceptions impossible to spot in a test setup. We report as well on the defects already spotted on production and comissioning of the detector, some of which did not seem a concern at that time, which are affecting the performance of the system and how they are dealt with. The main barriers encountered when trying to solve these problems without disturbing data taking and trying to keep the balance between performance improvement and risks taken are also analyzed.
Despite the need of hardware maintenance, the weakest link is the control system due to its need of scalability and flexibility to evolve and adapt to the control hardware and the demanding and ever changing needs of the shift crew.
The Silicon Tracker takes very special care of ensuring the safety of the electronics with up to three levels of security involving extensive monitoring of the environmental conditions of the electronics and multiple automated actions, and a fine granularity of the system, enabling the individual control of different scopes and detector regions.
We feel the need of sharing the improvements achieved since the start of data taking and the experience acquired and lessons learned since then.

Primary author: Ms SAORNIL GAMARRA, Sandra (Universitaet Zuerich (CH) on behalf of LHCb Silicon Tracker group)

Presenter: Ms SAORNIL GAMARRA, Sandra (Universitaet Zuerich (CH) on behalf of LHCb Silicon Tracker group)

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