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Operational Experience With The SCT Optical Links

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The optical links for the SCT have all been installed in ATLAS and are now used for data taking. This talk will review the processes required for the commissioning the links and the tools used to set-up the links and monitor their performance. This allows for an assessment of the current quality of the optical links as well as starting to monitor their long term performance. The methodology for setting up the timing of the TTC links will be described. Lessons learned from the commissioning of the optical links will be discussed.

Summary

The optical links for the SCT have been installed in ATLAS. The optical links read out the data from each of the 4088 SCT modules as well as providing the Timing, Trigger and Control data to each module. The final connections for the electrical and optical services for the links were completed last year and rapid tests were used to verify the continuity. It was essential to rapidly determine and fix any problems before access to the connections became impractical. A few cases of dirt inside optical connectors were found and were easily fixed by cleaning the connectors. One case of a broken fibre ribbon near the detector was found and this was repaired using a fusion splicer. The tests of the optical links, then allowed an assessment of the quality of the installed links, which was generally very good although there were a few dead channels. The chief causes of the dead and problematic links were ESD VCSELs and single fibres that were broken during the final integration, after which access became impossible. The low level of non-functional links will not lead to any significant loss of data, due to the data and TTC redundancy schemes that are being used. A very small fraction of the TTC links, have delivered optical power lower than required for long term operation and the corresponding VCSEL arrays in the counting room will be replaced.

The methodology used for setting up the data and TTC links, as well as the tools that will be used to monitor their long term performance will be reviewed. This monitoring involves a combination of analogue measurements, digital scans and some simple in-situ Bit Error Rate measurements. Some proposals for how to improve these tools for the upgraded tracker at SLHC will be discussed.

For the Timing Trigger and Control links it is essential to be able to adjust the timing of the L1 signal in order to read out the triggered event. It is also necessary to optimise the phase of the 40 MHz clock received by each module in order to maximise the detector efficiency. The procedures used to achieve this involved measuring the lengths of all the optical fibres from the counting room to the on detector patch panels. The final optimization of the timing will be done by scanning the phase of the 40 MHz clock and measuring the module hit efficiency using track data. Results from this procedure using Cosmic ray data will be presented. The TTC system uses BiPhase Mark encoding to encode the command data on top of the 40 MHz clock. Therefore, in order to minimise the jitter for the 40 MHz bunch crossing clock, it is important to optimise the mark to space ratio of the incoming 20 MHz clock. The procedures used to achieve this will be explained.

Finally some general lessons learned from the commissioning of the optical links will be discussed which will be relevant for the optical readout of the upgraded tracking detectors for the SLHC.

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