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ATLAS Silicon Tracker commissioning with cosmic ray and beam data

Monday 15 February 2010 14:50 (25 minutes)

The ATLAS Pixel Detector is the innermost detector of the ATLAS experiment at the Large Hadron Collider at CERN. It consists of silicon sensors equipped with approximately 80 M electronic channels and will allow to detect particle tracks and secondary vertices with very high precision.
After connection of cooling and services and verification of their operation the ATLAS Pixel Detector is now in the final stage of its commissioning phase. Prior to the first beams expected in Autumn 2009, a full characterization of the detector was performed. Calibrations of optical connections, verification of the analog performance and special DAQ runs for noise studies were done. Combined operation with other subdetectors in ATLAS allowed to qualify the detector with physics data from cosmic muons.
The talk will show all aspects of detector operation, including the monitoring and safety system, the DAQ system and calibration procedures. The summary of calibration tests on the whole detector as well as analysis of physics runs with data will be presented.

Summary (Additional text describing your work. Can be pasted here or give an URL to a PDF document):

Summary

The ATLAS Pixel Detector was connected to the electrical and cooling services and off-
detector readout electronics in March 2008.
All connections were certified before the detector was closed.
Prior to the operation with the Large Hadron Collider (LHC) beam,
all the necessary tunings of the pixel detector have been performed
and the detector itself has been fully qualified. The detector has been successfully integrated into the ATLAS Trigger and DAQ system
allowing data-taking with high efficiency synchronously with other sub-detectors.

The detector functionality checks have been performed starting from the early production phase. For this purpose, dedicated calibration techniques have been
implemented. These techniques have been developed with each detector assembly stage, matching the demands of the real detector services and readout system.
Additional calibration procedure, related to the operation in ATLAS, have been introduced.
The characterization aims for stable operation of the detector and
provides input for the offline analysis to guarantee high quality of the reconstructed data. Important detector characterization issues are:
- tuning of optical links - to have reliable connections between the detector and readout electronics and to adjust fine detector timing;

- threshold tuning - to have a uniform predefined threshold for all detector channels;
- ToT tuning - to have a uniform detector response upon detection of the same deposited charge for all detector channels . The ToT (Time over Threshold) is the number of LHC clock cycles detector signal stays above threshold, which is proportional to the signal amplitude.
- bump connectivity check - to check for unconnected channels;
- ToT calibration - to calibrate detector response to input charge;
- noise occupancy check - to verify low-noise performance and spot noisy channels;
- timewalk check - to study timing behaviour of detector channels;
- sensor check - to study charge collection efficiency and detector leakage current.

Previous experience with detector characterization so far has been limited to parts of the detector. In contrast, the results shown in this presentation
give a summary of qualification tests for the whole detector in situ.

In addition, analysis of special data-taking runs with pseudo-random triggers
to verify noise occupancy, as well as the outcome of combined runs with cosmic muons (and possibly beam collisions) will be presented, with measurement of detector performance (efficiency, occupancy, Lorentz angle and position resolution) with real data.

Ref 1: G. Aad et al., ATLAS Pixel Detector Electronics and Sensors,
Journal of Instrumentation,3, P09004 (2008)

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