Commissioning of the ATLAS Pixel Detector

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on behalf of the ATLAS Pixel Collaboration

The ATLAS Silicon Pixel Detector

- 1744 modules, 46080 pixel each
- 1.8m² active silicon
- 80 MHz TDC clock
- 15um (1.4ns)
- 3 track points to
- zero-suppressed, analog readout
- on-chip data reduction
- 1000 tracks of clusters associated with a cosmic muon track in the pixel detector

Optolink Commissioning

- Parameters to be tuned:
  - downlink (optional): laser power, discriminator thresholds
  - uplink (essential):
  - laser power on detector
  - off-detector PIN diode
  - off-detector timing
  - sampling clock phase
- Maximum error-free region
  - 30 BC
- Tuning procedure:
  - 0-1-0-1 pattern to check for transmission errors
  - Tuning procedure takes ~1h for full detector

Commission in 2008

- Phase 0: April
  - connection sign-off
  - first pixel cooling loop commissioning
- Phase 1: August
  - cooling loop commissioning
  - optolink operation (incl. onboard cooling and heating)
- Phase 2: September – October
  - optolink tuning
  - definition of largest possible set of modules
  - ATLAS combined cosmic data taking
- Phase 3: November – December
  - optolink tuning
  - module tuning of hits
  - debugging of module problems
  - ID combined cosmic data taking
  - various detector studies

Charge calibration - TOT tuning

The feedback capacitance of the charge-sensitive preamplifier is discharged by a constant, adjustable current. This results in a nearly linear dependence between the ‘time-over-threshold’ (TOT) and the input charge. TOT is measured in units of the bunch-crossing (25ns).

To calibrate the TOT an increasing charge is injected in the preamplifier input and the TOT response is parameterized.

A DAC determines the input charge and the TOTs are recorded. An accurate parameterization is needed to convert TOT to charge which is used to improve the position resolution of clusters.

The change distribution for clusters associated to a cosmic muon track in the pixel detector (left) peaks at the expected value of 20,000e, validating the chosen parameterization of the TOT.

The contribution of noise hits, which show a small charge, is very small.

Cosmic Data Taking

- first pixel cooling loop commissioning
- first joined ATLAS combined data taking on sept. 4
- wrong trigger timing -> no hits on tracks
- LHC first beam sept 10
- next data taking sept 14, improved timing
- first pixel tracks reconnected
- until then not much time for module debugging
- many modules damaged
- this improved with time and detailed module studies

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Threshold Adjustment

Discriminator thresholds can be adjusted individually (68--75e, dyn. range 7 bit)

Goal: threshold at 4000e

Measurement

- inject varying charge to amplifier
- fit gaussian error function
- threshold & noise

Doing this measurement on the full detector takes ~1.5h

Results for 75 million pixels or 96% of the full detector:

- Dr. Jens Weingarten