SCT Offline Software and Performance Overview

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28th October 2013

- Performance studies using Run 1 data
  - SCT performance paper
  - Other performance studies
- Ongoing software activities - preparing for next run
  - Preparing for radiation damage effects
  - Conditions
  - Other developments

SCT Performance Paper

- ATLAS paper covering operation and performance in 2010-13 (Run 1)
  - Operation, DQ and monitoring, alignment
  - Standard performance measurements: occupancy, efficiency, noise, Lorentz angle
  - Analyses: dE/dx, δ-ray production
  - Radiation effects: leakage currents and predictions, RadMon measurements, SEUs
- Several meetings with Edboard since May, to discuss structure and details of each analysis section
- Current draft (~50 pages) can be found in:

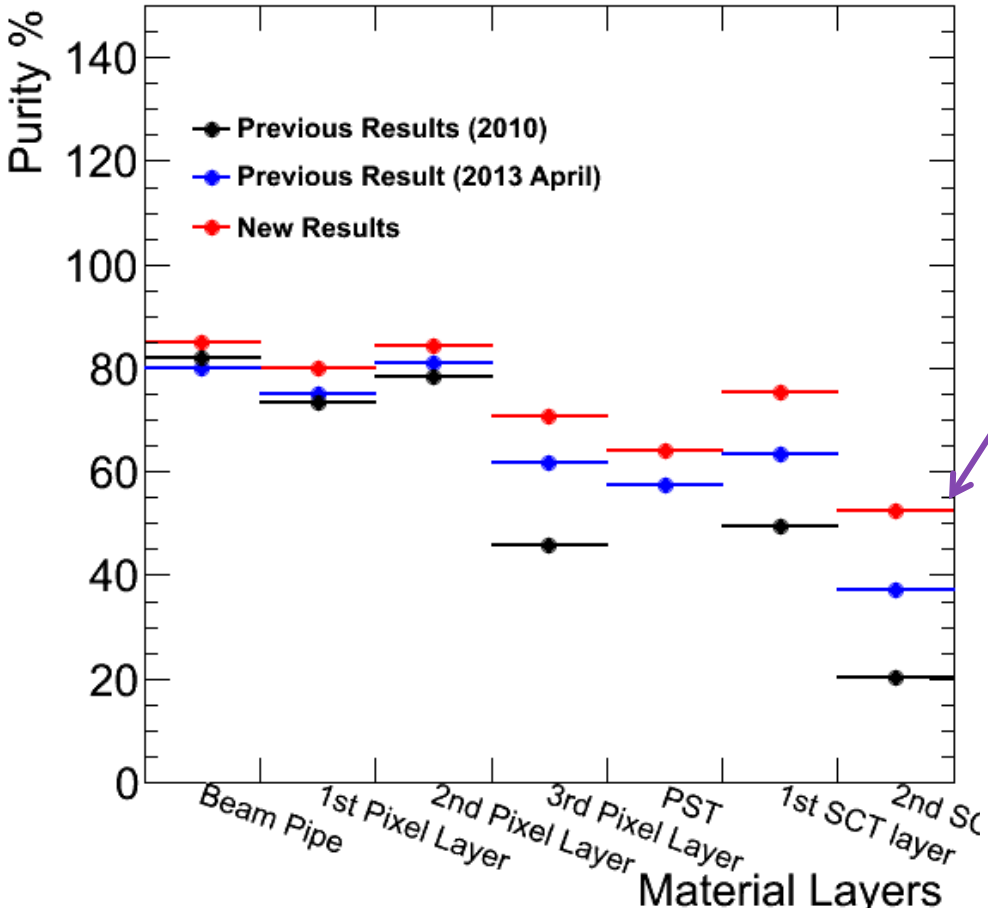
  https://cds.cern.ch/record/1554069/
- Comments from other members of ID welcome
- Aim to finish by end of the year

Performance Studies

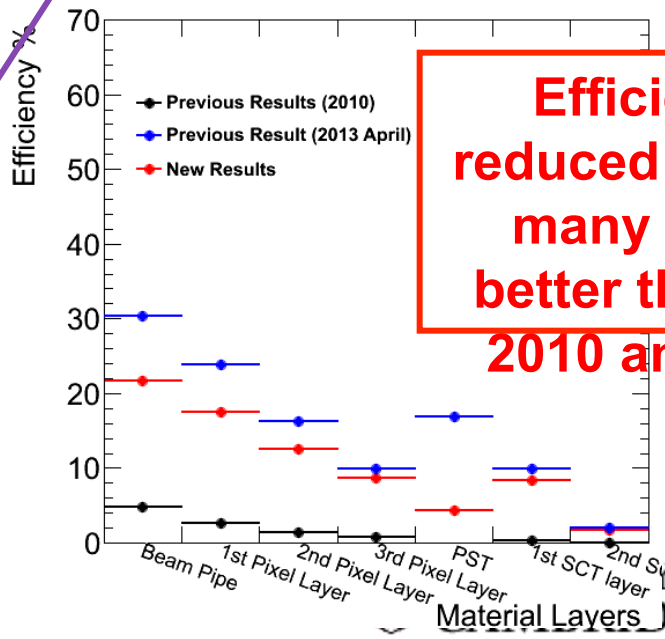
- Several performance studies in progress:
  - Cluster sizes (Laura Rehnisch)
    - Using identified muons to study time dependence of cluster size in 2012
    - Results expected soon
  - Lorentz angle (Cristiano Alpigiani)
    - Studying systematic errors for measurements in performance paper
  - Efficiency measurements (Pat)
    - Main source of inefficiency is dead / noisy strips
  - Material measurement using hadronic interactions (Nora Pettersson)
    - Trying to extend study to endcaps, but low efficiency and purity
    - Adding cuts on p_T of secondary track and $\Delta p_T/p_T$ of track wrt secondary vertex improves purity in barrel
    - See talk at SCT meeting tomorrow
- Performance studies reported in SCT weekly meetings, Tuesday 9:30 am
  https://twiki.cern.ch/twiki/bin/viewauth/Atlas/SctSoftwareMinutes

Purity and Efficiency for reconstructing secondary vertices – Nora Pettersson 24/9/13

- **Result** after adding the **new cuts**



- Improved purity in all layers
- 1st and 2nd SCT layers improved
  - 2nd SCT above **50%**!



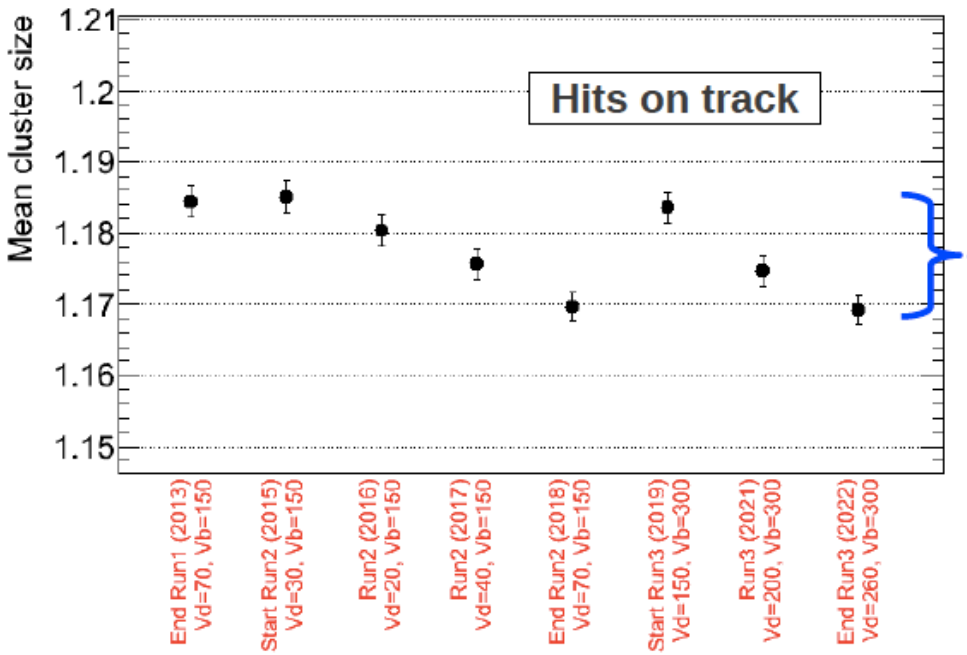
Efficiency reduced but still many times better than the 2010 analysis

SCT Software Activities

- To cope with the era of radiation damage:
- Radiation effects in SCT_Digitization (Marco Filipuzzi, Nils Flaschel)
  - Charge trapping implemented a while ago
  - Expected variation of mean cluster size between end of Run 1 and end of Run 3 is only 1.5%, assuming HV is increased to keep sensors fully depleted
  - No significant change expected in number of hits on track
  - Unnecessary to implement detailed position dependence of fluence now
  - Nils is studying effect of threshold and cross-talk in current digitization
- Use of measured Lorentz angle to correct model prediction in reconstruction (Sergio Grancagnolo)
  - Work just starting
- Implementation of Lorentz angle measurements in prompt calibration loop (Roger Naranjo)
  - Fill plots of mean cluster width v. incident angle in Tier0 monitoring
  - Fit in prompt calibration loop and store values in COOL
  - Currently studying statistics needed

Results

Focusing now on the cluster size for hits on track with the following cuts applied:



Cuts:

Goog track quality:

- pT > 500 MeV
- d_0 (w.r.t PV) < 1 mm
- # PIX hits > 1
- # SCT barrel hits > 7
- Negative tracks

Avoid to mix sensors:

- <111> modules
- Side 1

02/07/2013 Marco Filipuzzi, SCT weekly 12

SCT Conditions

- Run 1 conditions tags:
  - MC global tag includes appropriate SCT configuration data for all IoVs in 2010-2013
    - Tags like SctDaqConfigurationModule-MC-05
  - We use only one set of conditions for all MC for calibration and DCS data
  - For real data, no updates from Tier0 bulk tag needed

- Conditions services:
  - COOL vector payload and caching have been implemented in configuration data in DAQ (Carl Gwilliam)
  - Corresponding offline modifications are waiting for a nightly with COOL vector payload (Shaun Roe)

SCT Software Activities

- Other work in progress:
  - SCT_Digitization (Mahsana Haleem)
    - Restructuring code to improve (remove) code sharing
    - Dependency on SiDigitizationTool for pile-up simulation removed (SCT_Digitization-01-00-00)
    - More simplifications / improvements to be investigated
    - See talk at SCT meeting tomorrow
  - Fast digitization (Tina Sfiligo, Helen Hayward)
    - Implementing fast digitization for all Si detectors as part of ISF
    - First prototype expected before 2014
  - SCT module distortions (Adrian Bevan)
    - Previous study in 2010 (Anna Mayne) found effects negligible
    - Adrian is revisiting these, starting from first principles, using geometry and toy MC to understand expected magnitude of effects
    - Simple model: in-plane offsets sub-micron, temperature effects 2-3 micron
    - Toy MC in progress – see talk at SCT meeting tomorrow

Summary and Outlook

- SCT software has been rather stable during LHC running, but now significant developments in progress to be ready for Run 2
- At the same time, we are trying to finish performance studies on Run 1 data, and complete performance paper
- There are still some things needing effort:
  - Implementation of δ-ray correction in SCT_ClusterOnTrackTool
    - No progress for last 6 months
  - Investigation of cluster position bias
  - More studies on cluster size, and data / MC agreement in general
  - Do we need to change monitoring histograms for Run 2?
- More effort will be needed as we approach the milestone periods in 2014

Backup