AlCaDB Workshop on Run 2017 preparation – Pixel talk

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Pixel Offline meeting

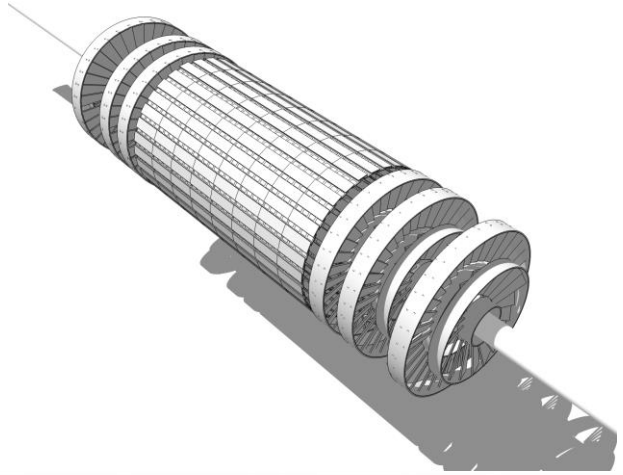
Preparation of 2017 data taking

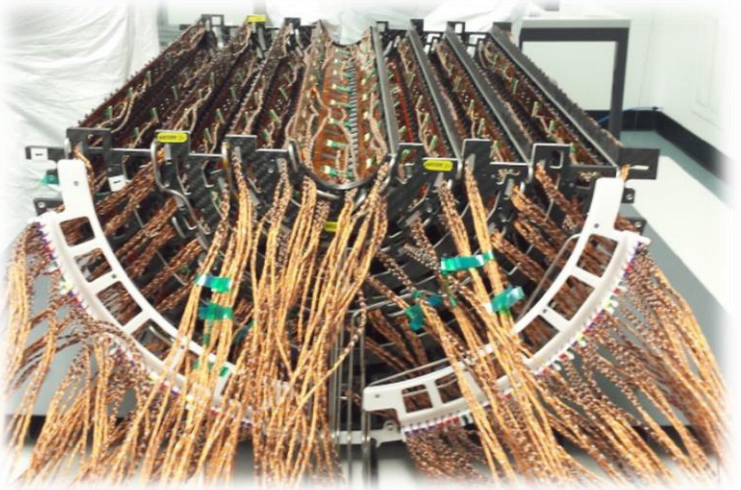
The New Phase I Pixel Detector

4 layers and 3-3 disks allow us better tracking, vertex reconstruction and b-tag efficiency

Digital readout with increased buffer sizes thus we can expect nearly 100% efficiency

Very similar sensor with slightly better resolution (smaller pixel threshold)





Pixel plan for 2017 running

BPIX/FPIX installation Feb 27/March 7

Commissioning and online calibration by week 15

In the beginning of the data taking in June detector alignment and standard set of calibrations and checks

Part of the calibration can be done (less accurately) with cosmics

Calibrations

In the beginning of data taking in around June, we plan to

Fine tune the timing of the detector using the first collisions:

- **Coarse** time alignment with **DQM**
- At the same time, **validate timing offline** based on offline analysis (Efficiency and Cluster charge/size)
- **High Voltage Bias** scan to validate Voltage settings

Measure the Lorentz Angle and update the Templates, GenErrors

Measure and validate that the resolution is as good as expected

Calibrations

Monitoring during the year

In the beginning of **each data-taking period**, we measure **LA, hit efficiency, resolution**, and check if performance is as expected –> update certain payloads if needed

Check the performance of the **simulation** against data and tune it if needed

Inefficiencies will be added when needed (although detector is designed to easily handle 2e34 instantaneous luminosities)

Calibrations

Later during the year

Occasional HV Scans

- after around 20-40 fb^{-1}, voltages will need to be raised
- (similar to the beginning of Run II)

Raising the voltage may only happen in 2018 if the integrated luminosity is not too great

Calibrations

Pixel Calibration Workflows twiki
https://twiki.cern.ch/twiki/bin/viewauth/CMS/PixelCalibrationWorkflows

Pixel DB Tags twiki
https://twiki.cern.ch/twiki/bin/view/CMS/PixelDBTags

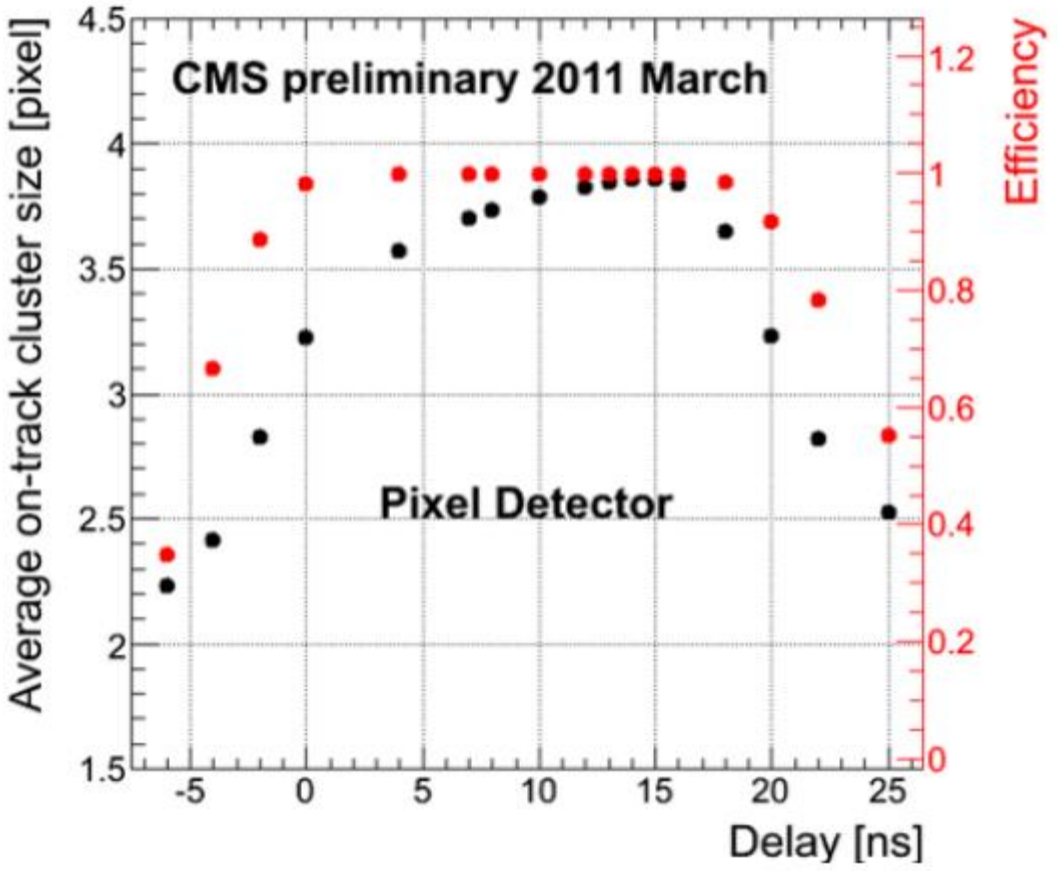
Main Pixel tools software repository:
https://github.com/cms-analysis/DPGAnalysis-SiPixelTools

First in-situ measurement & 2017 operations

Timing scan

Optimal setting of pixel detector clock vs LHC clock must be determined using first collisions:

- **Coarse time alignment** (WBC finding) with DQM dedicated online client is being prepared
- **Fine tuning** with DQM and offline analysis (efficiency and cluster size/charge)



During the data taking:
not planned

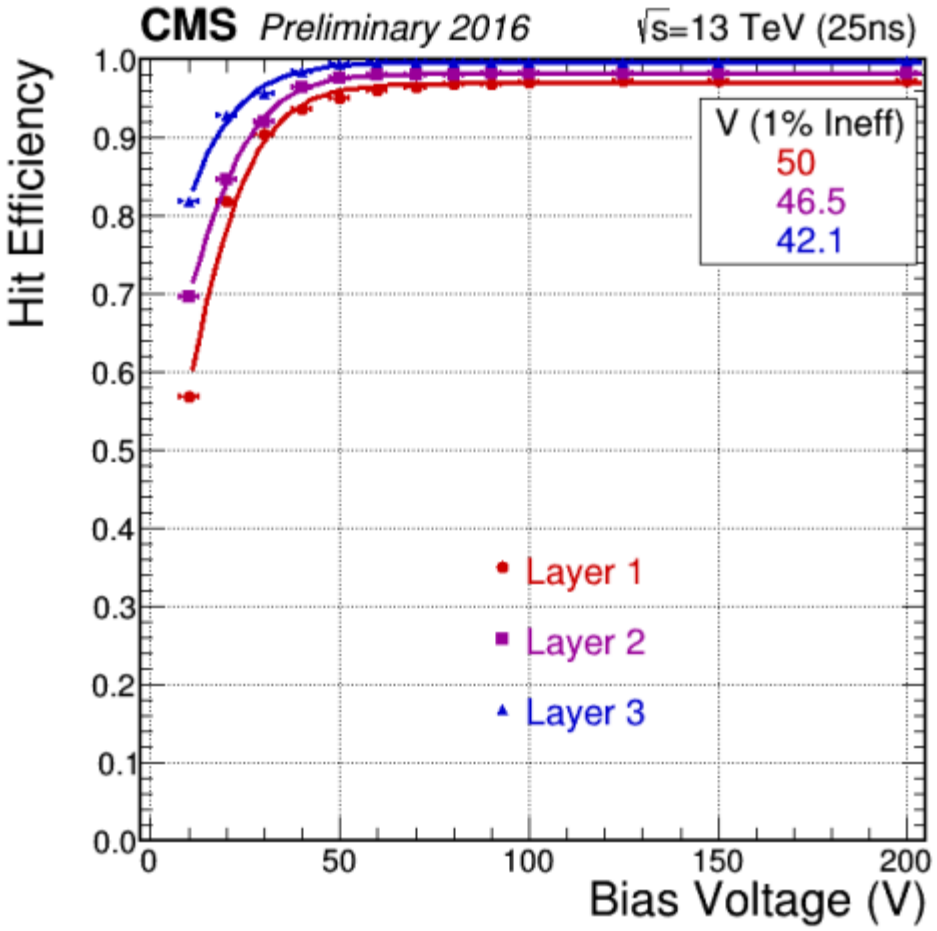
HV scan

The efficiency for the hits on track measured for different bias voltages → if silicon is fully depleted, hit efficiency reaches plateau

If short with time, HV scan might be skipped as sensors are new and known

Change in 2018 is probable (type-inversion)

Change in the HV settings leads to new LA/GenErr/Template payloads, too



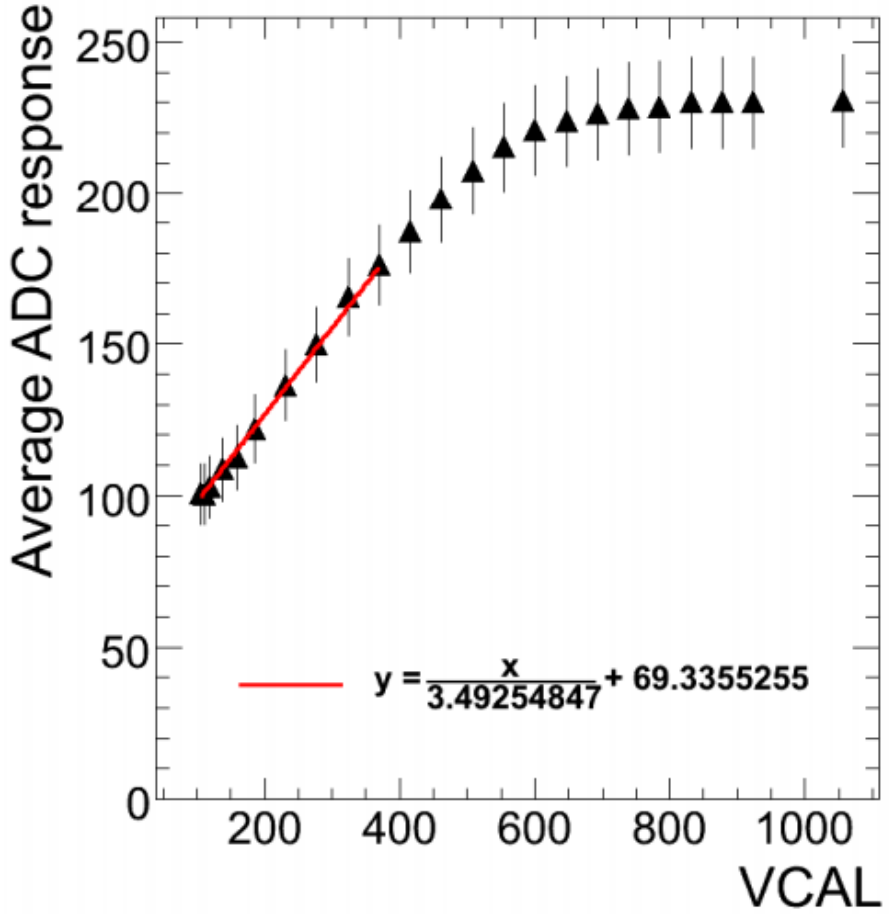
During the data taking
- Perform occasional HV scans
- Raise voltage if/when needed

Gain calibration

ADC to Vcal conversion

The gain and pedestals are extracted from a fit in the low VCal region for each pixel separately

This calibration doesn't require collisions and is done online while running in local Then it is analysed **offline**

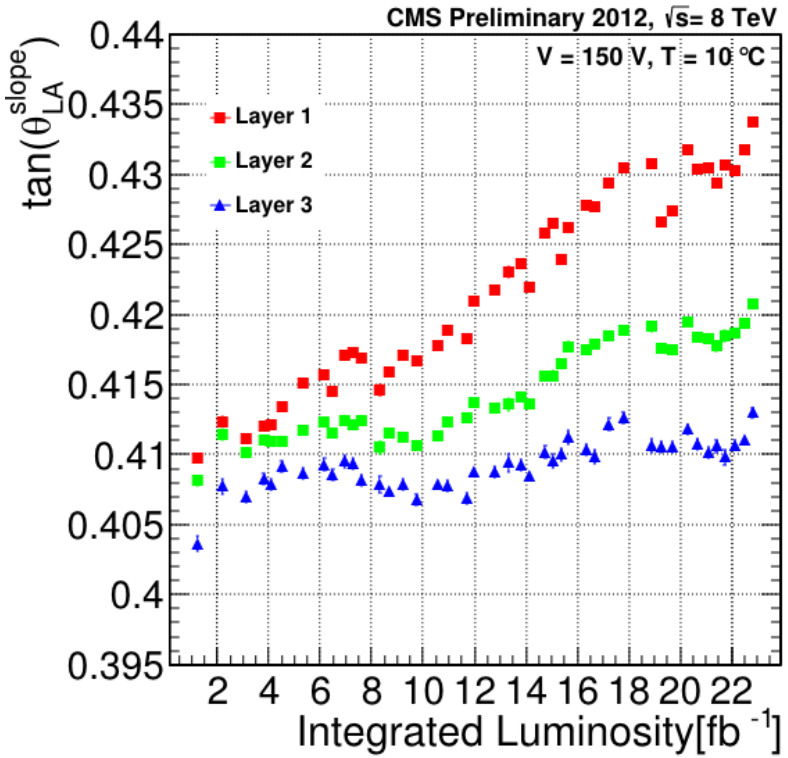


During the data taking
- Every few weeks, but
- DB update at the technical stops

Lorentz Angle Calibrations

Measurements procedure:

- **Barrel** – we use muons from collisions data (/MuOnia/ dataset)
- **Forward** – In Run I we mainly used Cosmic muons for the grazing angle method
- In both cases, we analyze the data **offline**



LA also strongly depend on accumulated **radiation dose** thus we need to measure and upload calibration constants regularly

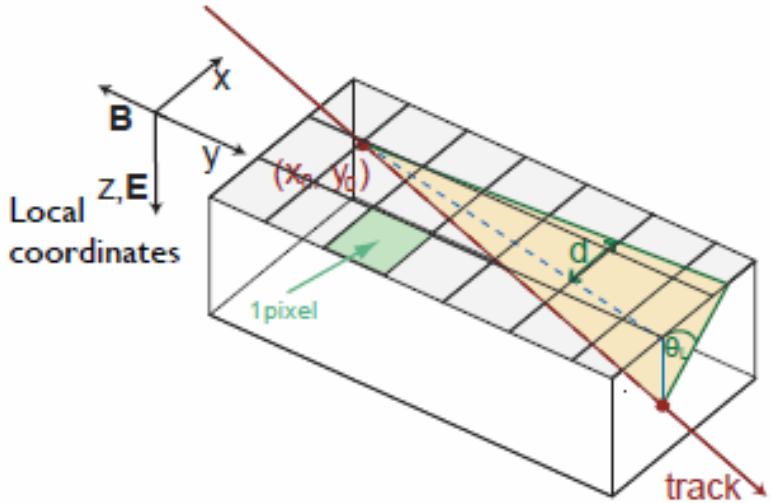
<u>During the data taking</u>

- 5-10 times per year

Templates

Template hit reconstruction:

- Yields a better estimate of the **cluster parameters** than that used in generic hit reconstruction
- Is needed by the alignment that measures the final values of the **Lorentz Angles** that are uploaded into the DB



- We analyze the same dataset **offline** that we use for the Lorentz Angle measurements
- The templates are created with a simulation that uses our Lorentz Angle measurements and is needed for the final ReReco

During the data taking

- DB update at the technical stops

SiPixelQuality – List of Bad Components

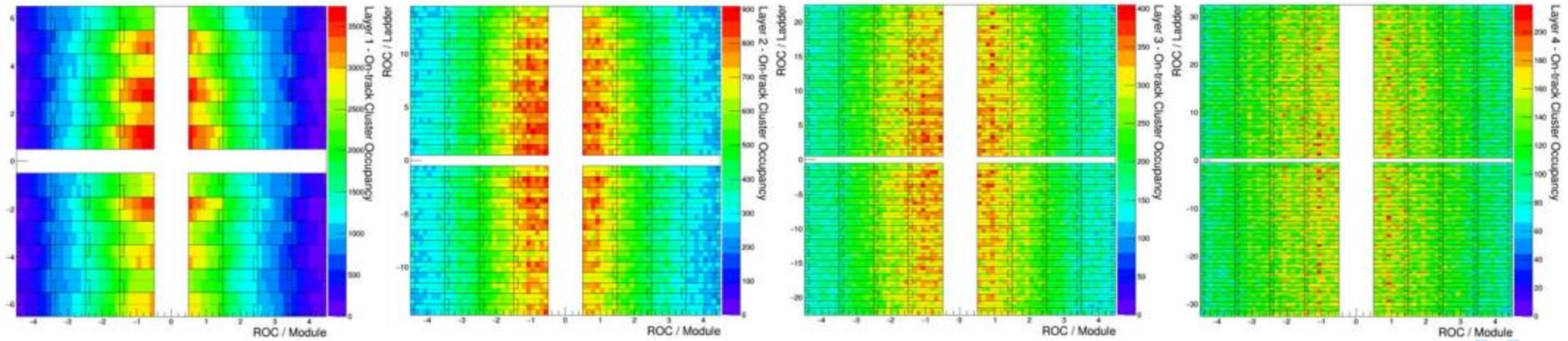
List of dead modules/readout chips of the detector

Problems we encountered in Run I:

- Broken parts (wire-bonds, VAna sense wire)
- Problem with the fiber extension cable
- Temporary issues with old readout chips

During the data taking

- DB update anytime needed



Automation of calibration measurement

Bad component list@PCL is planned

Until that time, SiPixelQuality is updated by hand

DB side of the payloads

Record names (Data)	Record names (Simulation)
SiPixelGainCalibrationOfflineRcd	SiPixelGainCalibrationOfflineSimRcd
SiPixelGainCalibrationForHLTRcd	SiPixelGainCalibrationForHLTSimRcd
SiPixelLorentzAngleRcd	SiPixelLorentzAngleSimRcd
SiPixelTemplateDBObjectRcd	SiPixelTemplateDBObjectRcd
SiPixelGenErrorDBObjectRcd	SiPixelGenErrorDBObjectRcd
SiPixelQualityRcd	SiPixelQualityRcd
SiPixelFedCablingMapRcd	SiPixelFedCablingMapRcd

Scenarios for MC Simulations

Scenarios for MC Simulations

Dynamic Efficiency loss can be simulated

Different parts of the detector fail –> Failure Scenarios study

The validation plots of study can be found in a presentation from me at the Pixel Offline meeting: https://indico.cern.ch/event/607513/#29-pixel-failure-scenarios