CMS SiStrip Calibration Prospects for NGT

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CMS NGT HLT Meeting
https://indico.cern.ch/event/1421776/

CERN | NexTGen Next Generation Triggers

Strip Calibrations at HLT

From the survey at cms-talk, spreadsheet Other general information on Twiki

	A	B	C	D	E	F	G
1	Record	Label	Tag	of workflow (O2O, PCL, popco	Critical?	Link to Configuration	How often is it updated (roughly)
295	SiStripApvGain2Rcd	-	SiStripApvGain_FromParticles_GR10_v1_hlt	PCL + MRH, manual upload	Slow reduction in hit efficiency, critical if let	alca harverster	Every couple of weeks/couple of months
296	SiStripApvGainRcd	-	SiStripApvGain_GR10_v1_hlt	O2O	Yes	O2O code, steering scripts documentatic	Every couple of weeks/month
297	SiStripBackPlaneCorrectionRcd	deconvolution	SiStripBackPlaneCorrection_deco_GR10_v1_hlt	Manual	N		no update
298	SiStripBackPlaneCorrectionRcd	peak	SiStripBackPlaneCorrection_peak_GR10_v1_offline	Manual	N		no update
299	SiStripBadChannelRcd	-	SiStripBadChannel_FromOnline_GR10_v1_hlt	PCL	No (only affecting offline)		Every run
300	SiStripBadFiberRcd	-	SiStripBadChannel_FromOfflineCalibration_GR10_v1_hlt	Manual	N		no update
301	SiStripBadModuleRcd	-	SiStripBadChannel_FromOfflineAnalysis_GR10_v1_hlt	Manual	Yes (localised loss of tracking efficiency at	N/A	Might be used occasionaly depending on
302	SiStripBadStripRcd	-	SiStripBadChannel_FromPromptReaction_GR10_v1_hlt	Manual	N		no update
303	SiStripClusterThresholdRcd	-	SiStripClusterThreshold_GR10_v1_hlt	Manual	N		no update
304	SiStripConfObjectRcd	-	SiStripShiftAndCrosstalk_GR10_v1_hlt	Manual	N		no update
305	SiStripConfObjectRcd	apvphaseoffsets	SiStripAPVPhaseOffsets_v3_hlt	Manual	N		no update
306	SiStripDeDxElectron_3D_Rcd	-	SiStripDeDxElectron_3D_30X	Manual	N		no update
307	SiStripDeDxKaon_3D_Rcd	-	SiStripDeDxKaon_3D_30X	Manual	N		no update
308	SiStripDeDxMip_3D_Rcd	-	SiStripDeDxMip3D_v03	Manual	N		no update
309	SiStripDeDxPion_3D_Rcd	-	SiStripDeDxPion_3D_30X	Manual	N		no update
310	SiStripDeDxProton_3D_Rcd	-	SiStripDeDxProton_3D_30X	Manual	N		no update
311	SiStripDetVOffRcd	-	SiStripDetVOff_GR10_v1_hlt	Manual	N		no update
312	SiStripFedCablingRcd	-	SiStripFedCabling_GR10_v1_hlt	O2O	Yes	O2O code, steering scripts documentatic	Every couple of weeks/month
313	SiStripLatencyRcd	-	SiStripLatency_GR10_v2_hlt	O2O	?		Every couple of weeks/month
314	SiStripLorentzAngleRcd	deconvolution	SiStripLorentzAngleDeco_GR10_v1_hlt	Manual	N		no update
315	SiStripLorentzAngleRcd	peak	SiStripLorentzAnglePeak_GR10_v1_hlt	Manual	N		no update
316	SiStripNoisesRcd	-	SiStripNoise_GR10_v1_hlt	O2O	Yes	O2O code, steering scripts documentatic	Every couple of weeks/month
317	SiStripPedestalsRcd	-	SiStripPedestals_GR10_v2_hlt	O2O	Not in std ZS data-taking		Every couple of weeks/month
318	SiStripThresholdRcd	-	SiStripThreshold_GR10_v1_hlt	O2O	Not in std ZS data-taking		Every couple of weeks/month

Strip Calibrations at HLT: O2Os

- **There is a block of 6 records, that are updated from the so-called DAQ O2O (more info)**
  - The Strip DAQ O2O populate tracker conditions from the online master data storage (OMDS) to the offline reconstruction conditions database (ORCON). Six types of payloads are populated in this O2O

SiStripBadStrip	SiStripBadChannel_FromOnline_GR10_v1_hlt
SiStripFedCabling	SiStripFedCabling_GR10_v1_hlt
SiStripLatency	SiStripLatency_GR10_v2_hlt
SiStripNoises	SiStripNoise_GR10_v1_hlt
SiStripPedestals	SiStripPedestals_GR10_v2_hlt
SiStripThreshold	SiStripThreshold_GR10_v1_hlt

- **The DAQ O2O is manually triggered by the online team in tkCommissioner.**
  - The conditions O2Oed reflect the measurements of the hardware at P5.
  - Regularly updated every time there is a change of configuration (e.g. FED permanently masked, change in the ZeroSuppression mode for Heavy Ion, et.c)
  - The CMSSW jobs for the six tags run in parallel using python's subprocess package.

Strip calibration at HLT: O2O (part 2)

- **SiStripDetVOffRcd (dummy tag at HLT)**
  - The Strip DCS O2O populate tracker HV/LV information from PVSS database to the offline condition database (ORCON). This DCS info is used in prompt reco. Modules that are OFF are retrieved from the PVSS database and stored in the condition database via hourly cron jobs. Three cron jobs are set up for the DCS O2O, including one production job and two validation jobs, each write to a different tag in the condition database with a different delay in time.

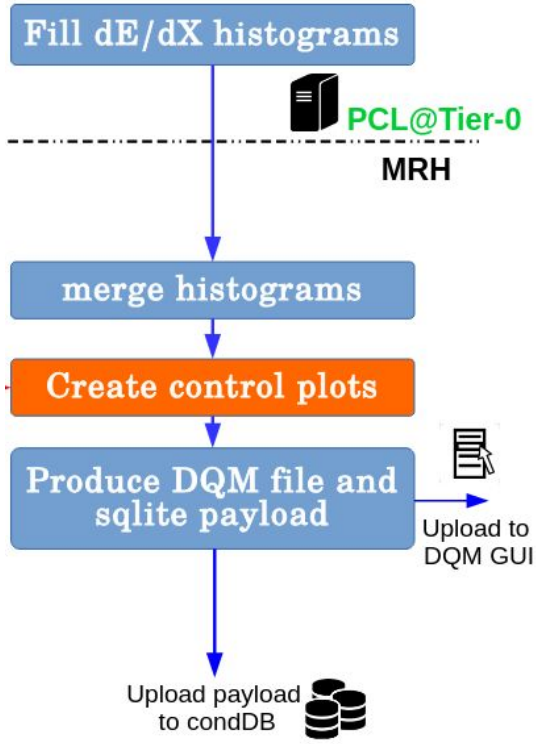
  - This O2O doesn't write on the HLT tag, because it's deemed too dangerous for data-taking if any error in the population of the tag occurs (masking of the wrong part of the detector can lead to complete tracking failure).

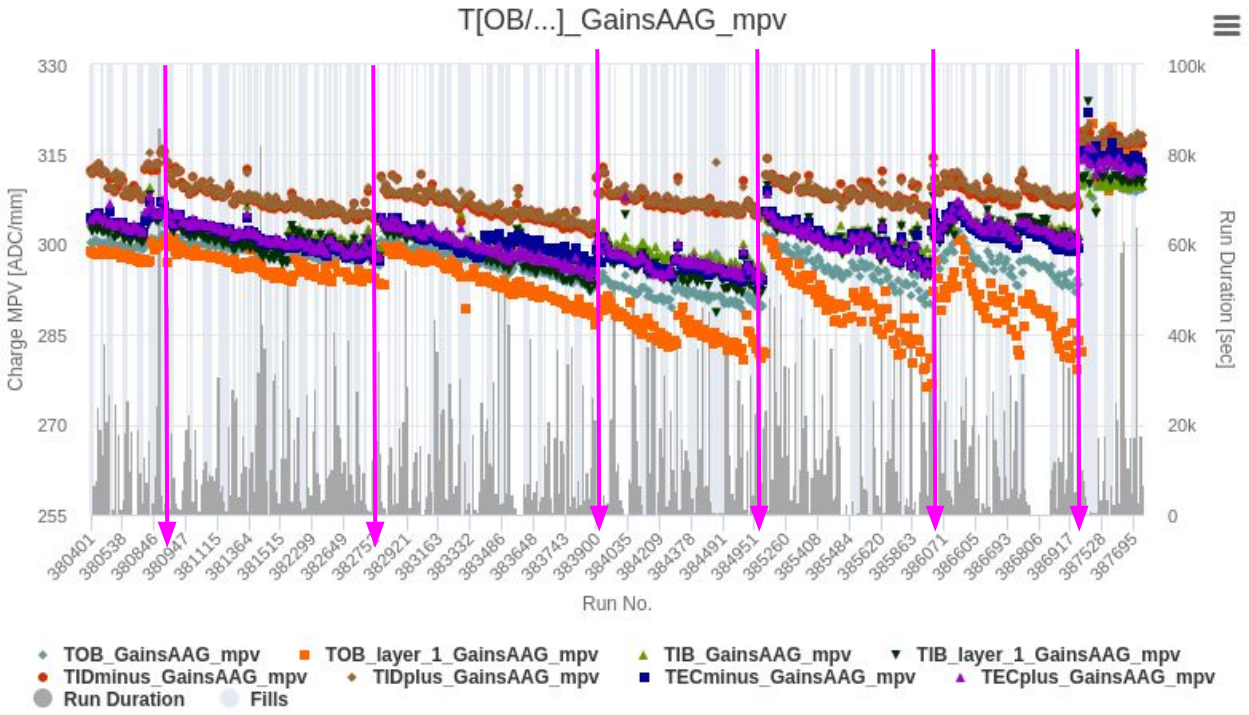
Strip Calibrations at HLT: Gains

- **The gain calibration is performed in two sequential steps, each one delivering a calibration factor. These steps, referred as the calibration sequence, are:**
  - **Trick Mark calibration** (SiStripApvGainRcd): the tick marks are external signals, input into the readout chips every 35 LHC clocks, that are used to synchronize the tracker modules to the central trigger. When the detector is synchronized, the height of the voltage pulse at the tick mark is equalized in gain among all the readout chips to 640 ADC counts. This calibration corrects for the electronic effects at the readout level but does not account for the differences at the sensor level.
    - This is performed via the so-called tickmark O2O more information
  - **Particle Calibration** (SiStripApvGain2Rcd): the particle calibration equalizes the detector response for the measurement of the m.i.p. charge. The charge measured by each cluster on track is corrected for the track path in the sensor depletion region and therefore used to build the distribution of the ionization charge per unit of length. The voltage gain is tuned to have the most probable value of these distributions, made for every sensors, set to 300 ADC counts / mm. This procedure requires a lot of track statistics (~1B clusters).
    - This is performed via a multi-run harvesting based PCL workflow: more information

Strip Gain2 calibration PCL

- **Calibration runs in the PCL (via Multi-Run Harvesting).**
  - Monitoring of cluster charge MPV happens in the central DQM (also in hDQM), status report, optimization studies
  - Monitoring of the conditions moved to the centrally maintained Payload Inspector: status report;

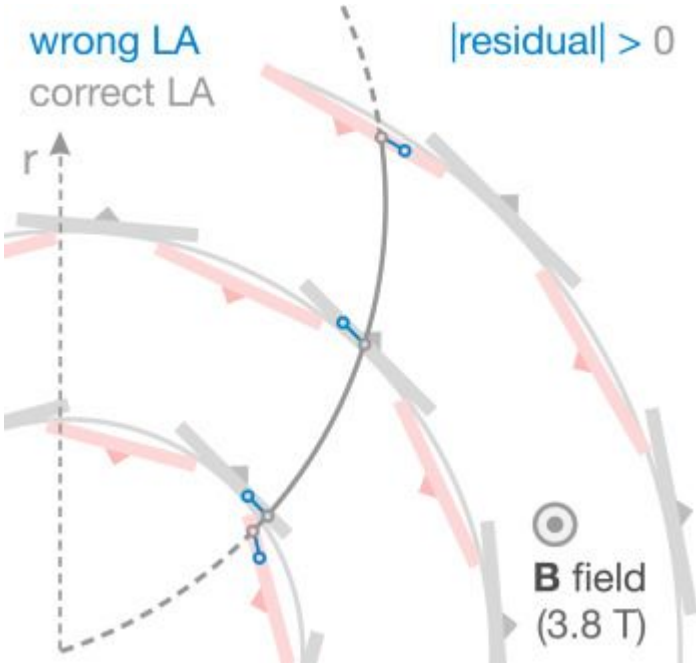




- **Payloads are manually uploaded by the Strip experts after a fast track validation.**
  - calibration of 70k APVs requires a lot of input statistics (1B clusters), so it's done only every so often.
- **Bumps in the average cluster charge clearly visible once calibration is performed.**

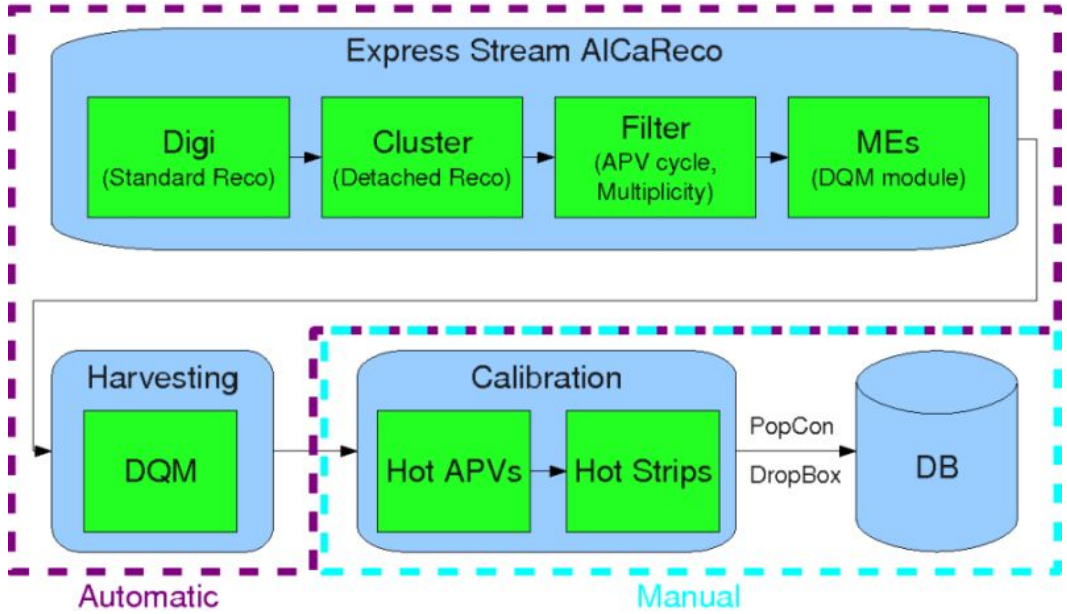
Strip CPE related conditions (Twiki)

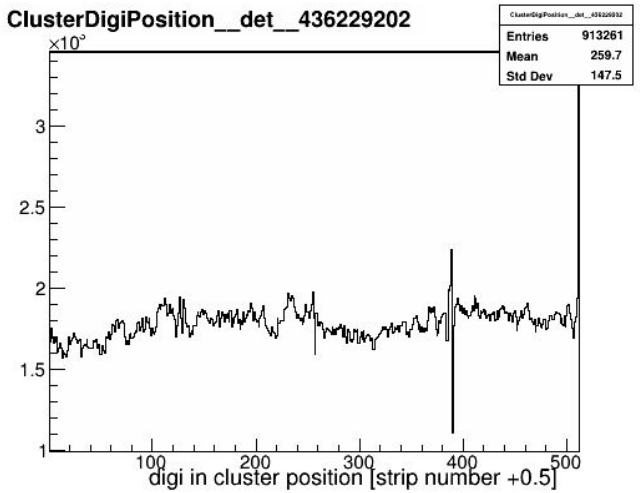
- **There are 2 CPE (for the non-initiated, this means the cluster -> ratchet conversion) related conditions:**
  - **SiStripLorentzAngleRcd**
  - **SiStripBackPlaneCorrectionRcd**
- **Both come in 2 flavors (2 labeled tags): “deconvolution” and “peak”**
  - Depending on the readout mode (in nominal 40MHz collisions we **always** are in deconvolution)
- **Both calibrations require dedicated workflows that need special data (3.8T cosmics, 0T cosmics, low PU collisions, etc. etc.)**
  - They have basically never been updated since the early Run 2;
  - As they influence the global position of the Strip hits, they are effective incorporated in the Tracker Alignment calibration, as the procedure treats a CPE condition miscalibration as geometrical mis-positioning of hit.
    - For better or worse not directly calibrated, a stub of monitoring workflow that runs in the PCL exists (see this presentation)



Strip bad components (Twiki)

- **For the identification of bad components it's important that the analysis is based on data which do not take into account the knowledge of bad components identified during the offline analysis of previous runs.**
  - This has to be ensured because bad components might be recovered from one run to another so that they have to be qualified unbiased afterwards. Since the reconstruction chain used to produce the usual tracker AlCaReco streams already includes bad components from offline analysis, these streams cannot be used here.
- **Therefore, a new AlCaReco stream dedicated to the bad component identification in the strip tracker was introduced in the AlCaReco workflow. It is called ALCARECOSiStripCalZeroBias and has the following properties:**
  - The input are the digis from standard reconstruction since they are independent from bad channel masking. The reconstruction is performed up to cluster (so only the digi to cluster step is performed in the AlCaReco).
  - Only bad components from cabling and o2o are taken into account during reconstruction. Bad components from offline analysis are not considered.
  - Only events with random trigger are selected. For collision data the HLT path HLT_ZeroBias and for cosmic data the HLT_Random
  - The output of the stream contains only the cluster collection and the L1AcceptBunchCrossings collection (needed by the filters against APV induced noise). This can be used as starting point in case the calibration has to be redone.
  - The DQM output contains one cluster occupancy histogram per strip detector. These histograms are used as input for the bad component algorithms. In addition, the ClusterVsAPVCycle and the TotalNumberOfCluster histograms are stored for each sub-detector.
- **Once the DQM output of a given run with enough statistics is available from the central DQM harvesting, the bad component identification can be performed as described here: Twiki link**





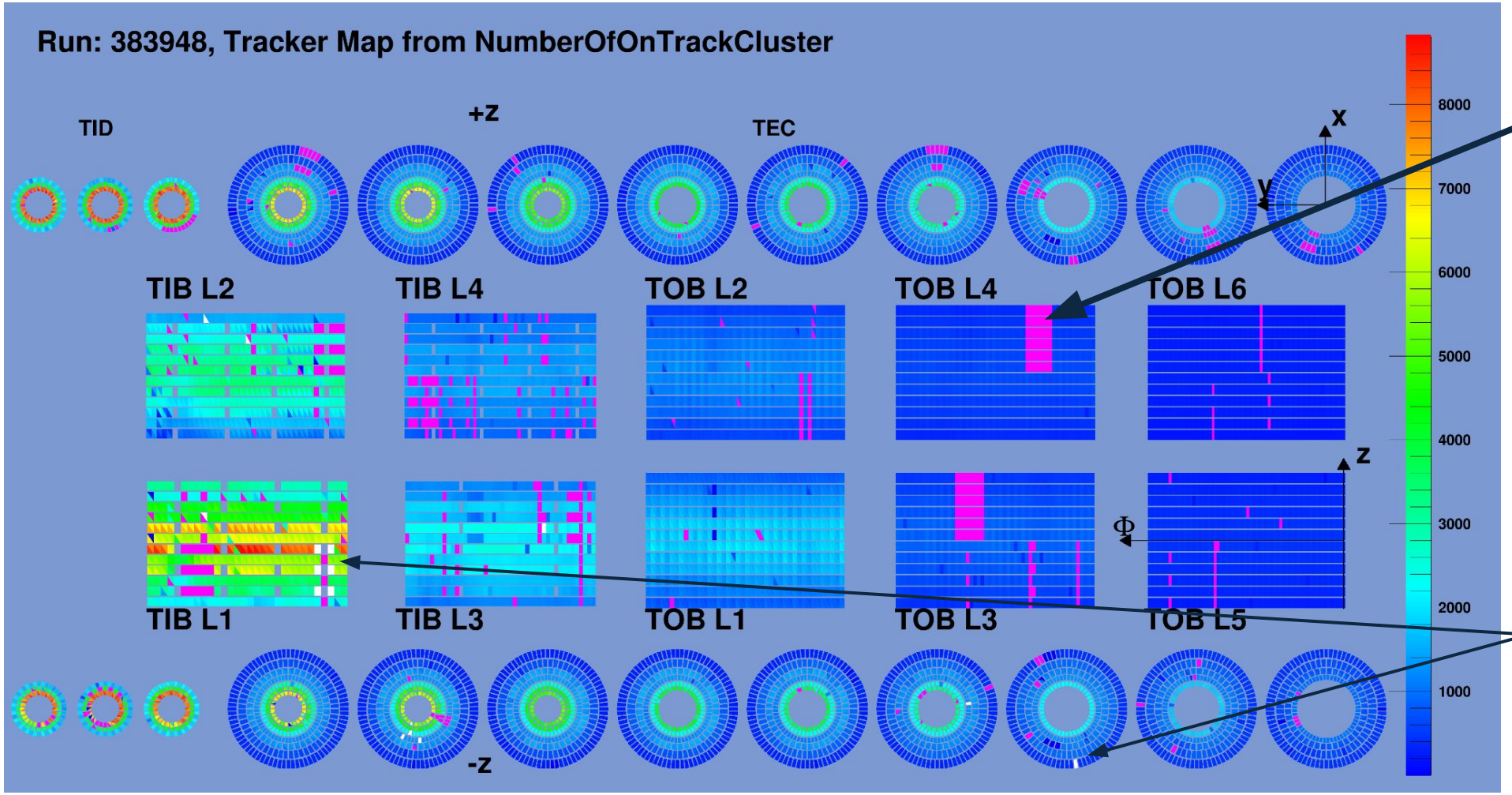
Strip bad components at HLT

- **The bad components are applied in reconstruction in such a way that different levels of masking - usually associated to different levels of the readout: single strips, APVs, fibers (two APVs) or whole modules - are merged together in a single EventSetup object (SiStripQuality, ESProducer)**
  - SiStripQuality is then used in several place in the CKF-based tracking in order to let the algorithm know if a missing hit is really missing or it's sitting on a "inactive" detector (thus the hit becomes inactive).
  - This allows to take different branches of the code and bolsters efficiency in case of known holes.
- **At HLT for most of this tags (only exception is the tag populated via O2O SiStripBadChannel_FromOnline_GR10_v1_hlt) we have an "ideal" payload, for the same reasons we don't profit of the SiStripDetVOff (see slide 4)**
  - It was initially deemed too dangerous to populate these tags with anything that could jeopardize tracking at HLT;

SiStripBadChannelRcd	-	SiStripBadChannel_FromOnline_GR10_v1_hlt
SiStripBadFiberRcd	-	SiStripBadChannel_FromOfflineCalibration_GR10_v1_hlt
SiStripBadModuleRcd	-	SiStripBadChannel_FromOfflineAnalysis_GR10_v1_hlt
SiStripBadStripRcd	-	SiStripBadChannel_FromPromptReaction_GR10_v1_hlt

  - It was recently realized that an appropriate detector masking helps with the muon inside out iterations at HLT: a manual cross-check workflow has been put into place to monitor holes known to HLT reco.

Example cross-check of HLT bad components masking



In magenta are the modules are marked as “inactive” at HLT, taken from e.g.: here

The rest of the map is filled with the number of on-track clusters collected during that run.

Areas that remain “white” in these maps, are modules that are not masked, but do not send hits, thus they should be masked by they aren’t

Summary

- **In terms of strip calibrations that makes sense to include in the NGT workflow (notice though that there won't be a Strip detector in the Phase 2 Tracker - OT will be a mixed technology detector with different layout and readout), the only thing that would fit nicely is the bad components masking.**
- **That's true for a series of reasons:**
  - it runs already in the PCL;
  - it requires a small input statistics to be able to find obvious new holes;
  - it has some non-zero potential impact on the trigger decisions (e.g. as recently shown in N different TSG meetings a masking reflecting the detector state helps track building in the inside out muon reconstruction)
- **All the rest requires either much more development (no complete PCL workflow in place) or much more input statistics**
  - e.g. the G2 gains, albeit having that would have some small impact on the cluster charge cut we use in the track building - potentially seeding when extending it to Strips.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