ID Data Quality: TRT, ID global and the interplay of the subsystems

Steffen Schaepe

Physikalisches Institut
Universität Bonn

Ringberg Castle, January 17, 2011

universitätbonn

ID Data Quality: TRT, ID global and the interplay of the subsystems

1. TRT Data Quality
   - Results from 2010 running
   - DQ tools used by the TRT
2. Data Quality: ID subsystems
   - ID global / alignment
   - Cooperation of ID subsystems
3. DQ Defects Database
4. Outlook

TRT DQ results from 2010 running

- Rule of thumb: TRT is green ;)
- Only one Lumiblock red during pp running
- . . . due to "human error"
- Problems with the gas mixture at the beginning of the year turned out to be recoverable after recalibration
- At the beginning of the HI running TRT was turned off in the reconstruction due to a communication problem
- After reprocessing with TRT enabled all HI runs could be flagged green

$\Rightarrow 100\%$ data taking efficiency!
Many Thanks to the whole TRT team!

Problems observed in 2010

Wrong gas mixture Due to broken parts in the gas system, will hopefully not happen again

TRT turned off in reconstruction Due to confusion at the beginning of HI running

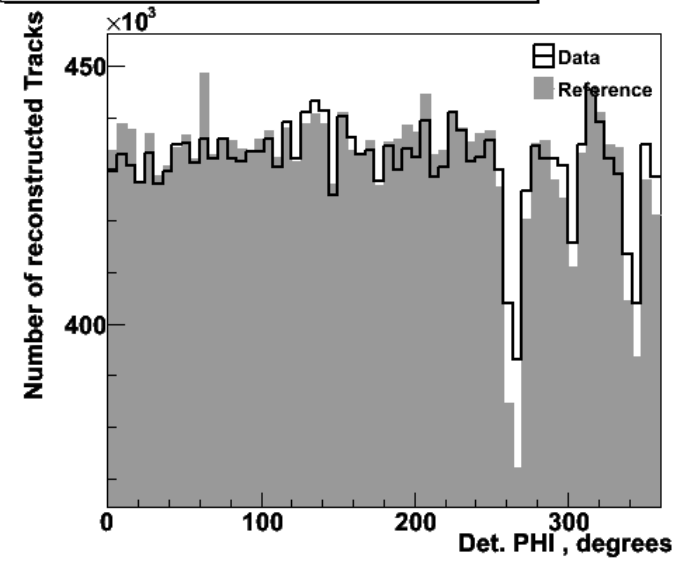
Problems with HV Only relevant for DQ if large parts of the detector affected (this was the one LB red)

Broken components in the readout chain Happen from time to time but do not impose a serious problem to the DQ (small regions affected)

Byte stream errors Problem in early running w/o stable beams, fixed by the beginning of collision data taking

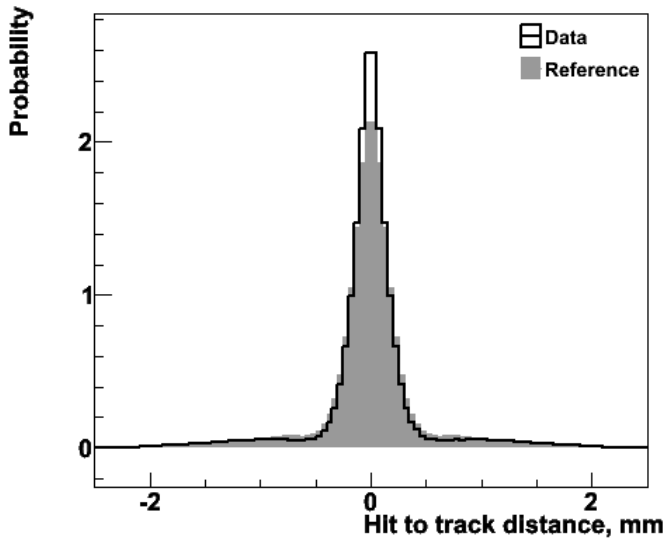
Some examples of TRT DQ plots

Number of reconstructed tracks vs PHI(2D)



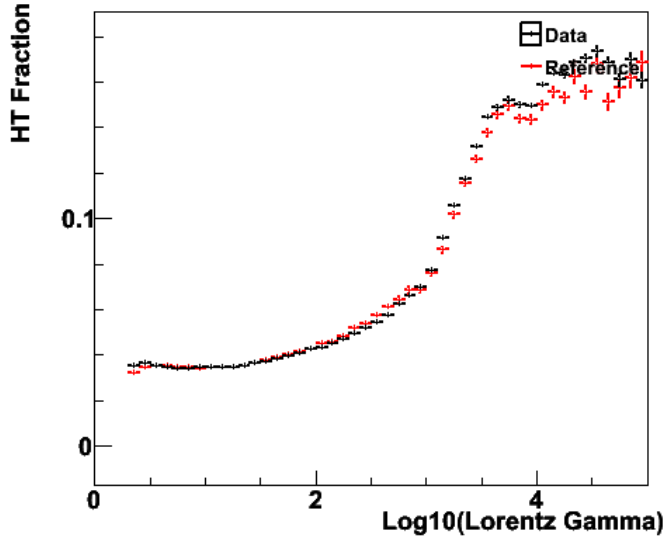
Run 167776, 1774/express_express
/InnerDetector/TRT/TRTEC/hNumTrksDetPhi_C

Residuals for all straws



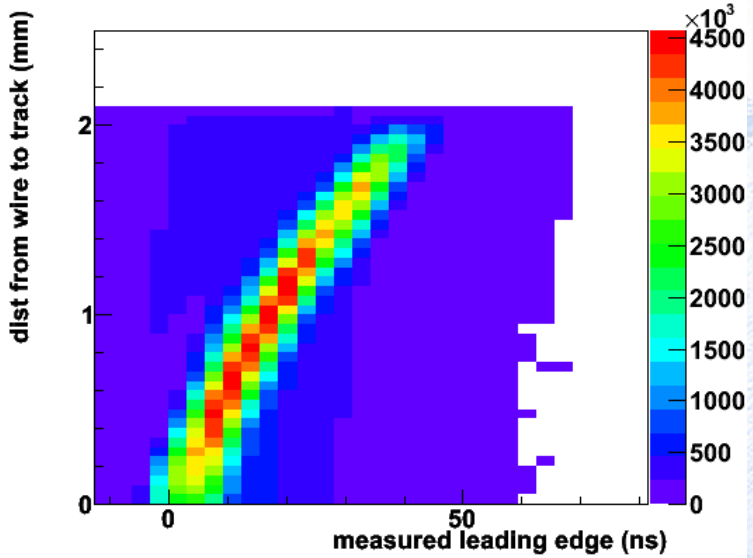
Run 167776, 1774/express_express
/InnerDetector/TRT/TRTB/hResidual

HT Fraction per Candidate vs. Lorentz Gamma Factor in BarrelA



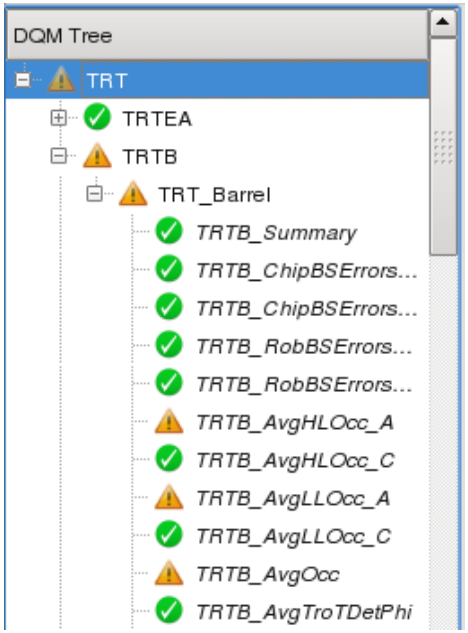
Run 167776, 1774/express_express
/InnerDetector/TRT/_HTMonitoring/BarrelA/pHTFracGammaAll

rt relation

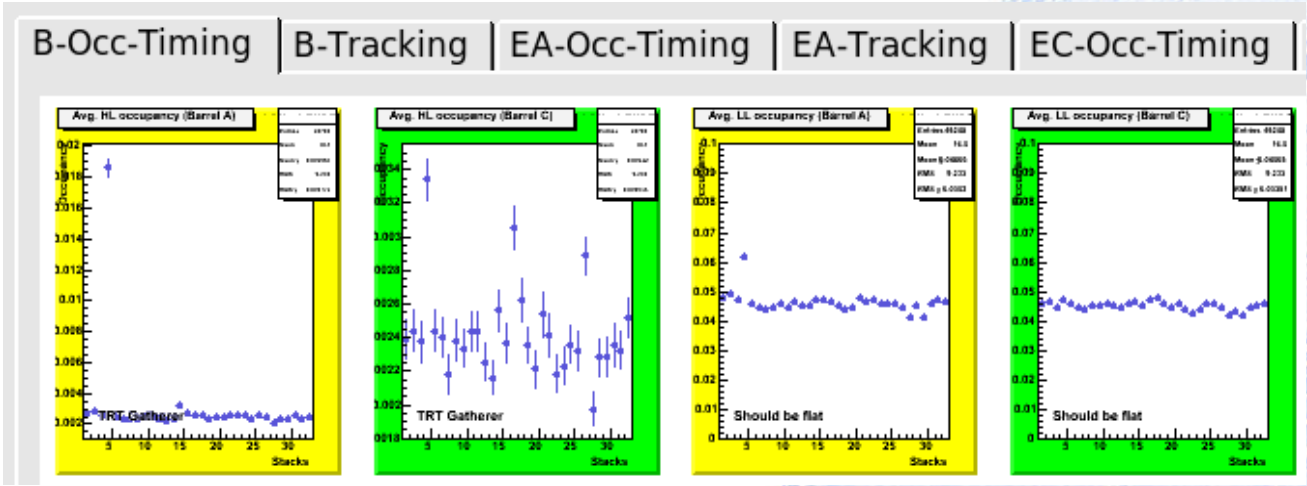


Run 167776, 1774/express_express
/InnerDetector/TRT/TRTEA/hrtRelation_A

DQ tools used by the TRT



- Heavily rely on standard tools for both online and offline DQ
  - DQMF / DQMD
  - OHP
  - HAN / Web display
- Adaption to special TRT needs using custom algorithms
- One additional online DQ tool: TRTViewer



Automatic DQ checks

- TRT relies mainly on standard tools for online and offline DQ
- However there are some special features which are not covered by standard checking algorithms
- Introduced two algorithms tailored to the needs of the TRT DQ assignment

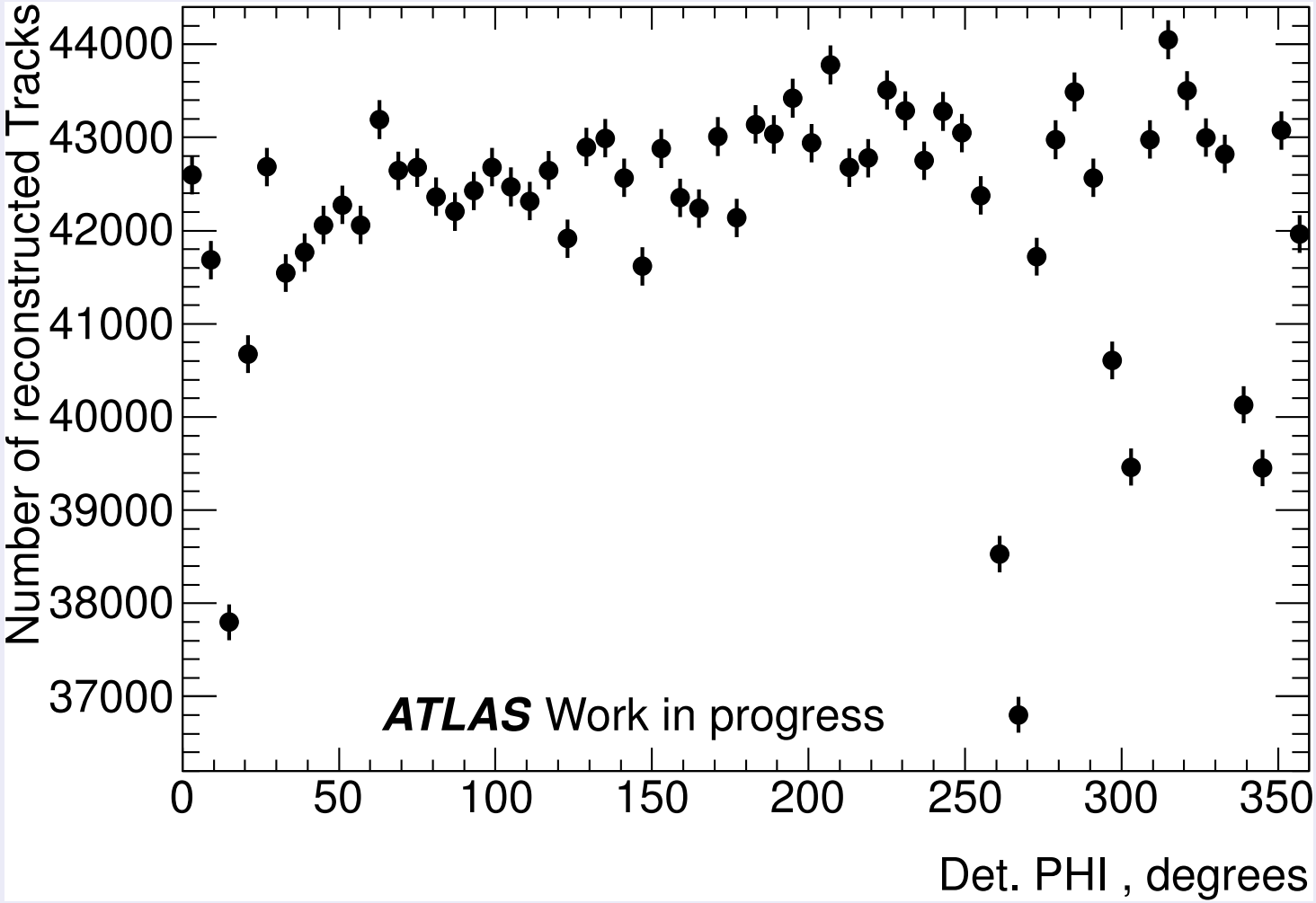
  Outlier and flatness test Tests a distribution for outliers, removes those and tests the remaining data for flatness

  Iterative Gaussian fit Finds and fits a Gaussian shaped core in a distribution with non-Gaussian tails
- Might be usable for other Systems as well

Automatic DQ checks

Outlier and flatness test

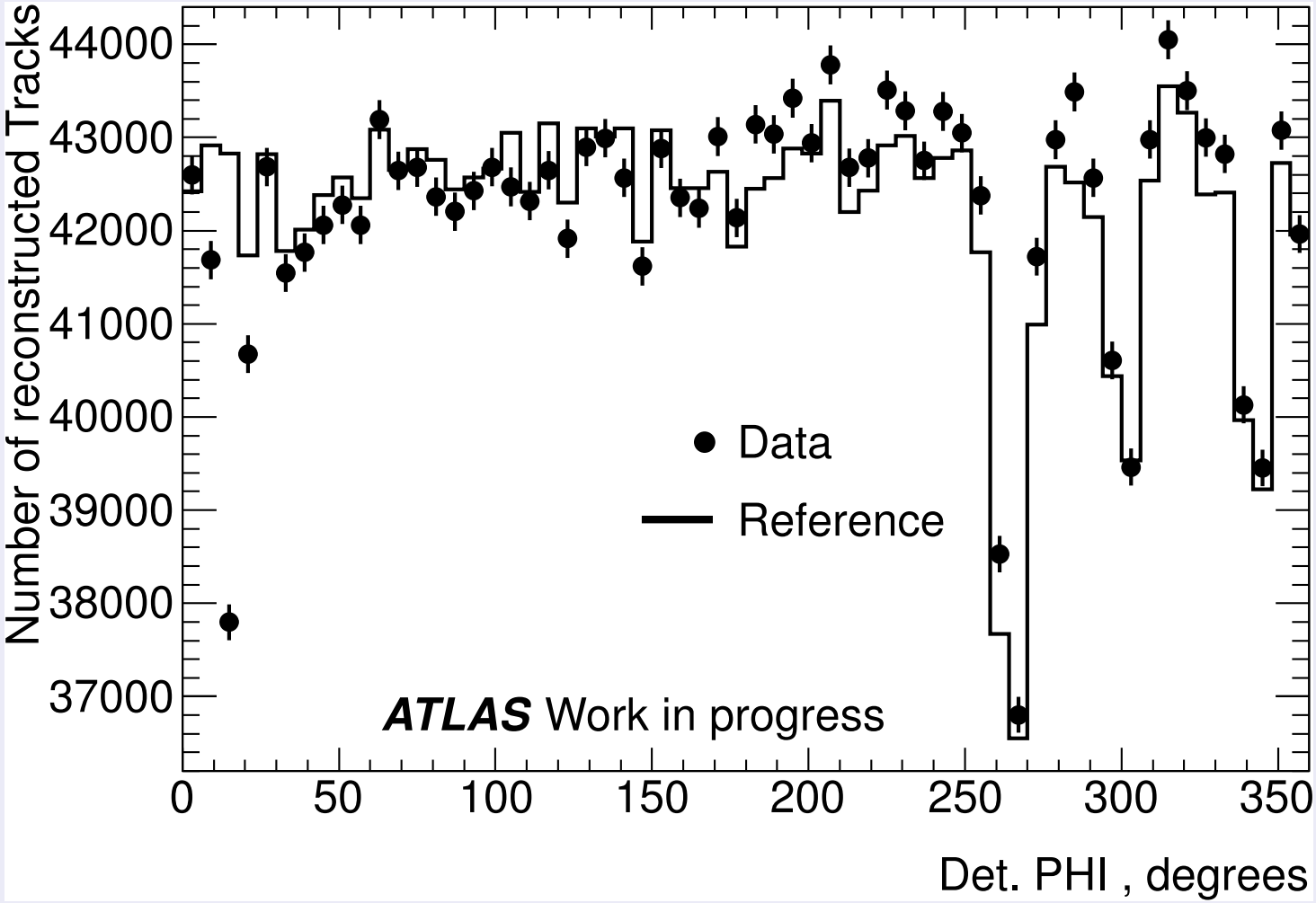
Example: No of tracks vs. phi



Automatic DQ checks

Outlier and flatness test

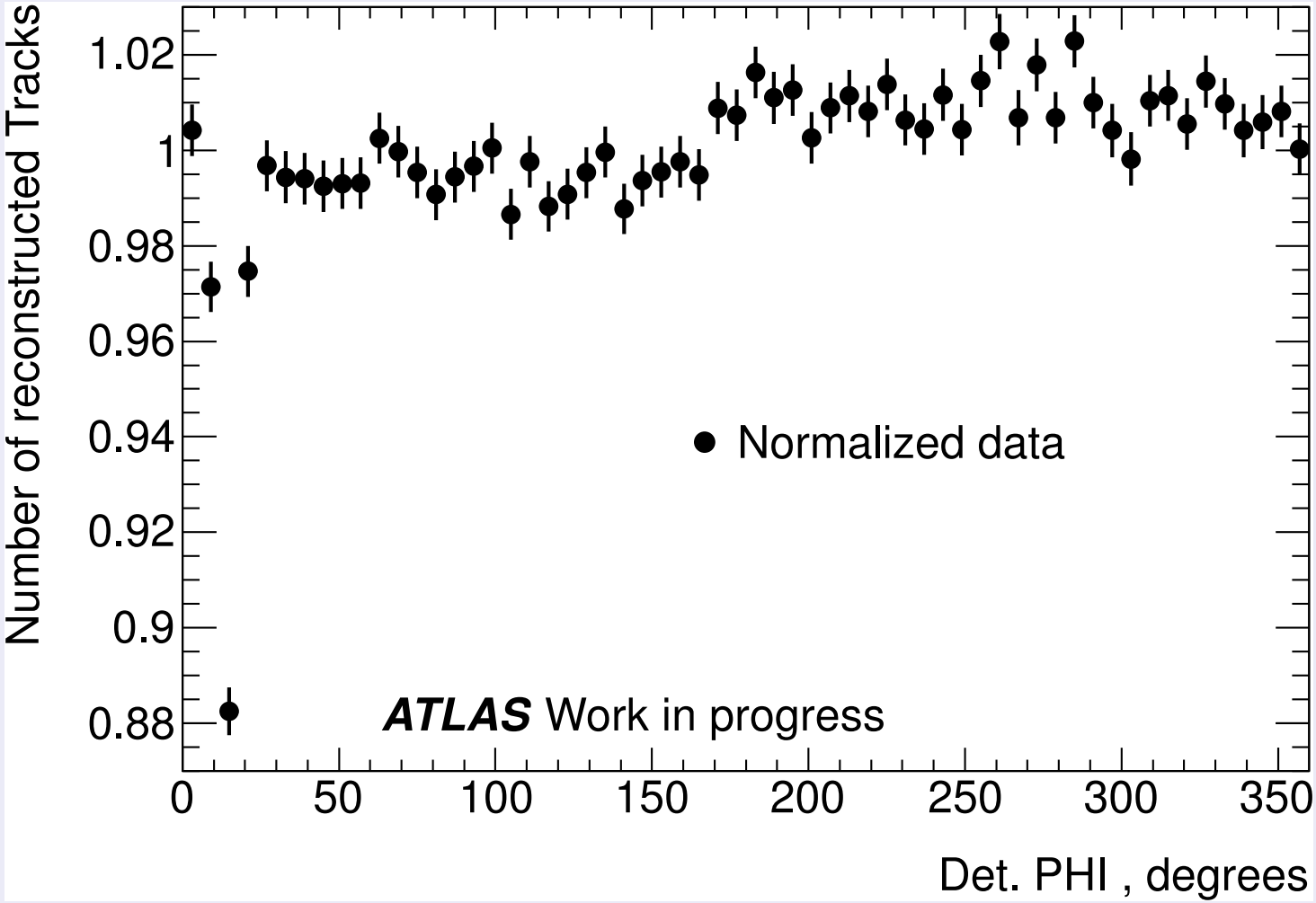
. . . scaled to a reference distribution



Automatic DQ checks

Outlier and flatness test

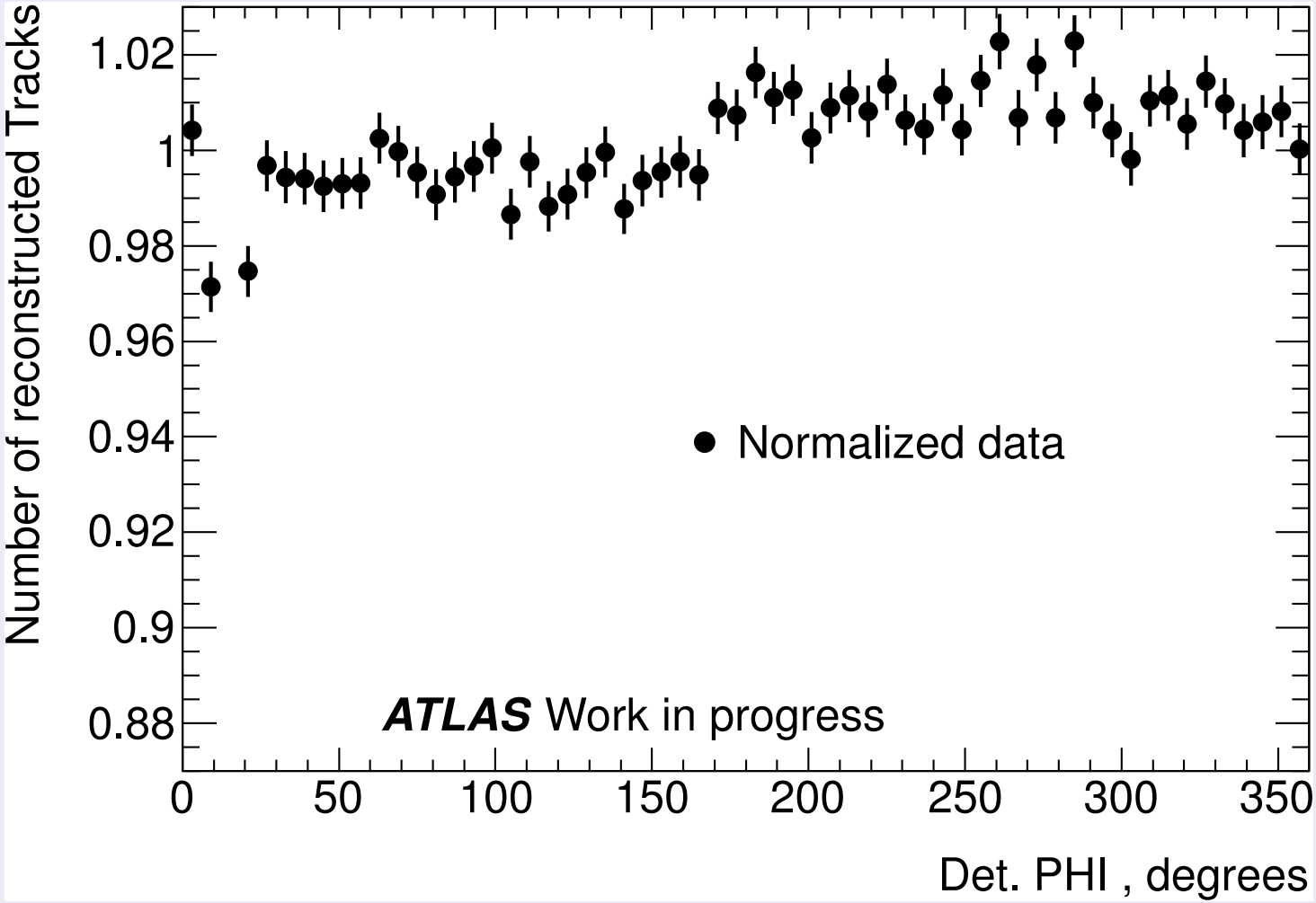
Data normalized to reference



Automatic DQ checks

Outlier and flatness test

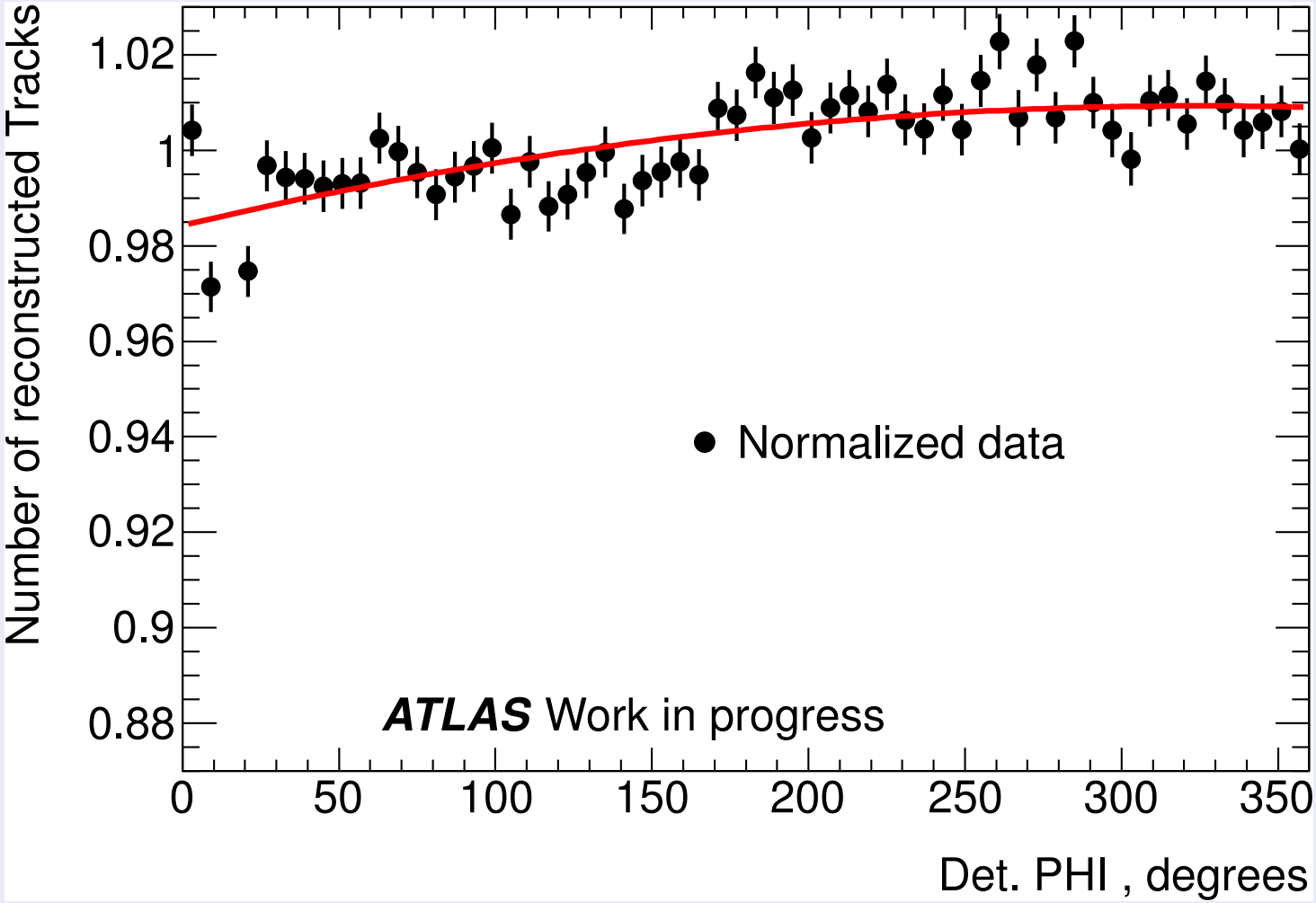
. . . outliers removed



Automatic DQ checks

Outlier and flatness test

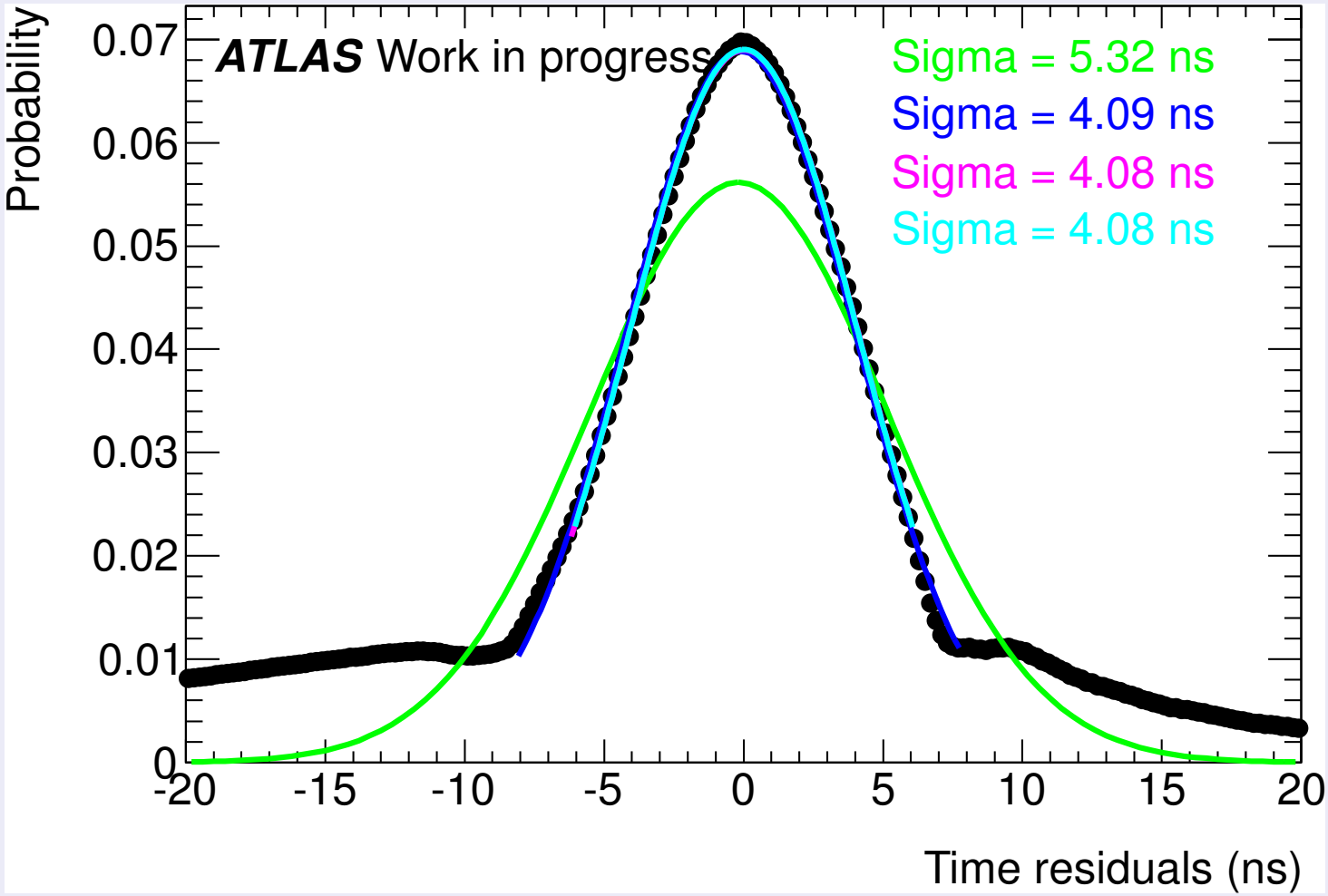
. . . and finally fitted



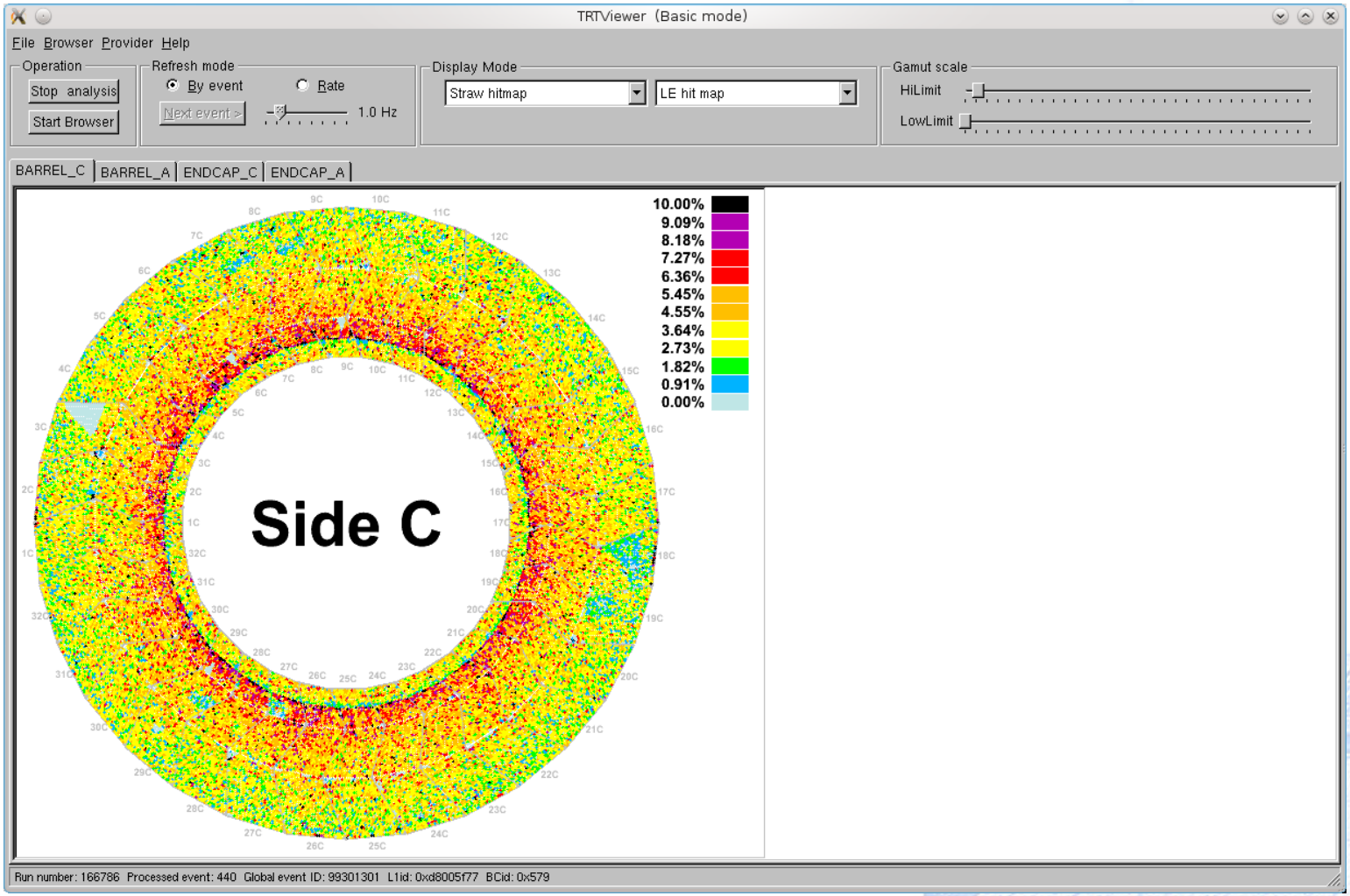
Automatic DQ checks

Iterative Gaussian fit

Example: Time residuals in HI running (all iterations)



TRTViewer



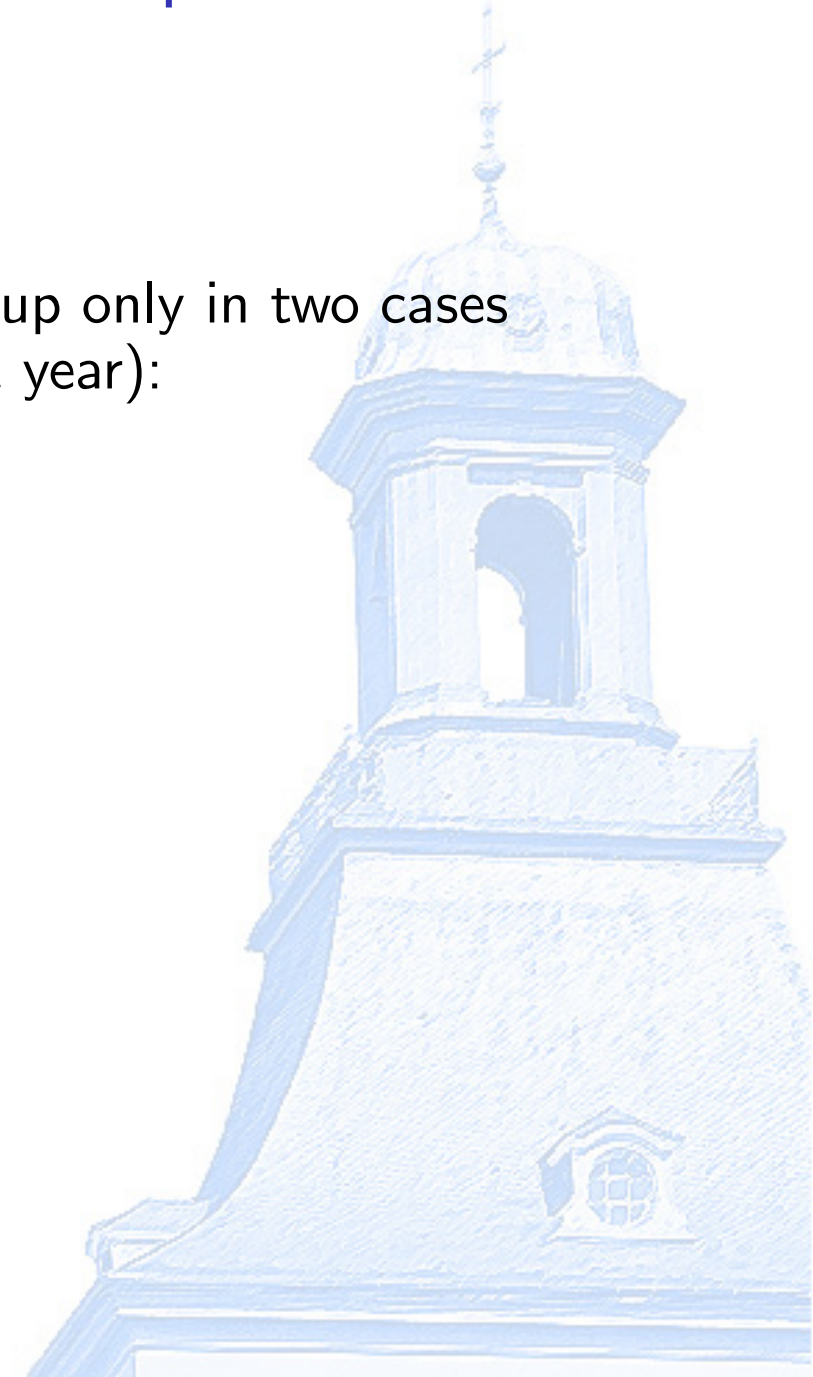
- "Topological" representation of single events and monitoring histograms
- Selection of displayed quantity allows for selection of detector property to be monitored (here: Occupancy)

What does ID global / alignment look at?

- Looks not at detector level but on high level performance
  - Distribution and resolution of combined ID tracks
  - Correct accounting of hardware failures (e.g. disabled SCT RODs) in reconstruction
  - Vertexing
  - Beam spot
- Typical plots: distribution of tracks vs. geometric parameters, invariant masses, position of primary vertices a.s.o.
- Main reason for non-green flags in 2010: Disabled RODs in SCT
- Uses information from subsystems (but in a way not entirely transparent to the subsystem experts)

ID global from the TRT point of view

- Contact with ID global group only in two cases (happened a few times last year):



ID global from the TRT point of view

- Contact with ID global group only in two cases (happened a few times last year):
  1. ID global to TRT: "There is something strange in one of our distributions which might be related to the TRT, do you see something strange as well?"

ID global from the TRT point of view

- Contact with ID global group only in two cases (happened a few times last year):
  1. ID global to TRT: "There is something strange in one of our distributions which might be related to the TRT, do you see something strange as well?"
  2. TRT to ID global: "We see something strange in our distributions and have no idea what's going on. Do you have any ideas?"
- That's all...
- Certainly room for improvement

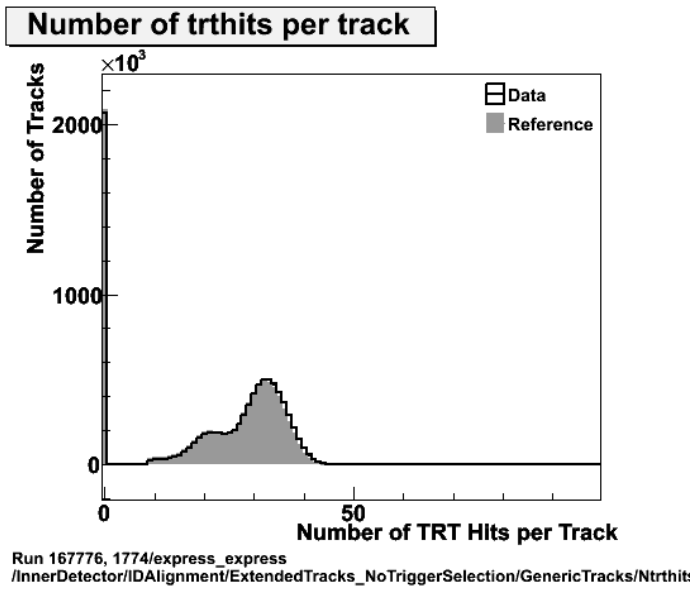
Communication between ID global and subsystems

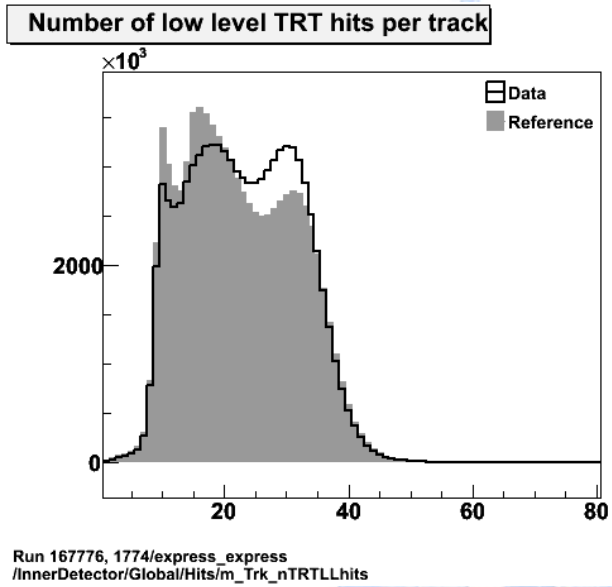
- So far only in case of single problems
- Before preparing this talk I didn't know exactly what ID global was looking at (after one year as TRT DQ expert)
- All groups produce and use their own distributions
- Some of the sub detector problems could've possibly been handled more easily by the global ID monitoring and vice versa
- Plenty of things are done by different people using different methods multiple times

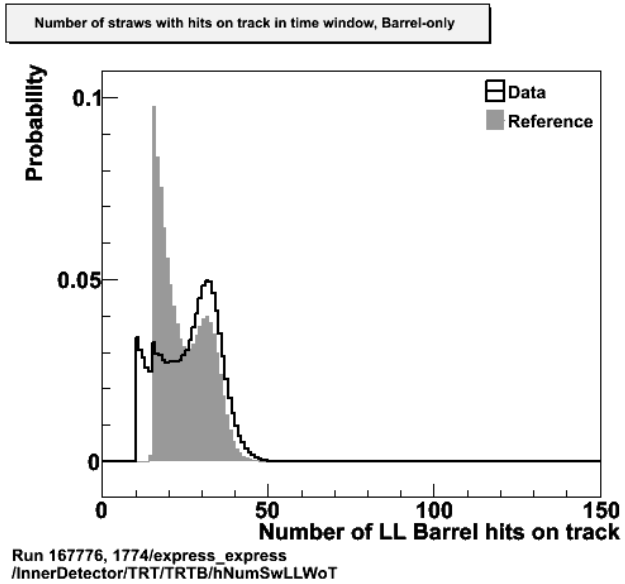
$\Rightarrow$ Improved communication and more defined responsibilities might help streamlining our day to day tasks!

Things done twice (or more)

Example: TRT hits on track

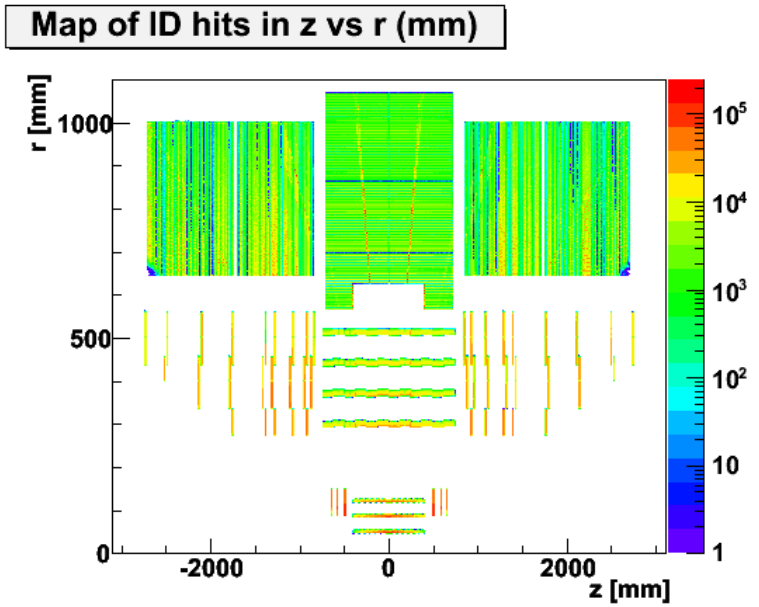




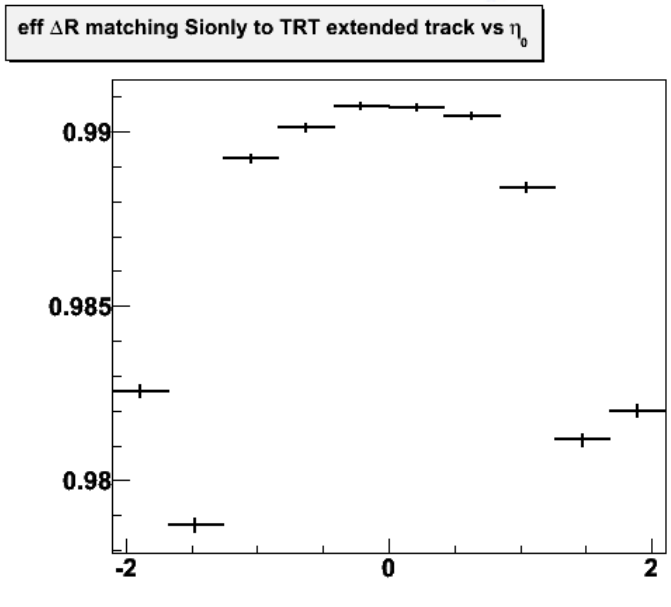


- More or less identical distribution present in three places
- Differ in selection criteria
- Might be useful, might be not. . .

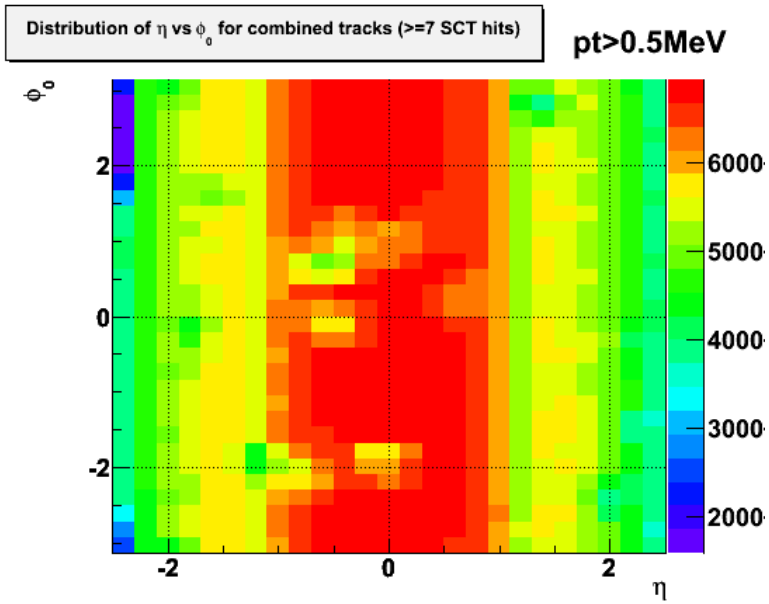
Some examples of ID global DQ plots



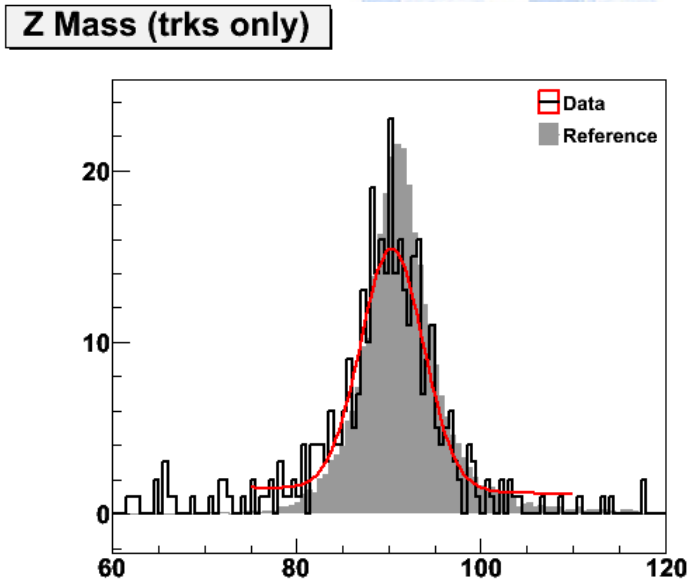
Run 167776, 1774/express_express
/InnerDetector/Global/Hits/m_ID_hitmap_z_r



Run 167776, 1774/express_express
/InnerDetector/IDAlignment/SivsTRT_Detail/NoTriggerSelection/eff_simatch_eta0



Run 167776, 1774/express_express
/InnerDetector/Global/Track/m_COMB_goodSctTrk_eta_phi



Run 167776, 1774/express_express
/InnerDetector/IDAlignment_Perf/Z-->mumu/NoTriggerSelection/z-mass_trks

ID wide problems

- There were some problems during 2010 data taking which affected the monitoring of all ID subsystems in the same way:
  - IS magnetic field reading incident.
  - ATLAS was running in cosmics mode although having collisions so the reconstruction tried to monitor cosmics from collision tracks.
  - Lots of wrong configurations and other problems when switching to HI running.
- Those were (partially) solved in cooperation. Generally speaking all of them were more or less general problems and not really under the responsibility of any ID subsystem.

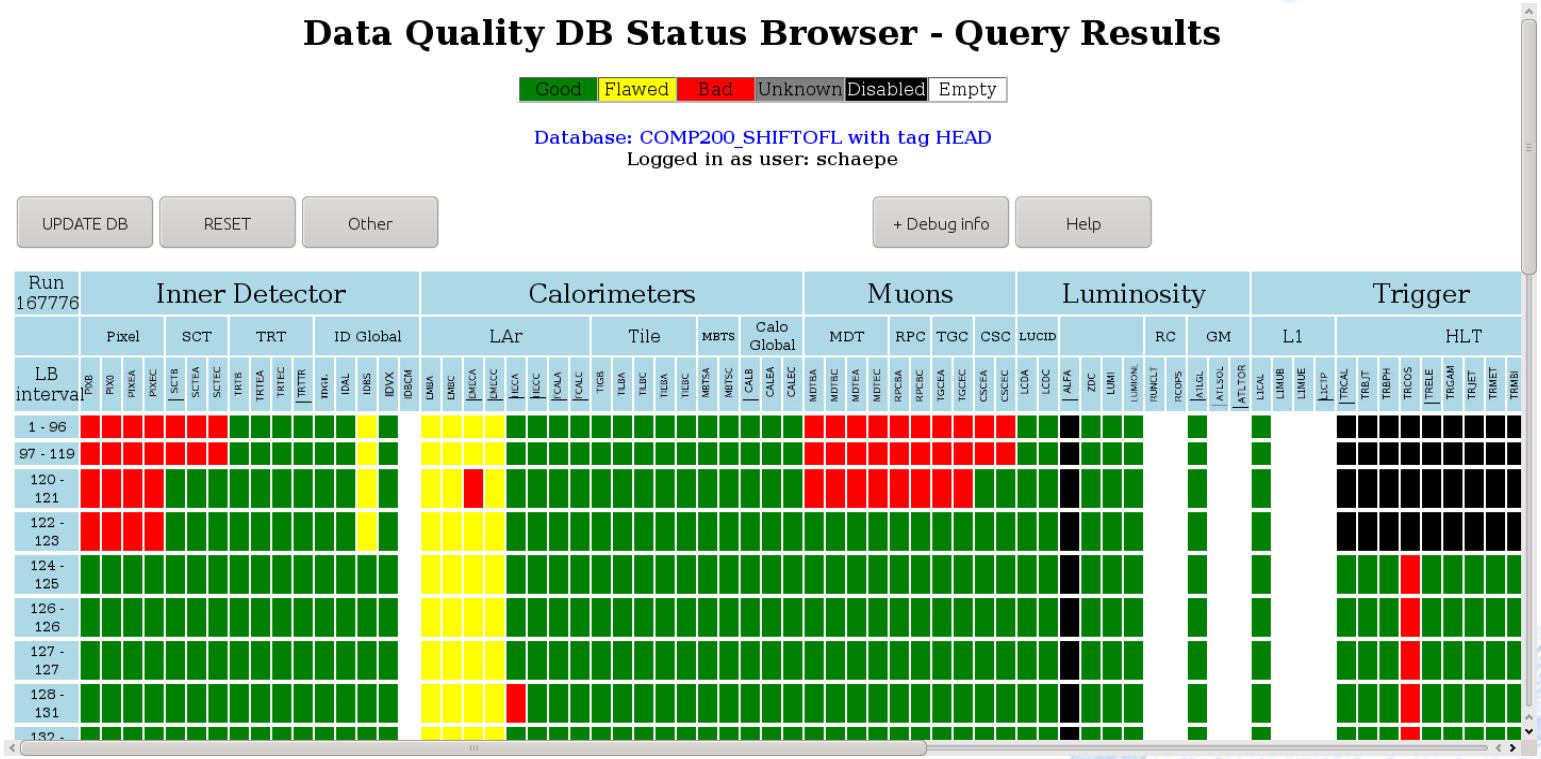
$\Rightarrow$ ID wide DQ collaboration needed! (Kick-started by Lucie)

ID DQ cooperation

- So far consisting of the DQ experts of the three subsystems
- Goals:
  - Share information which might be interesting for others as early as possible (atlas-p1-onlinereconstruction)
  - Collect information in one place (https://atlasop.cern.ch/atlas-point1/twiki/bin/view/Main/IDDQMonitoring)
  - Define a list of people responsible for certain things in the subsystems
  - Coordinate work common to all subsystems, e.g. transitions to new releases
- Collaboration already pretty good during HI transition
- Aiming to get a regular DQ time slot in the ID general meeting
- Next steps: Experts try to gain insight in monitoring of other subsystems to prepare shift merging

Documentation of DQ assessment

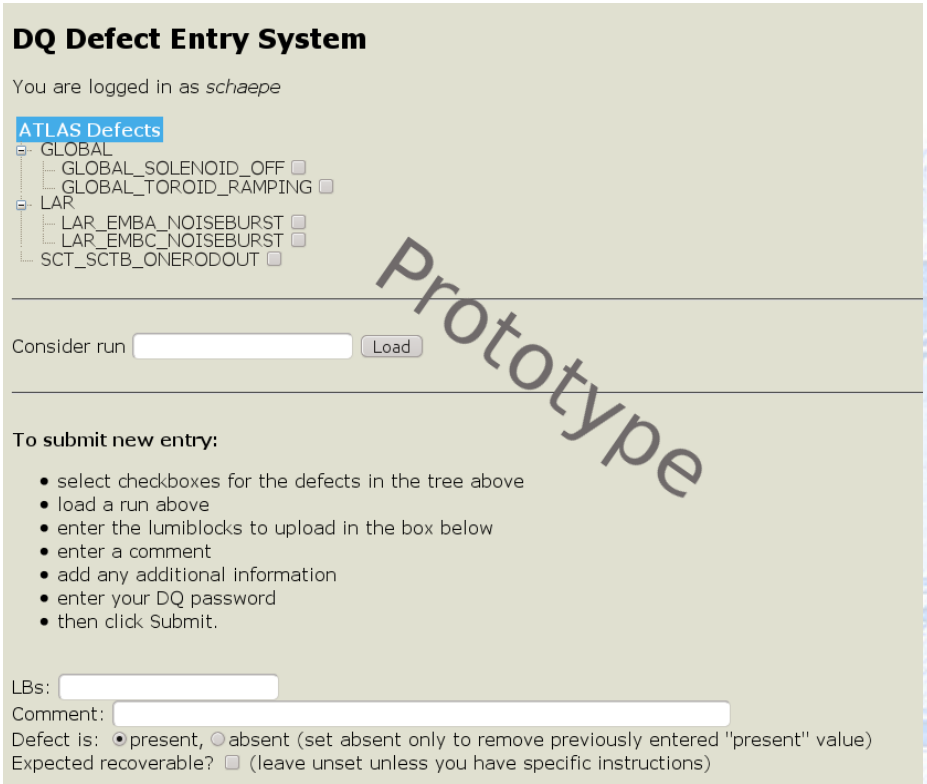
Then . . .



- Classification of predefined DQ partitions into (only) 3 + 2 states
- If DQ not green, no information of the nature of the problem stored (except a comment string)

Documentation of DQ assessment

. . . and now



- Each subsystem can define multiple binary “problems”
- Problems can be tolerable or intolerable by going “upwards” towards GRL generation
- Lots of potential but all have to contribute by defining a limited yet significant set of problems

Outlook

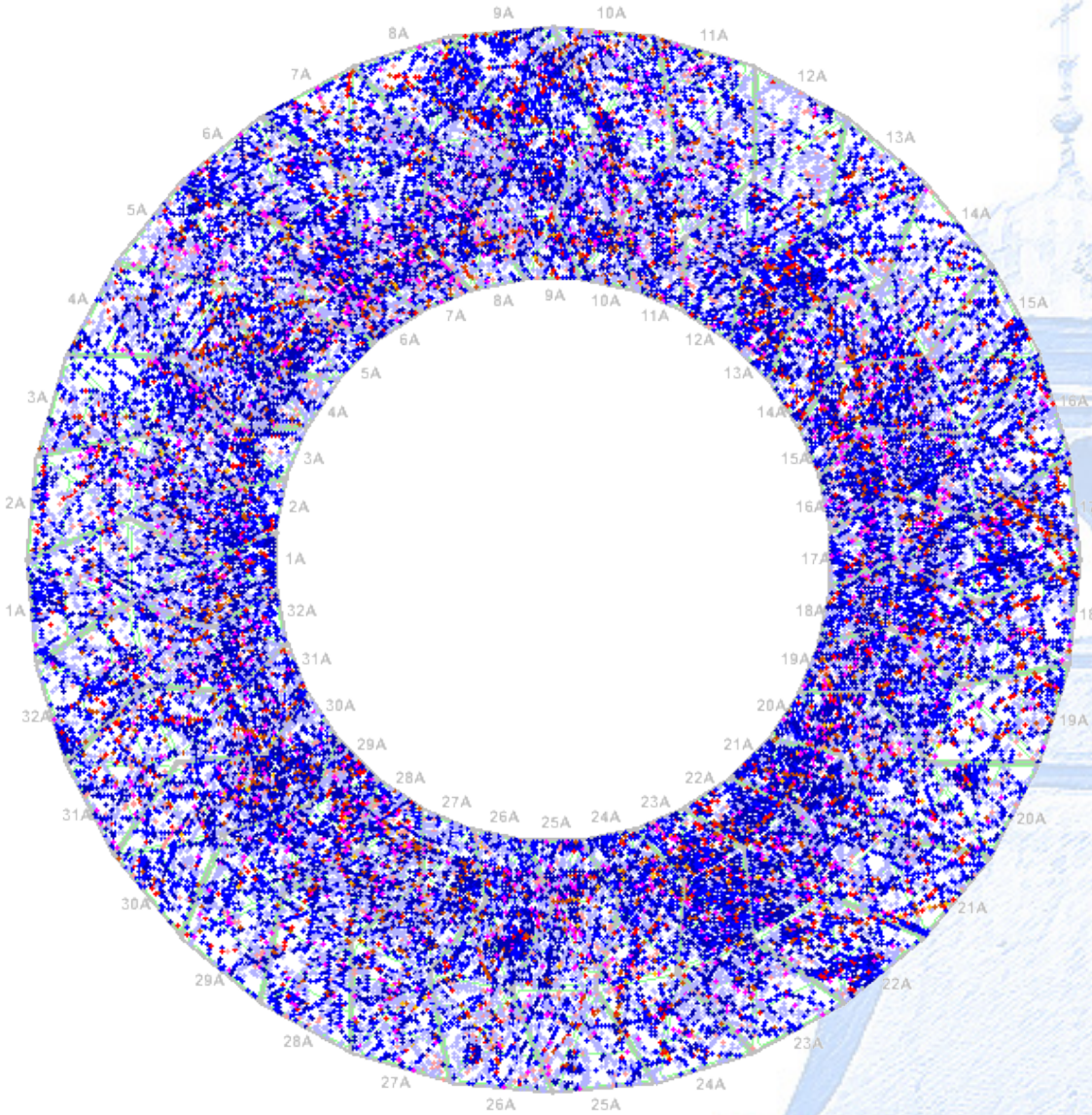
What will this year bring?

- Lots and lots of "green" ID data
- A new "defects database" replacing the color scheme and allowing for more precise classification of Data Quality
- Merging of ACR shifts will most probably happen mid year requiring reworking of DQ tools and work flows
- $\Rightarrow$ Closer collaboration between all ID DQ groups

We reached a level of performance and efficiency where we can start thinking about optimizing our workload

Thanks to Adrian, Thijs and all the ID DQ folks for their input

Thanks for your attention



Questions?

Backup

Readout segmentation

- Lots of different segmentations for different services: LVBoard, HVCell, HVFuse, DTMROC, Module . . .
- Here are the ones relevant for monitoring:
  - ASDBLR: Analog frontend chip. Reads 8 Straws
  - DTMROC: Digital frontend chip. Reads 16 Straws
  - Stack/Slice: Barrel and Endcap segmented in 32 phi segments
  - RODs: Each ROD reads half of a Barrel segment (side A or C), in each Endcap 2 RODs read one phi segment 192 RODs in total
  - No modules in the sense the silicons are using
- Readout problems usually at chip or board level, straw level problems cannot be addressed

Monitoring Jobs

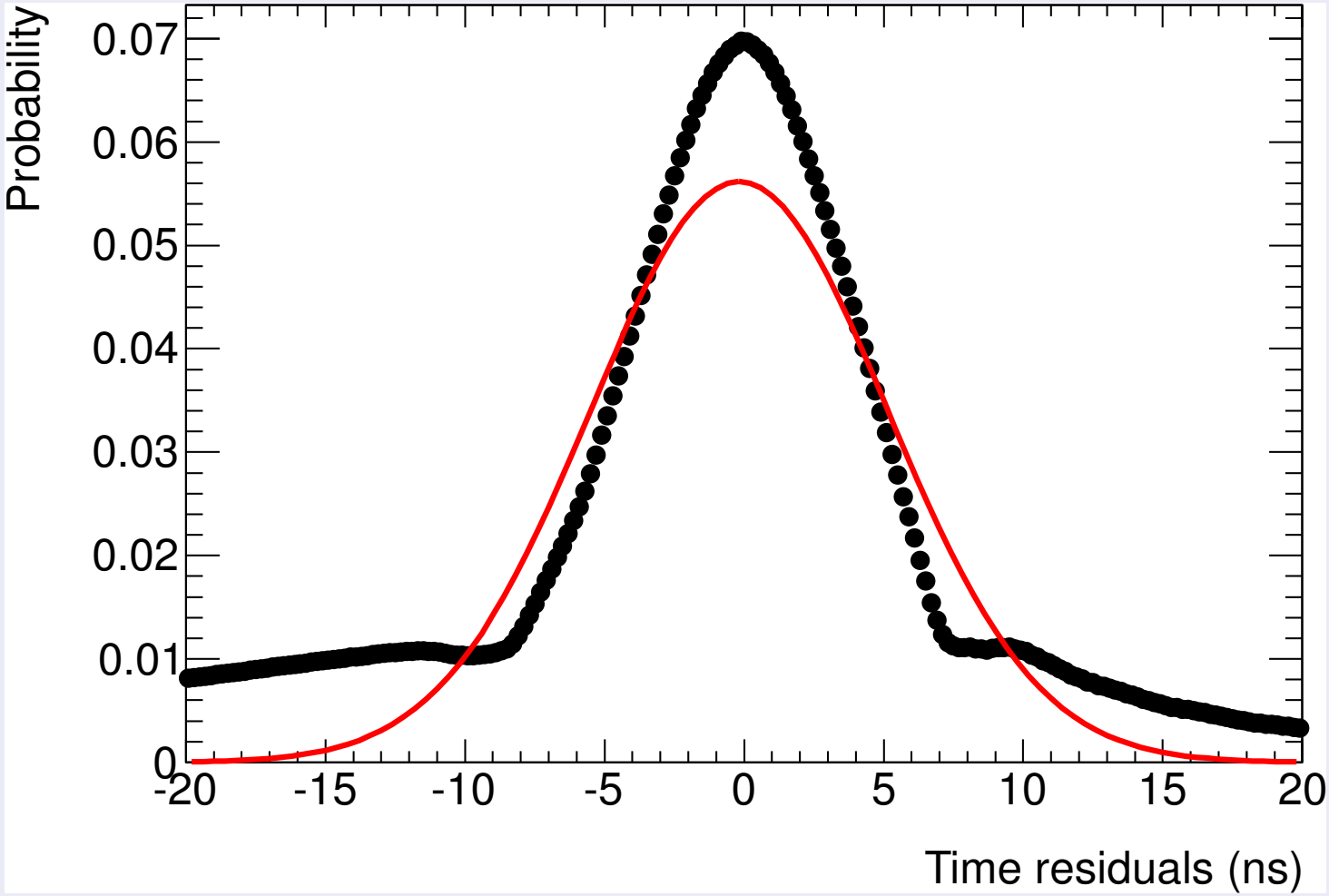
2010 Version

- 8 Monitoring jobs on **pc-tdq-mon-24/25**
- Infrastructure (MDA, IS, Gatherer) on **pc-tdq-mon-14**
- 6 Provider run on physics streams (2× Egamma, 2× Muons, JetTauEtmiss, MinBias for pp, 6× bulk for HI). Those are gathered
- 1 Provider runs on L1_RD(0|1)_EMPTY trigger items: Noise monitoring
- 1 Provider runs on L1_RD(0|1)_FILLED trigger items: Beam monitoring
- Sources in /det/trt/TRTMonitoring/athena
- Different sources for beam and regular monitoring
- Configured by RecExOnline_Partition_Online_TRT.py script in /Reconstruction/RecExample/RecExOnline

Automatic DQ checks

Iterative gausian fit

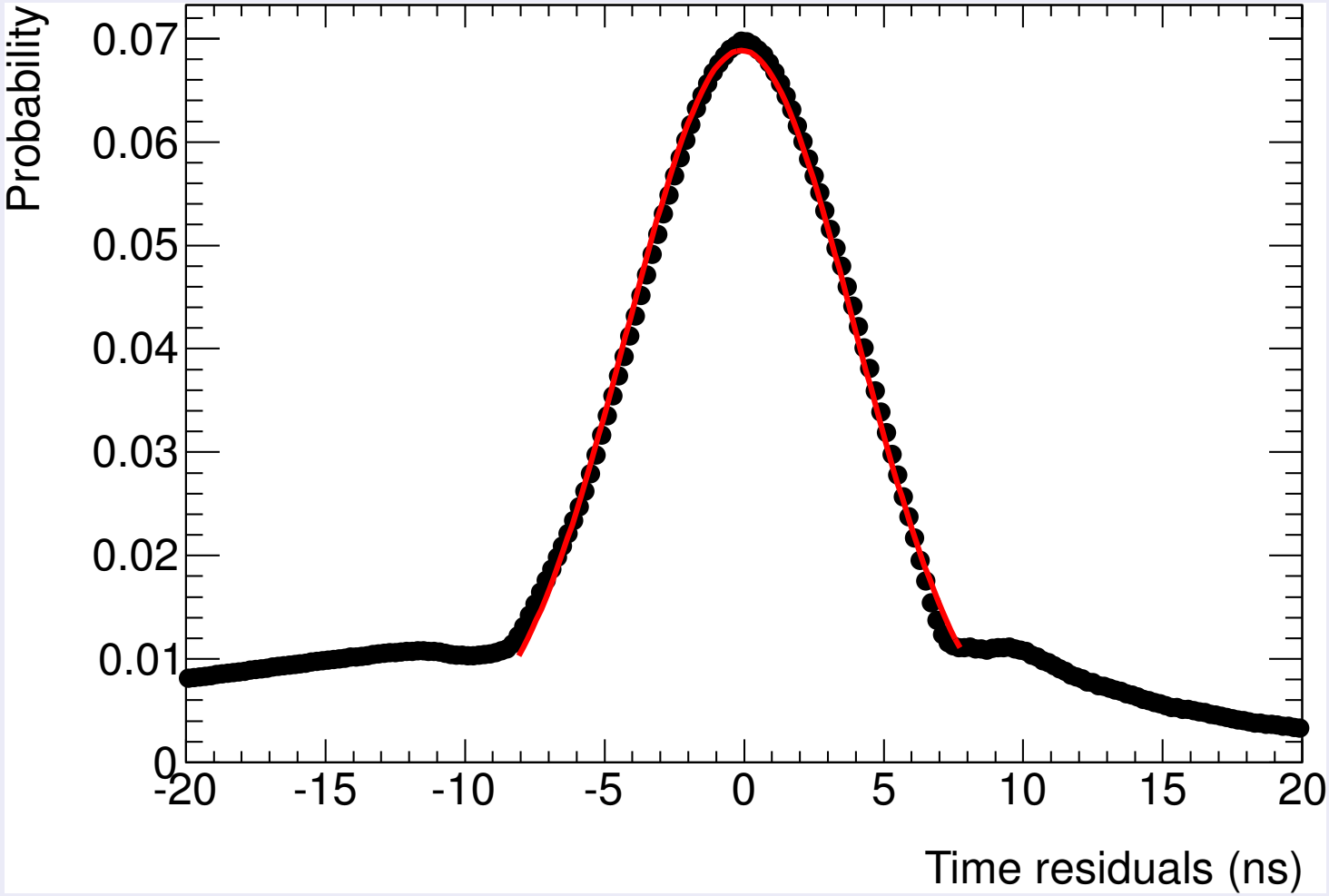
Example: Time residuals in HI running (1st iteration)



Automatic DQ checks

Iterative gausian fit

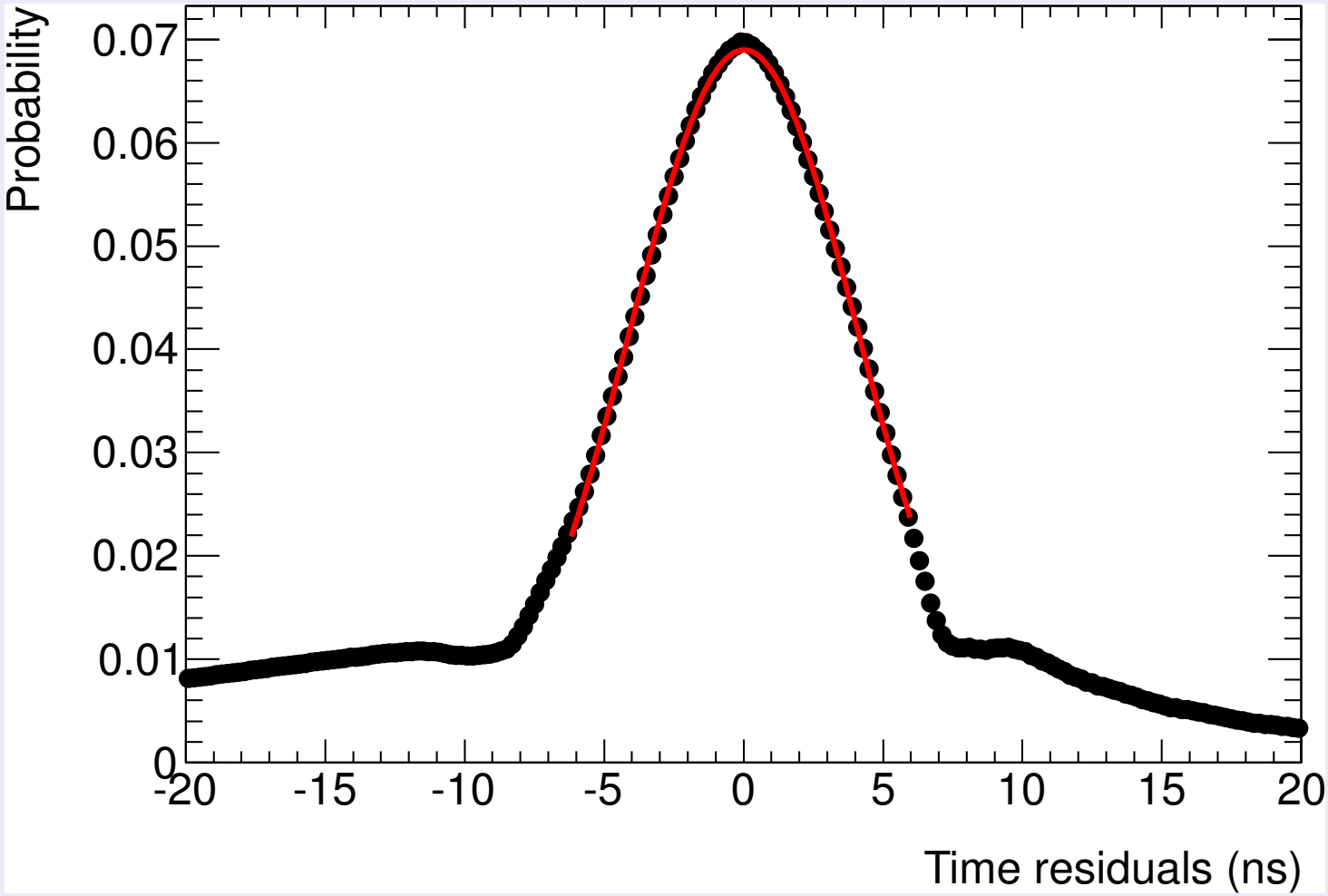
Example: Time residuals in HI running (2nd iteration)



Automatic DQ checks

Iterative gausian fit

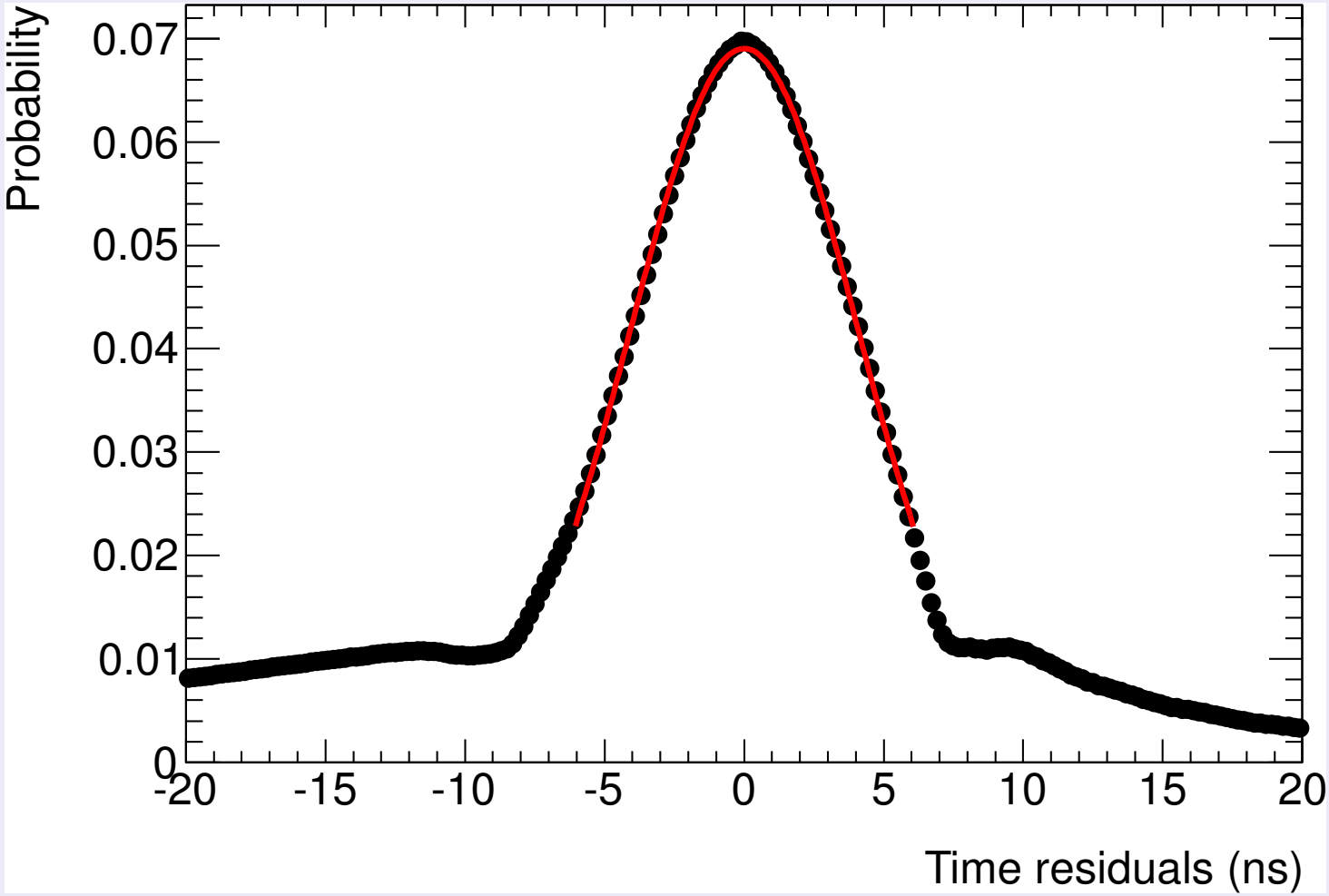
Example: Time residuals in HI running (3rd iteration)



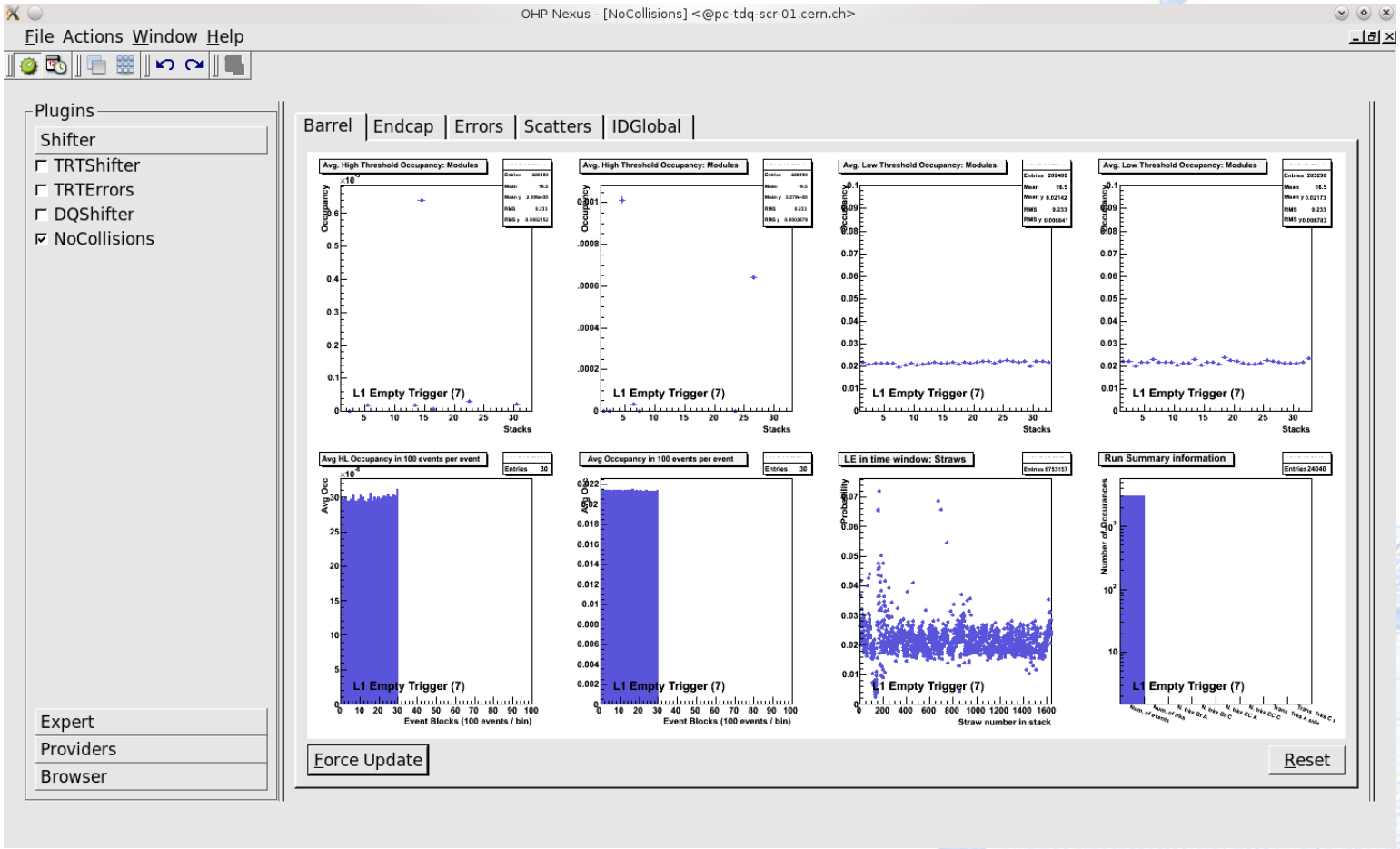
Automatic DQ checks

Iterative gausian fit

Example: Time residuals in HI running (4rd iteration)



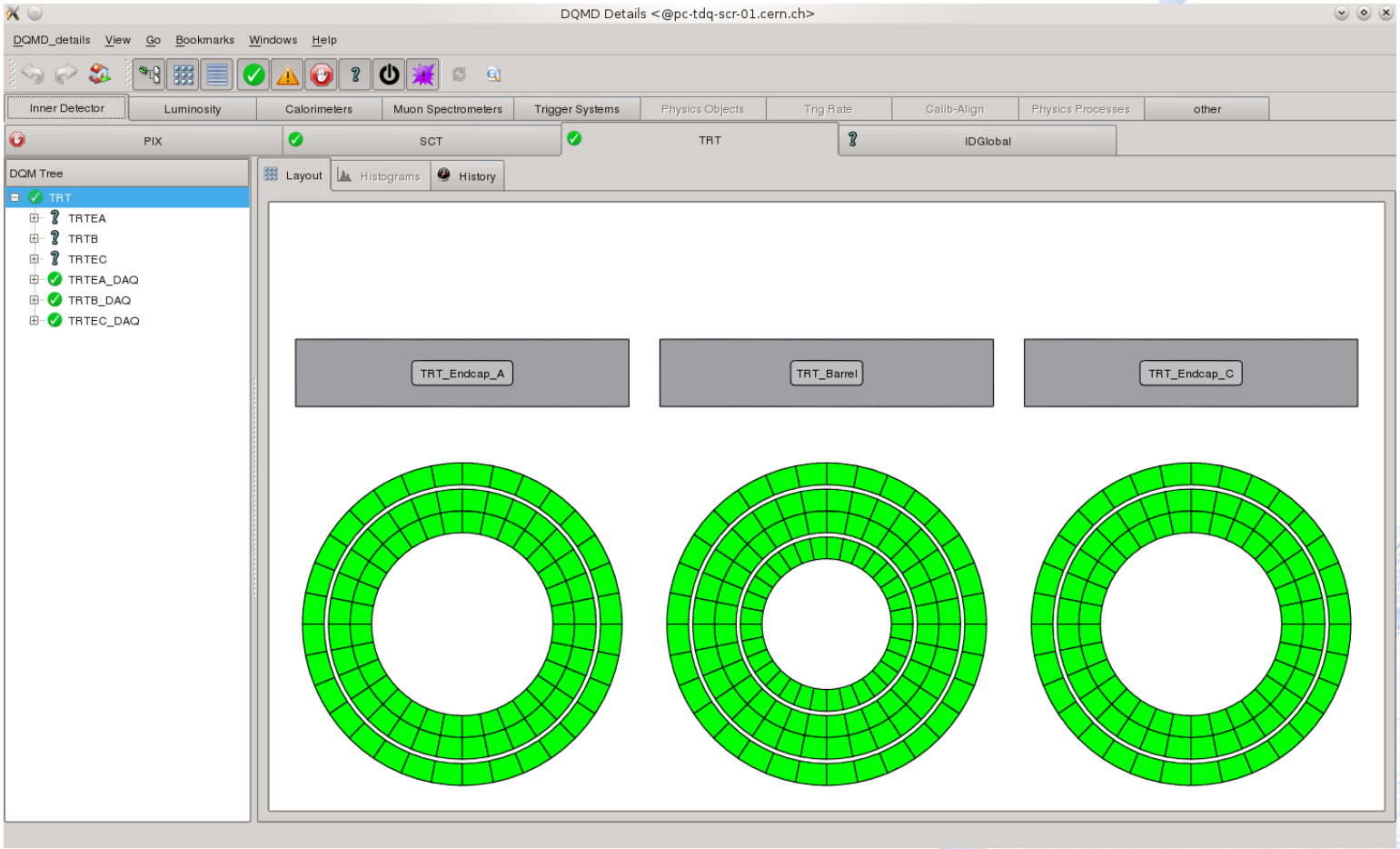
OHP


OHP Nexus - [NoCollisions] <@pc-tdq-scr-01.cern.ch>
File Actions Window Help
Plugins
Shifter
TRTShifter
TRTErrors
DQShifter
NoCollisions
Expert
Providers
Browser
Barrel
Endcap
Errors
Scatters
IDGlobal
Avg. High Threshold Occupancy: Modules
Avg. High Threshold Occupancy: Modules
Avg. Low Threshold Occupancy: Modules
Avg. Low Threshold Occupancy: Modules
Occupancy
Stacks
L1 Empty Trigger (7)
Avg HL Occupancy in 100 events per event
Avg Occupancy in 100 events per event
LE in time window: Straws
Run Summary information
Avg Occ
Probability
Number of Occurances
Event Blocks (100 events / bin)
Straw number in stack
Force Update
Reset

OHP

- Two different tabs for standby mode and physics running
- Basically only noise occupancy monitoring for standby
- Mainly track related histograms for physics running
- Key distributions: Residuals and number of tracks / hits on tracks
- Configured by /atlas/moncfg/tdaq-03-00-01/trt/ohp/TRTMonitoring.ohp.xml

DQMD

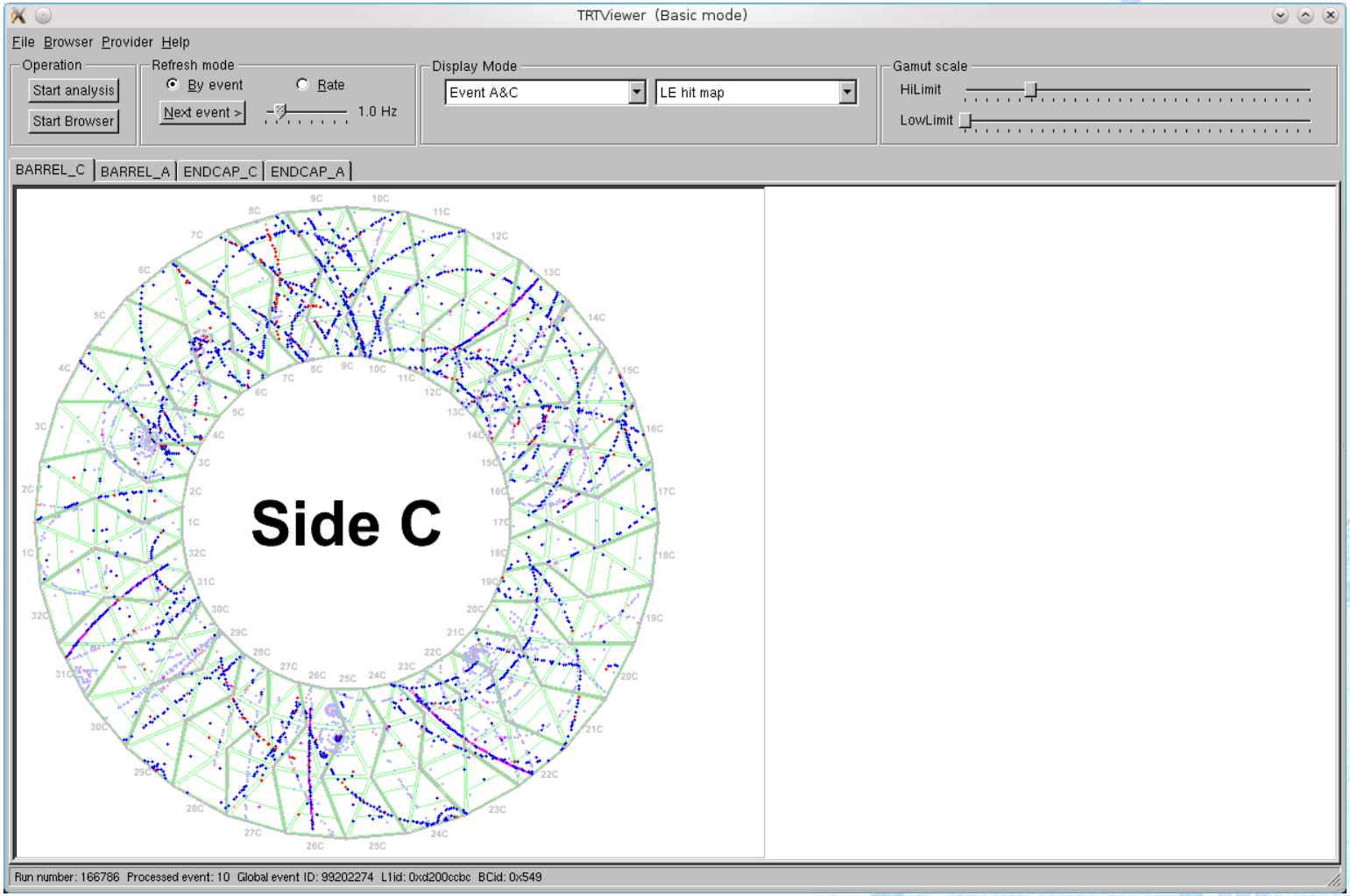

DQMD Details <@pc-tdq-scr-01.cern.ch>
DQMD_details View Go Bookmarks Windows Help
Inner Detector
Luminosity
Calorimeters
Muon Spectrometers
Trigger Systems
Physics Objects
Trig Rate
Calib-Align
Physics Processes
other
PIX
SCT
TRT
IDGlobal
DQM Tree
TRT
TRTEA
TRTB
TRTEC
TRTEA_DAQ
TRTB_DAQ
TRTEC_DAQ
Layout
Histograms
History
TRT_Endcap_A
TRT_Barrel
TRT_Endcap_C

DQMD

- Two regions for Shifter (73 histograms) and Expert (320 histograms) monitoring
- Expert histograms = chip and straw level noise occupancies
- Global state only from Shifter histograms
- Shifter histograms only active in physics running (fed by gatherer)
- Histograms, checks, references and thresholds configured in oks

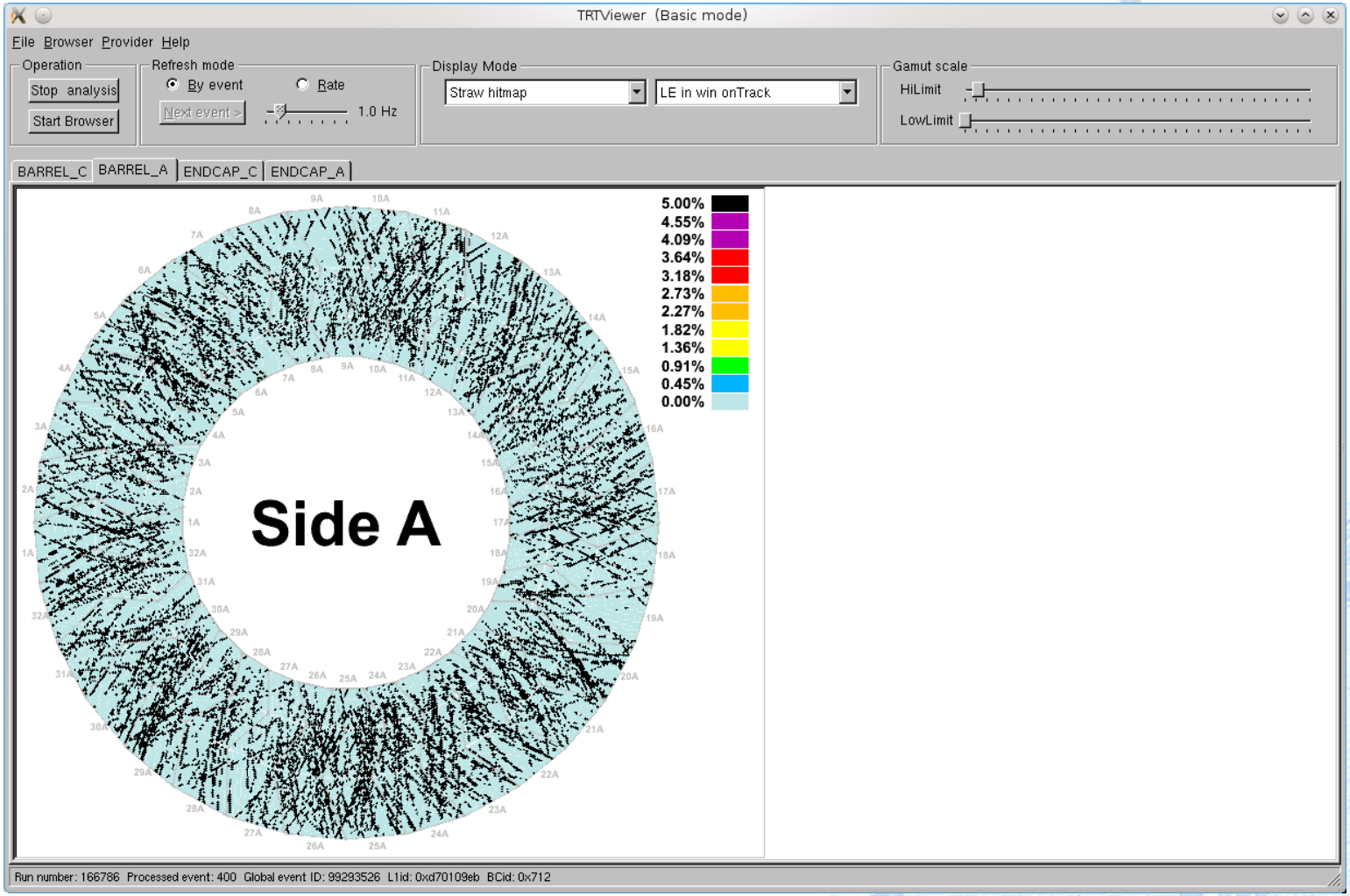
TRTViewer

Single event



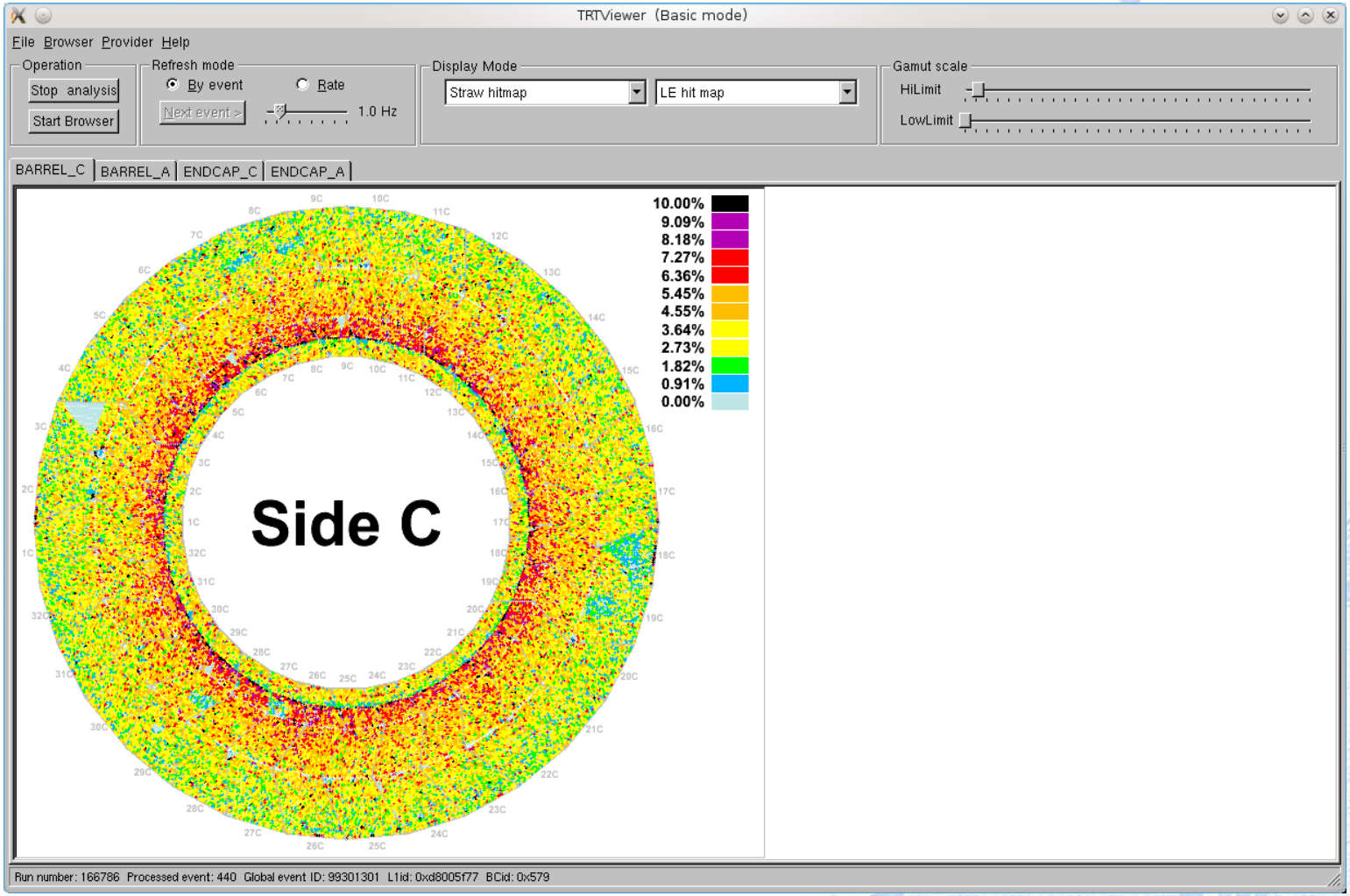
TRTViewer

Overlay of tracks taken from multiple events



TRTViewer

Occupancy



TRTViewer

Time over threshold