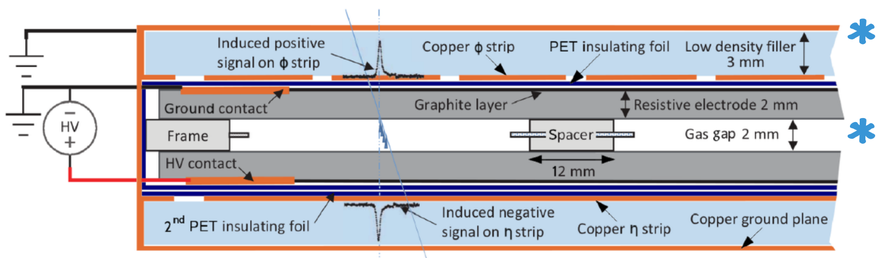
XVI Workshop on Resistive Plate Chambers and Related Detectors
26-30 September 2022

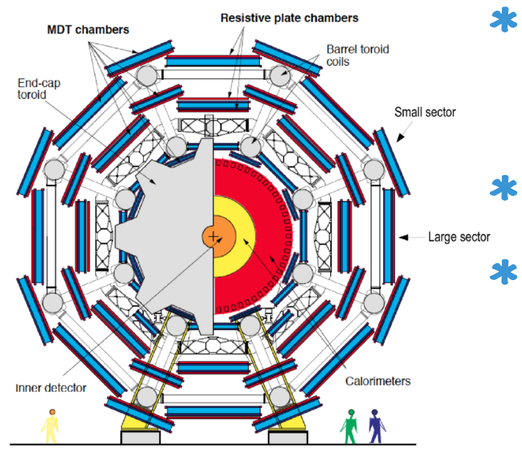
Development of new offline analysis for the monitoring of RPC detector parameters at the ATLAS experiment during LHC Run3

The RPC system at the ATLAS experiment

* The Level-1 muon trigger system uses Resistive Plate Chamber (RPC) detectors to identify muon trigger candidates in the barrel detector region



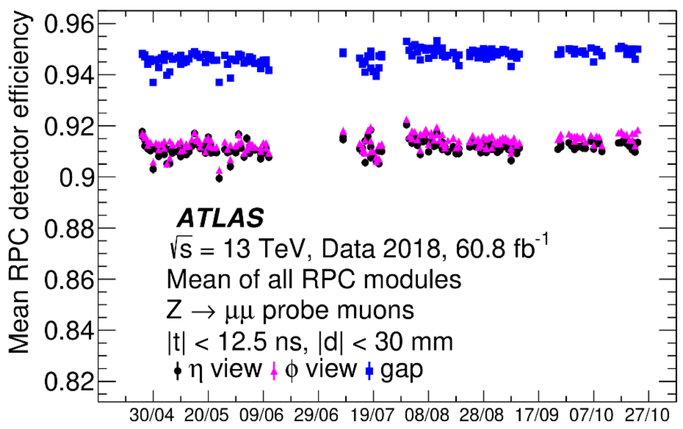
* three concentric doublet layers, ~4000 m², $|\eta| < 1.05$
* ~3700 RPC gas volumes of 2 mm width



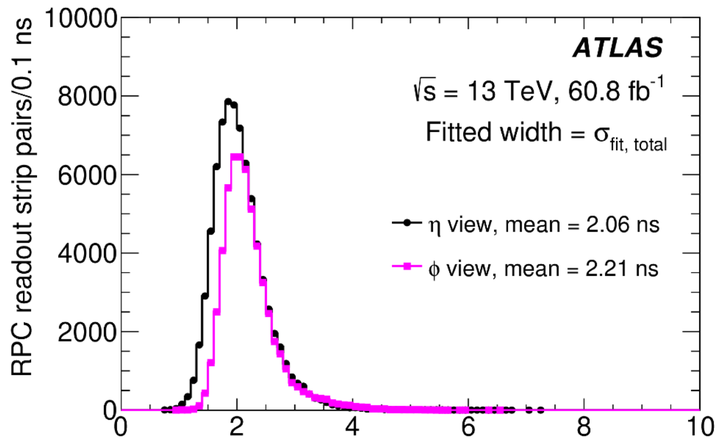
* Trigger algorithm based on hit coincidence of the RPC doublet layers: coincidence between the two innermost layers for the low-p_T triggers, a further coincidence on the outermost layer for high-p_T triggers
* Signal read-out by two orthogonal planes of strips, in η and ϕ views, with a width of 23-35 mm
* RPC are used:
  * for triggering given their fast response and good time resolution
  * in the track reconstruction as 2nd (ϕ) coordinates

Performances during Run-2

* The detector efficiency has been measured during the 2018 and it has been found stable across the whole year
  * ~94% for single modules
  * ~91% for η and ϕ panels

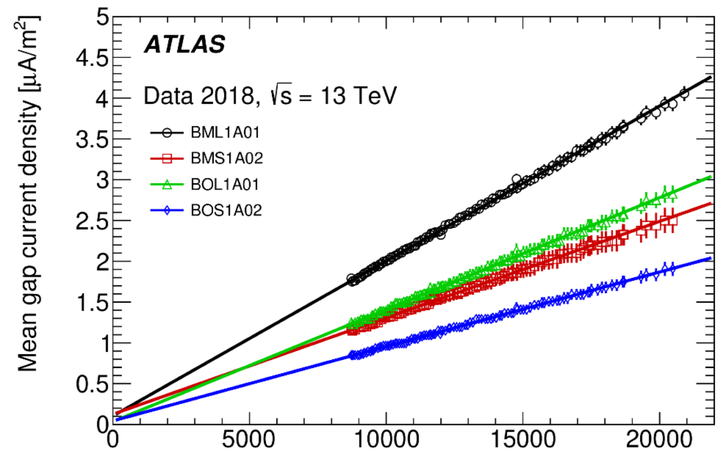


* The time difference between the signal response of two parallel layers in the same module and fired by the same muon is dominated by the time resolution
  * it is measured to be ~2.1 / √2 ~ 1.5 ns



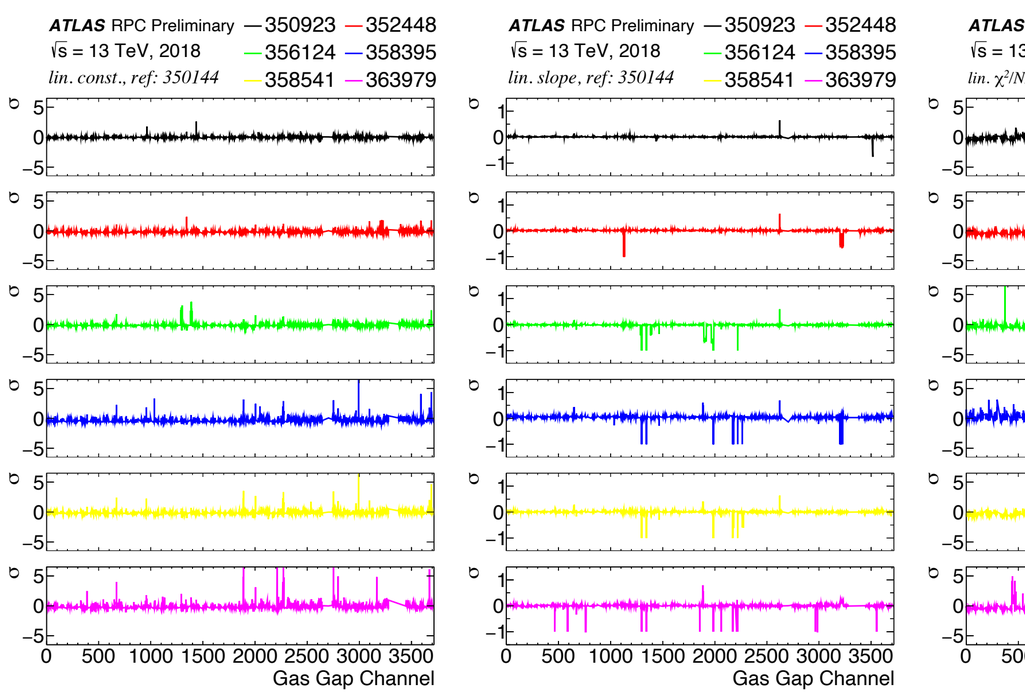
RPC currents measurements

* The current response is expected to increase linearly with the instantaneous luminosity
* Current averaged over all the modules in each RPC station has been evaluated



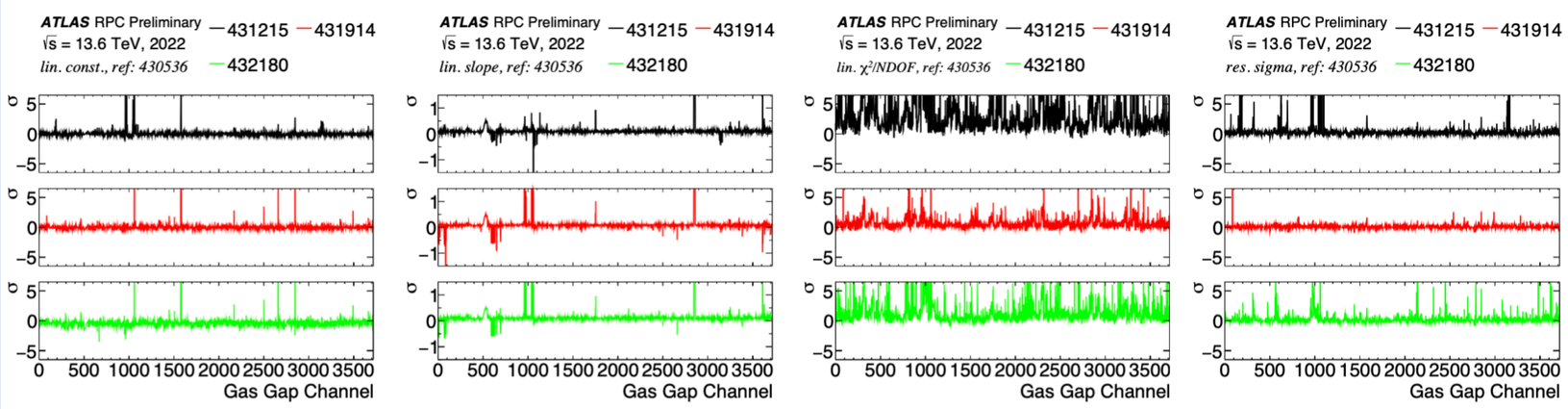
New offline data analysis for RPC monitoring

* A new tool has been developed to analyse DCS offline RPC data
  * Oracle module allows a faster and stable access to DCS data
  * validate new analyses on Run-2 data and prepare automated monitoring for Run-3 data
* Starting from the linear response of the current to th luminosity, fit parameters are used to build estimato
  * $\sigma = (\theta - \theta_0) / \theta_0$
  * θ is a parameter, θ_0 is the same parameter i a reference run
* Significant deviations from the bulk values of these estimators hint behaviours in the response that are not expected
  * the spikes in the estimators hint gas volum channels that started to misbehaving and that are worth investigating



θ = linear fit constant | θ = linear fit slope | θ = linear fit χ^2/NDOF | θ = linear fit residuals

Future perspectives and new Run-3 data



θ = linear fit constant | θ = linear fit slope | θ = linear fit χ^2/NDOF | θ = linear fit residuals

* First look at Run-3 DCS offline data
* The potentiality of the estimators is confirmed in new runs
* An automated warning alert monitoring the time evolution of behaviours will be set for Run-3 operations
  * looking at new runs as soon as they are available would allow to monitor the response of each single channel in ~real time
  * the time evolution during Run-3 and alerts on suspicious responses will be set

References:
- ATLAS collaboration, Performance of the ATLAS RPC detector and Level-1 muon barrel trigger at √s = 13 TeV, JINST 16 (2021) P07029, DOI:10.1088/1748-0221/16/07/P07029
- https://atlas.web.cern.ch/Atlas/GROUPS/MUON/PLOTS/MDET-2022-06/

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