Performance of the ATLAS RPC Detector and Trigger at 13 TeV

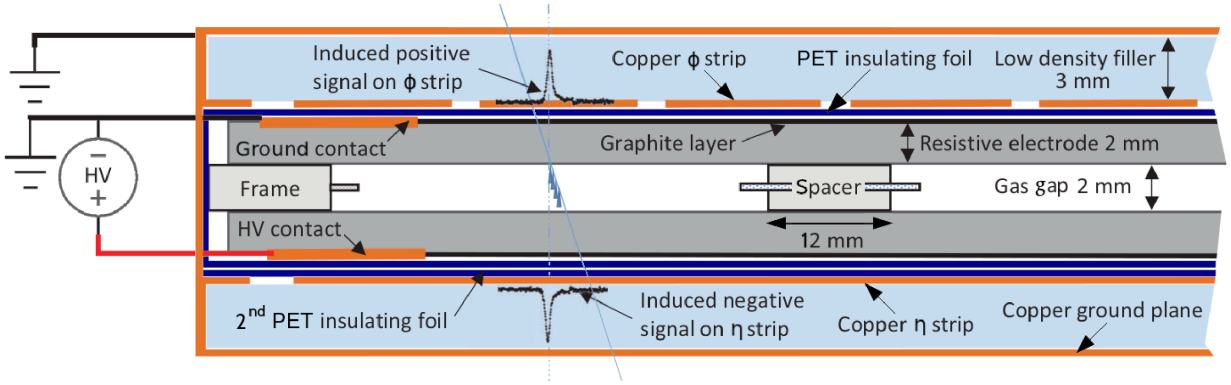
Ye Chen
University of Science and Technology of China

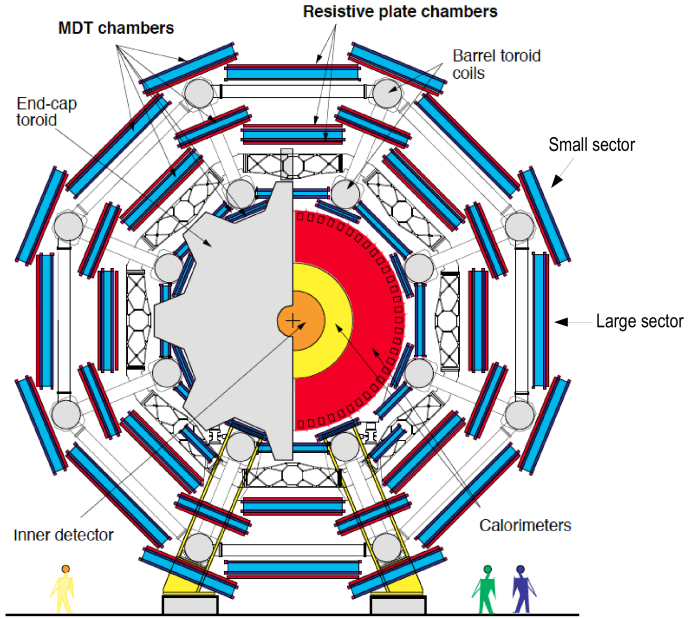
CLHCP2021 Poster Session

2021.Nov.25

RPC Detector @ ATLAS

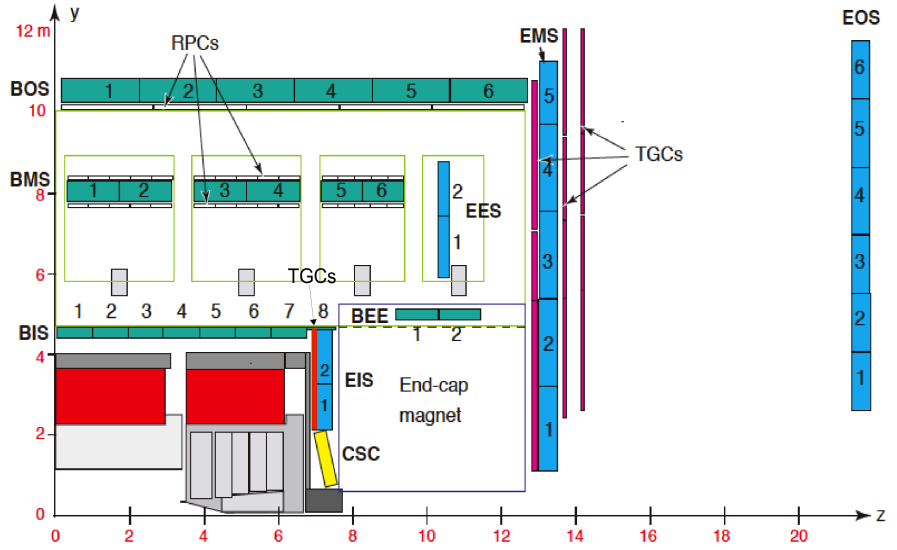
The RPC technology was chosen by the ATLAS experiment for fast response, good time and position resolution, and relatively low cost.





ATLAS muon trigger in the barrel region

- 3 concentric RPC layers
- 16 physical sectors, ~3700 gas volumes each physical sector is segmented in 4 trigger sectors
- 64 trigger sectors in side A and side C each trigger sector is segmented along η in towers [1] [3]



RPC Detector Performance

Hit position resolution

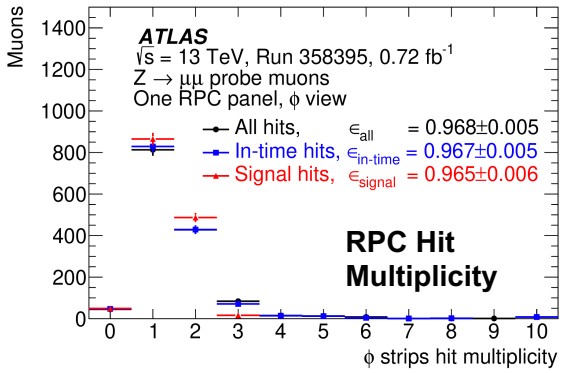
- Reasonable hit multiplicity & cluster size
- Good position resolution with small hit residual to RPC clusters

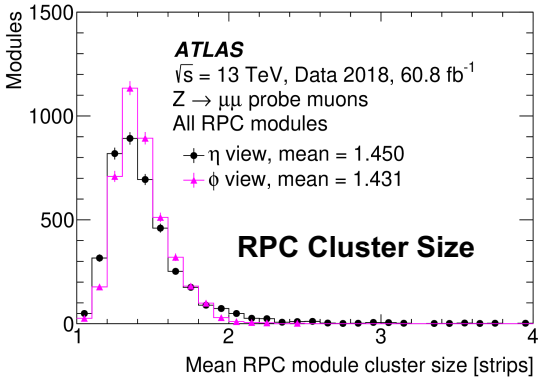
Total time resolution

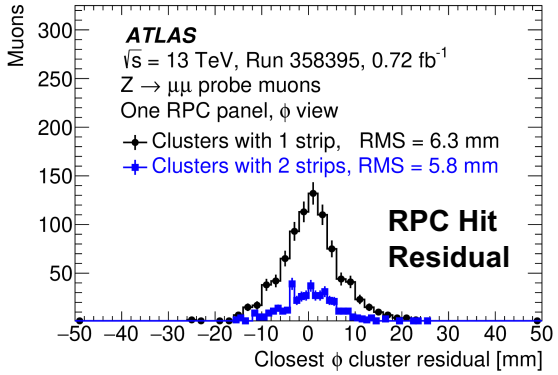
- $\sigma^2_{total} = \sigma^2_{Electronics} + \sigma^2_{Intrinsic}$
- Evaluation : width of gaussian fit for $t^{\eta(or\ \phi)}_{layer\ i} - t^{\eta(or\ \phi)}_{layer\ j}$
- 2.06 ns for η panels and 2.21 ns for ϕ panels

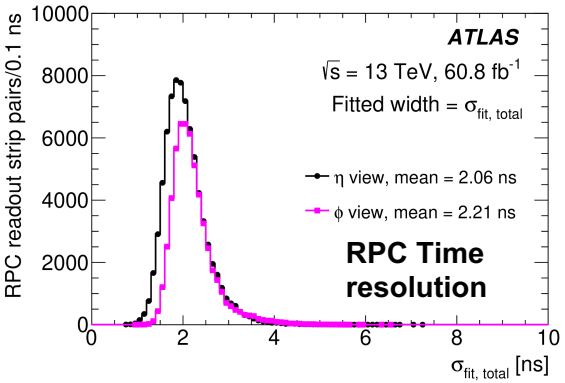
RPC detector efficiency

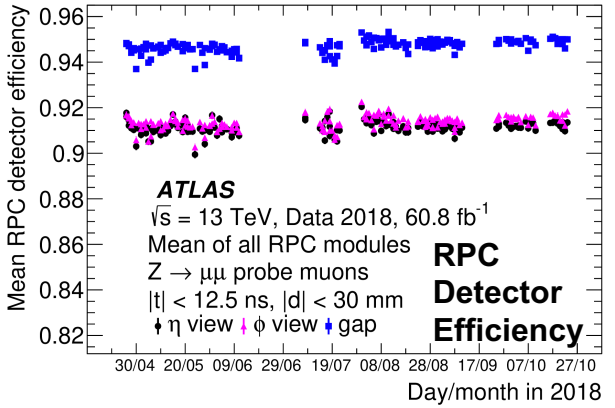
- High efficiency and stable performance





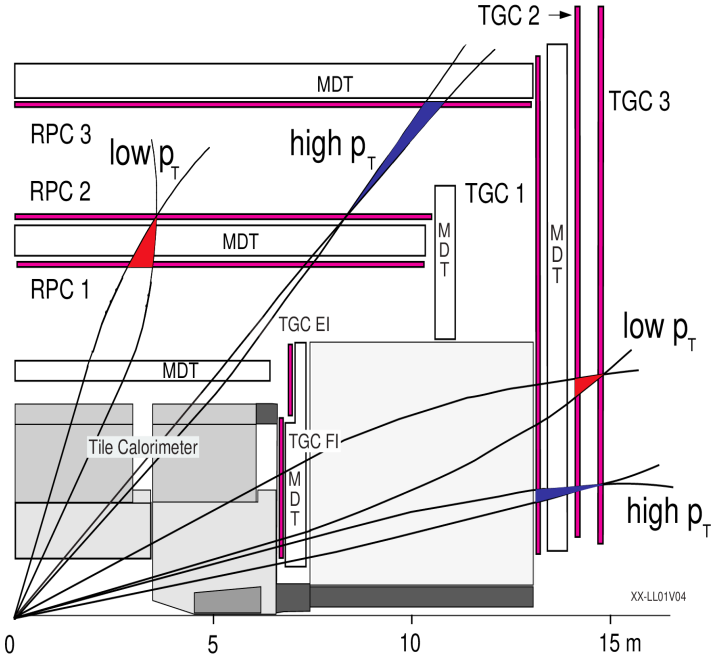






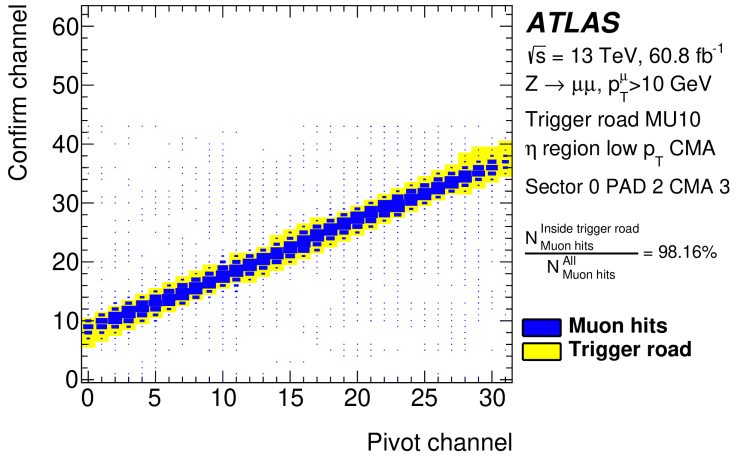
RPC L1 Trigger algorithm

- Based on hit coincidence of 3 concentric RPC stations
- Low p_T trigger : coincidence between RPC1 & RPC2
- High p_T trigger: additional confirmation on RPC3



Trigger tower logic

- Processing in RPC FE electronics processor box (PAD)
- Each **PAD** contains four coincidence matrices ASIC(CMA)
- **CMA** calculates pT threshold by comparing hit position and trigger road information
- **Trigger road** : store geometrical correlation between pivot and confirm layer



RPC L1 Trigger Performance

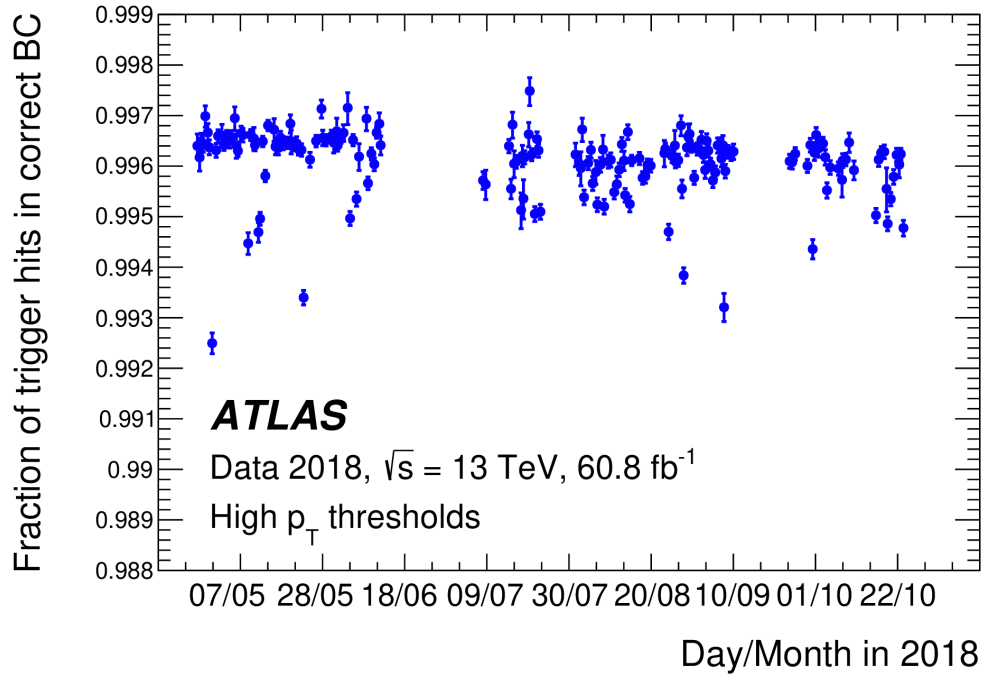
Measurement : using unbiased muons from $Z \rightarrow \mu\mu$ candidates.

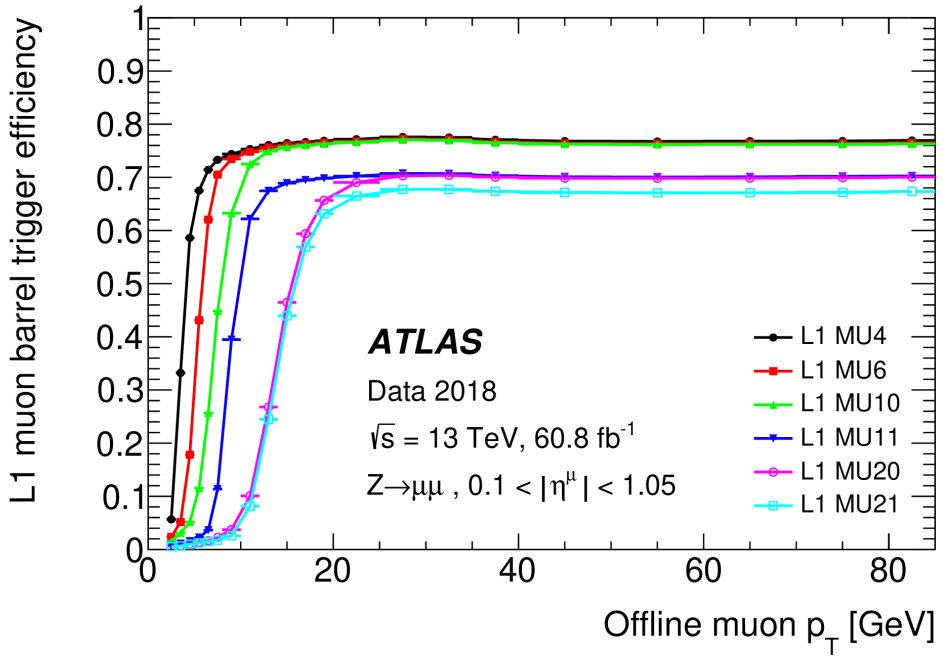
Trigger timing performance

- **~ 99.7%** of muon trigger candidates associated to the correct bunch crossing (BC)

Trigger efficiency of different muon *p*T thresholds

- muon candidates with $pT > 20$ GeV is **~ 76.5%** for low *p*T thresholds and **~ 70%** for high *p*T thresholds with good stability during the data taking.





RPC Currents and Counting Rate

- **RPC currents :** generated from ionization current in RPC gas gap , were recorded during periods of pp collisions with stable
- **RPC counting rate :** using zero-bias collisions, dominated by background events from neutron and photon interactions with the RPCs.
- **RPC avalanche charge :** $Q = \frac{Current\ density}{Counting\ rate}$
- **Prospect for Hi-Lumi LHC :** Extrapolate counting rate and current density to Hi-Lumi using linear functions, reasonable HV is 9.2kV