sTGC Landau Peak Studies from ATLAS NSW GIF++ Test Beam

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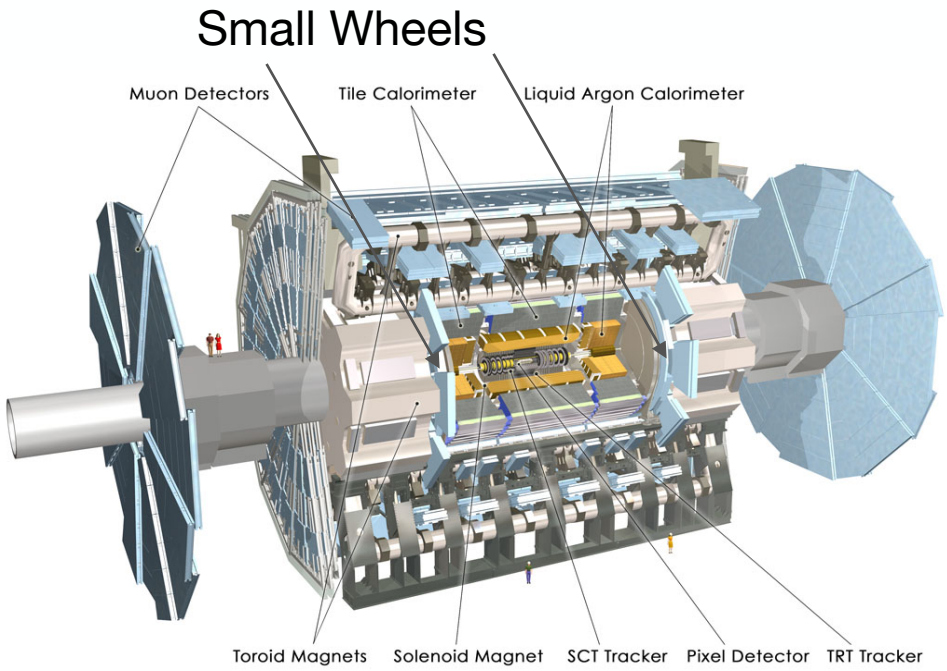
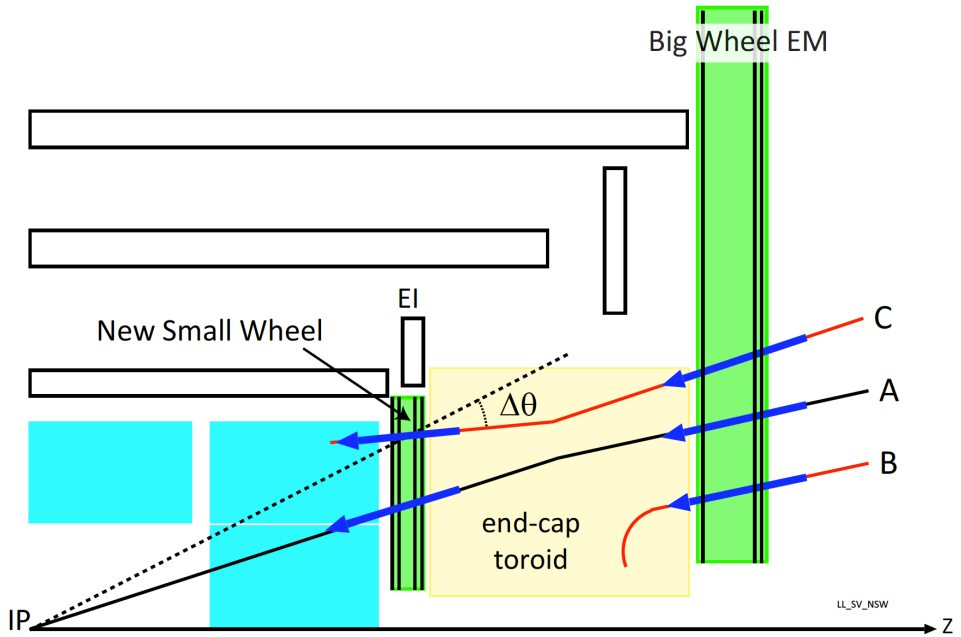
WNPPC 2/18/2022

ATLAS New Small Wheel

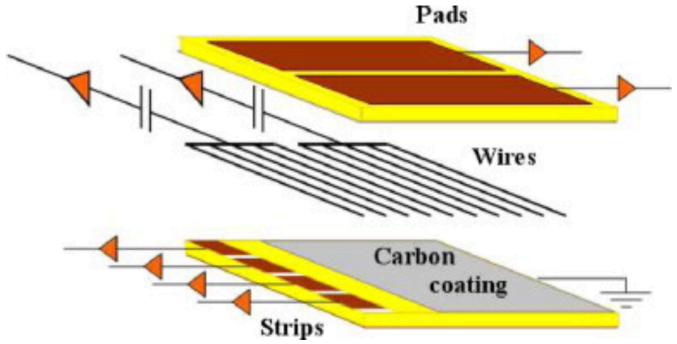
- NSW will reduce fake muon trigger rate in forward region by rejecting tracks that do not point to the Interaction Point

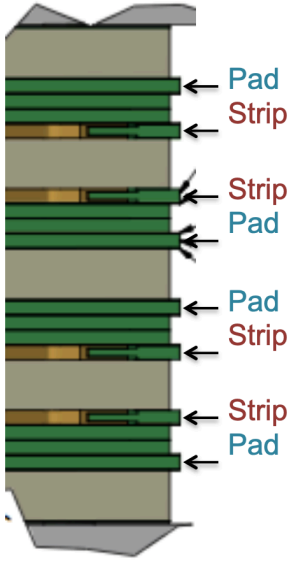


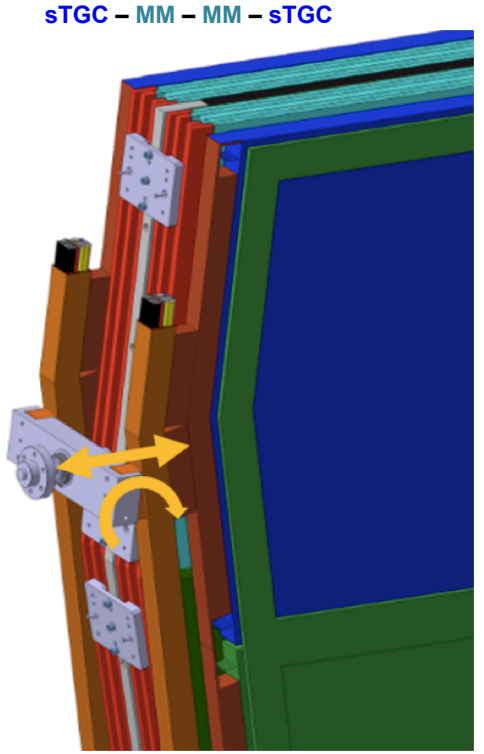


sTGC structure and construction

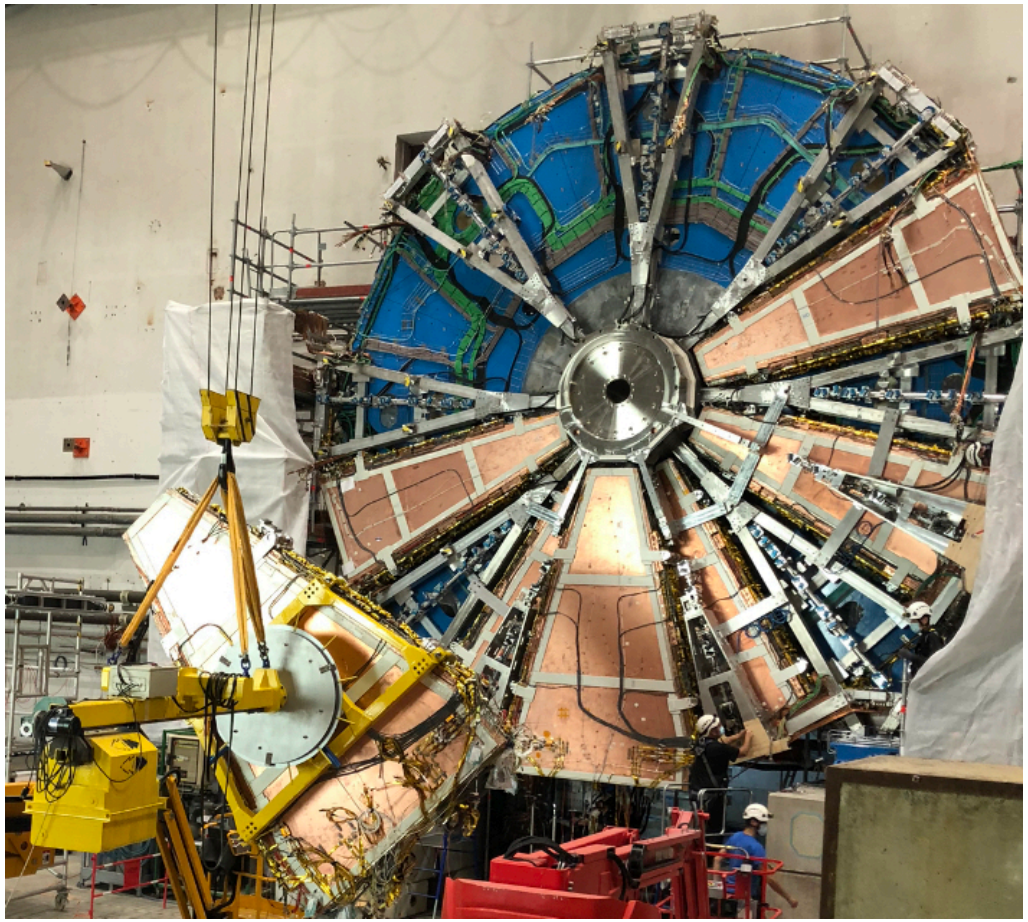
- Small-strip Thin Gap Chamber
  - Precision thin gap chambers for triggering
- Gas-gaps composed of 2 cathode planes
  - Each gas-gap is a layer in sTGC module
- Quadruplet modules have 4 layers



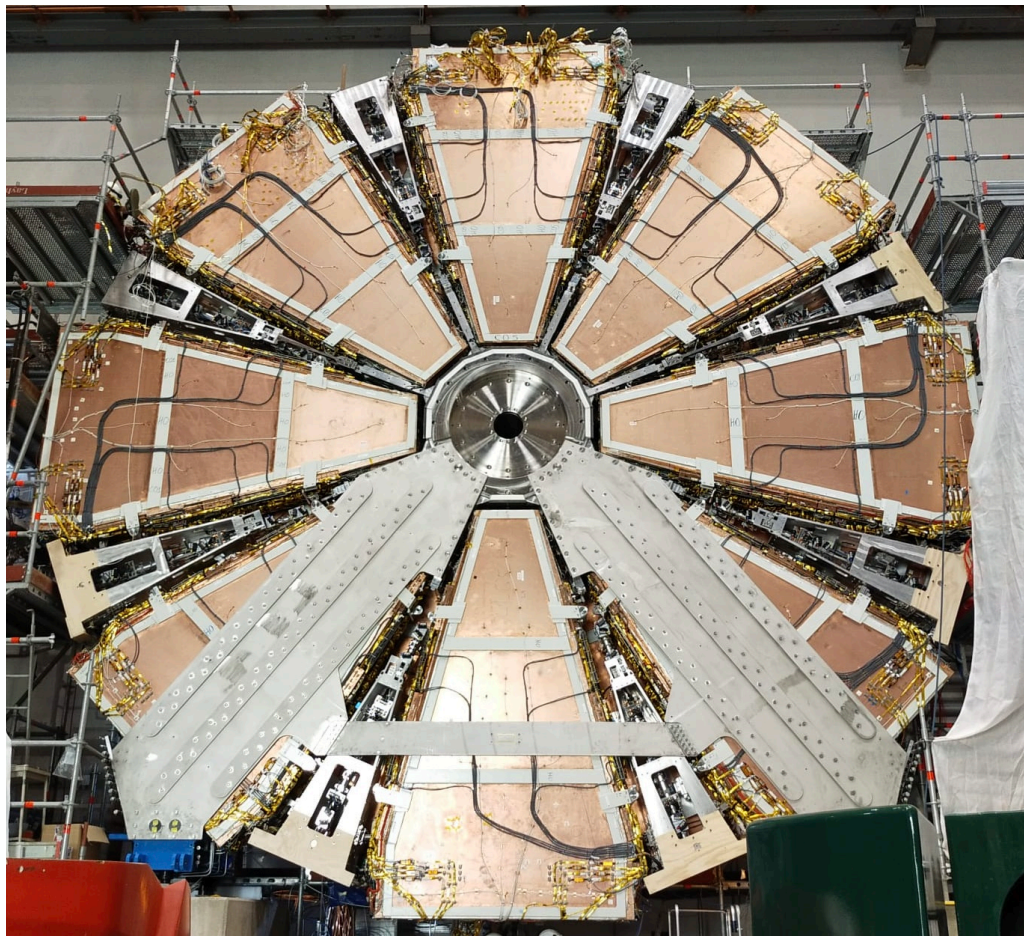




NSW Surface Commissioning



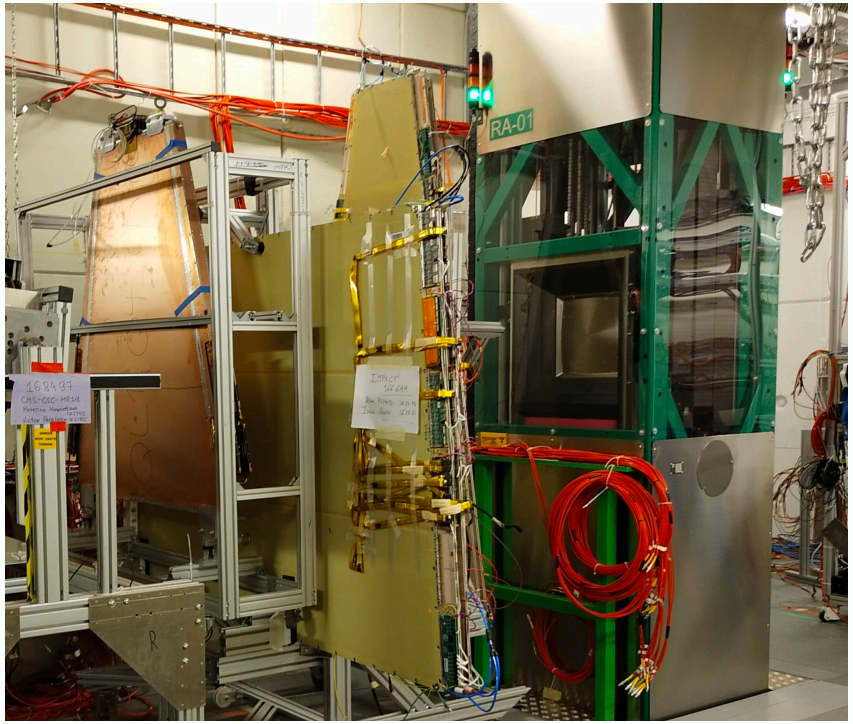
July 20, 2021



September 13, 2021

NSW Test beam at GIF++

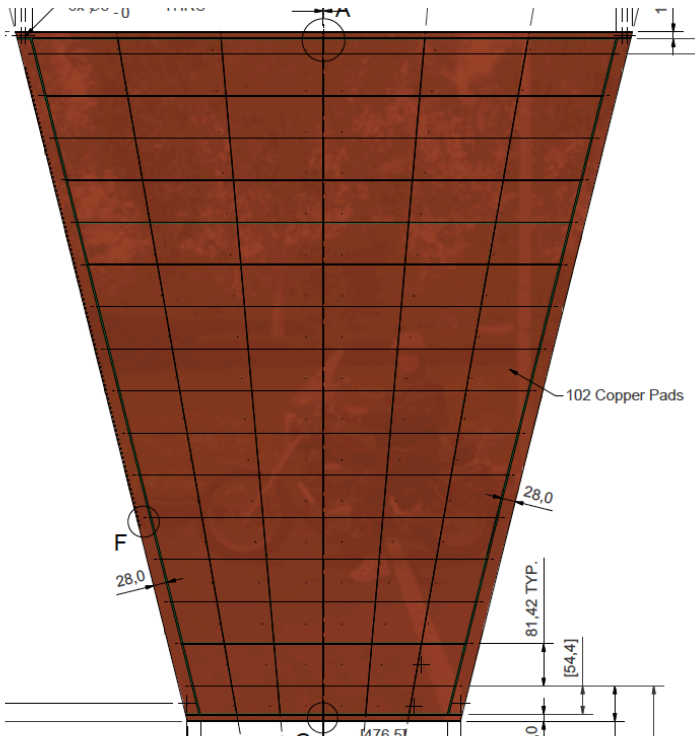
- Gamma Irradiation Facility
- CERN SPS H4 beam line
- 10 cm radius muon beam
- Max momentum 100 GeV/c
- 14k muons/beam spill
- 14 TBq Cs-137 source can be attenuated
- Unattenuated γ rate of 13 kHz/cm^2 on sTGC



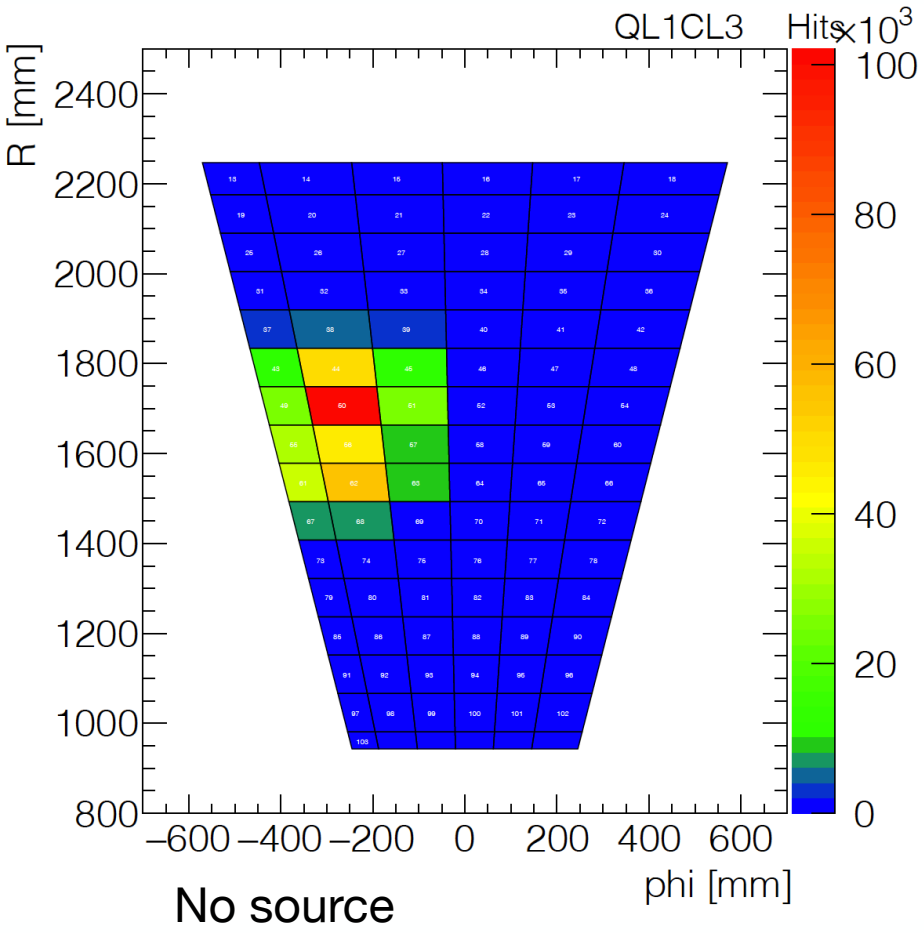
Ksenia Solovieva

sTGC Test beam studies

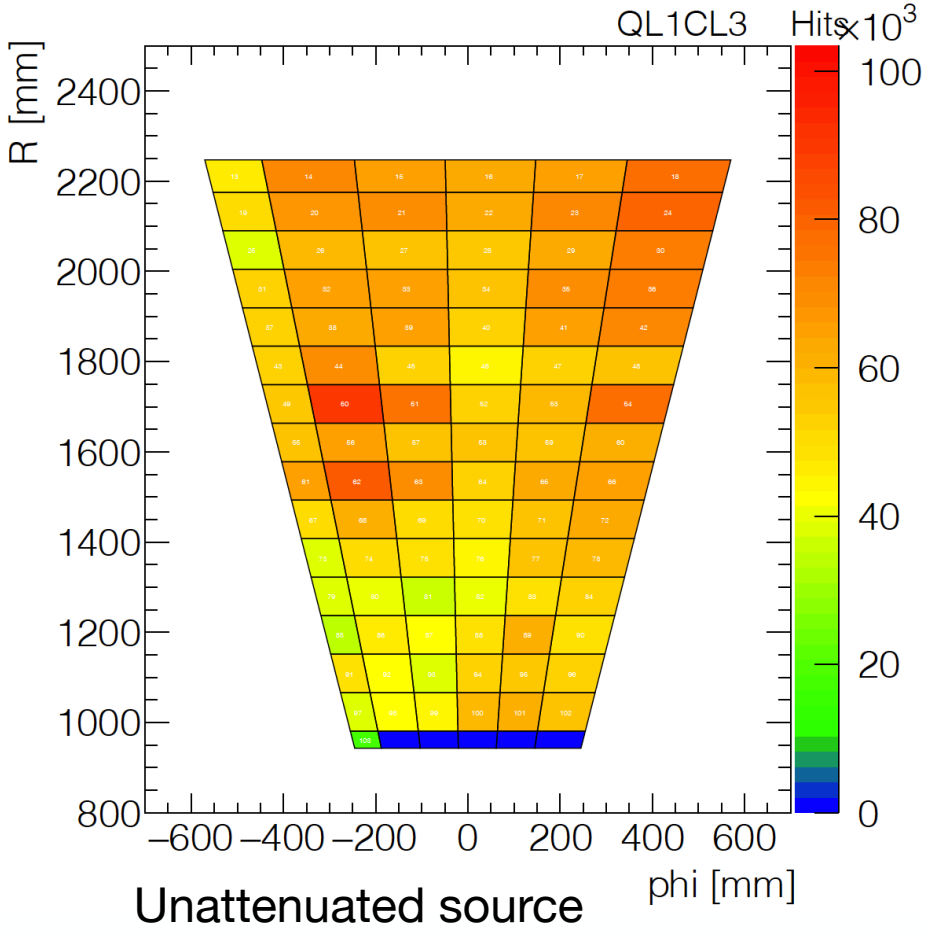
- Performance at different high voltage settings
- Strip clustering with different readout parameters
- Pad efficiency with and without background
- 25 and 50 ns signal peaking times



Distribution of hits



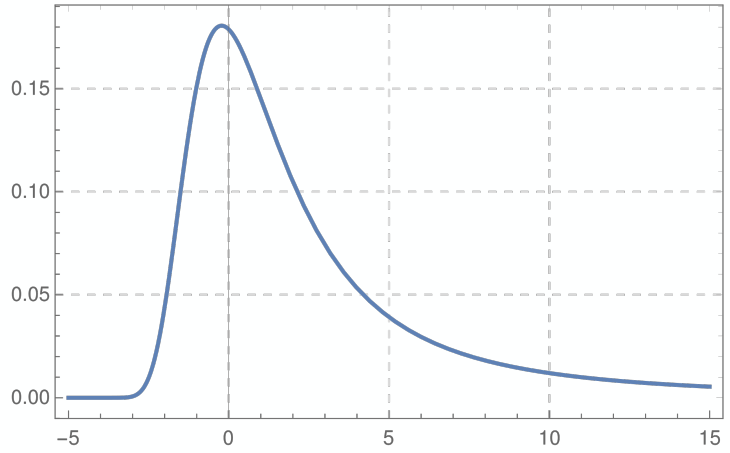
No source



Unattenuated source

sTGC Landau distributions

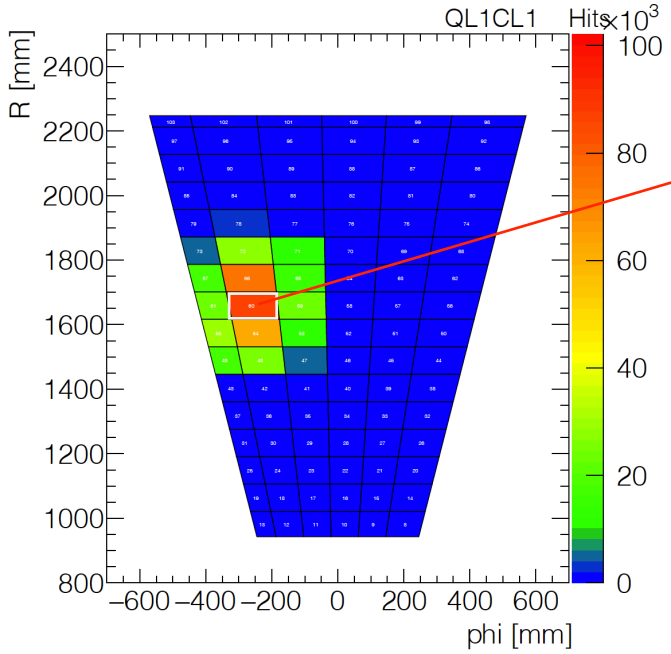
- Energy loss of a minimum ionizing particle (MIP) in thin detector follows Landau distribution
  - Sharp peak, long tail
  - Most probable value (MPV) less than mean
  - Scaling parameter σ = FWHM/4
- For thin detectors, long tail is due to rare high energy depositions; muons that bremsstrahlung instead of ionize

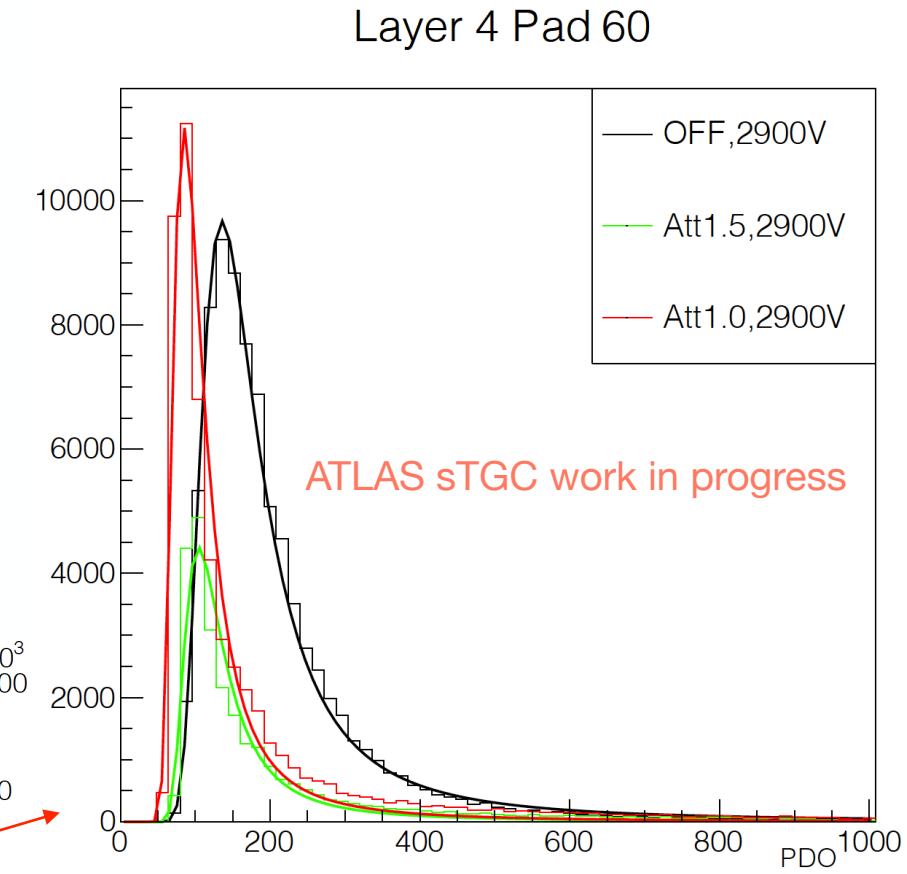


https://en.wikipedia.org/wiki/Landau_distribution

PDO distributions

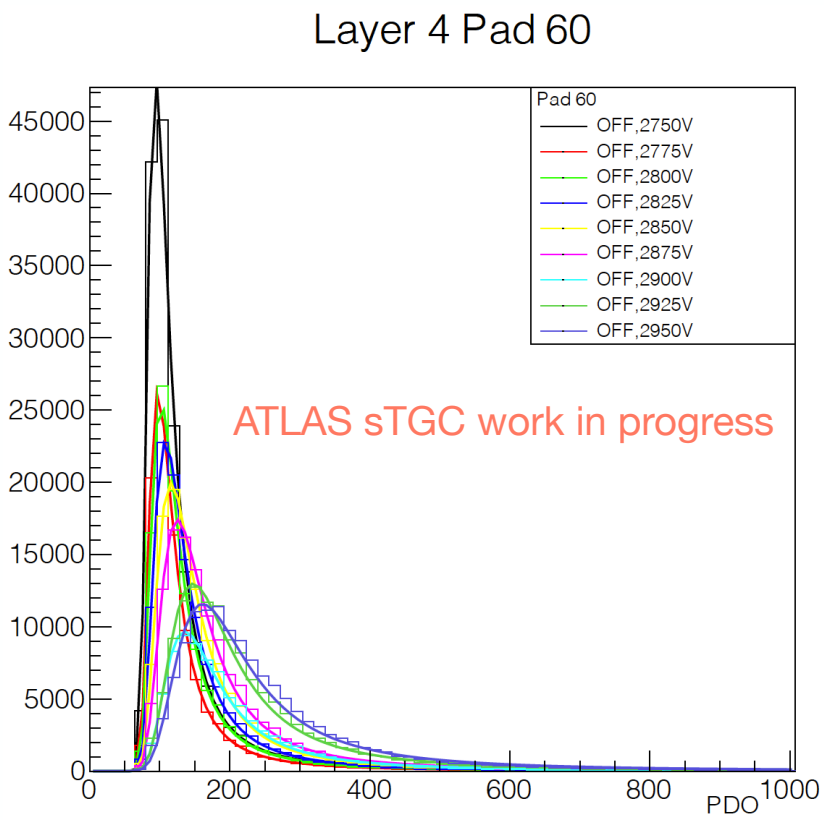
- Pedestal Detector Output: measure of pulse height above threshold
- PDO histograms are a distribution of energy deposition by charged particles in detector

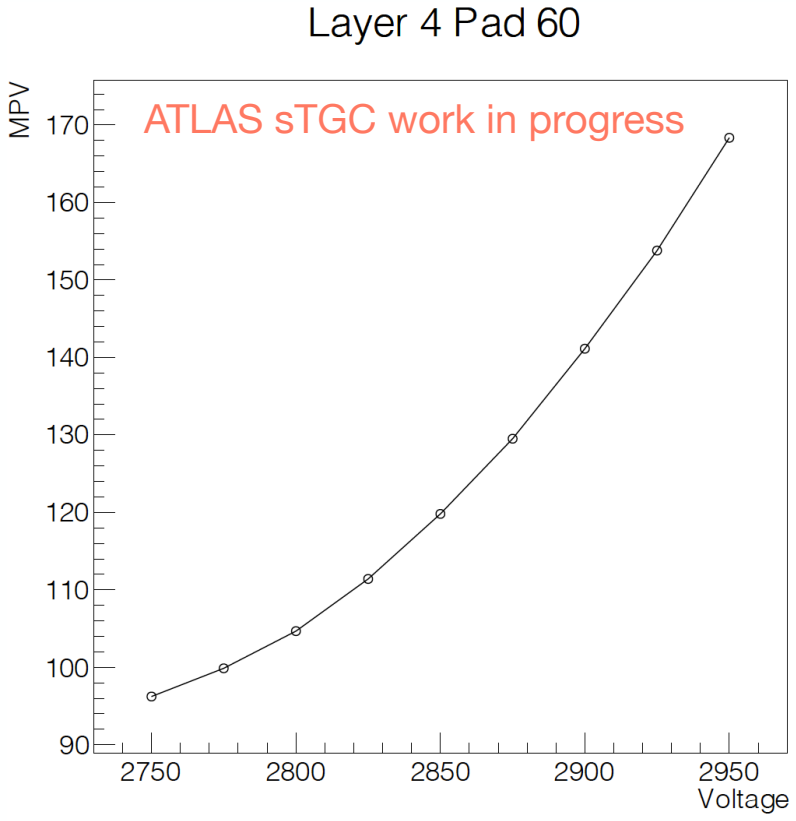




MPV distributions

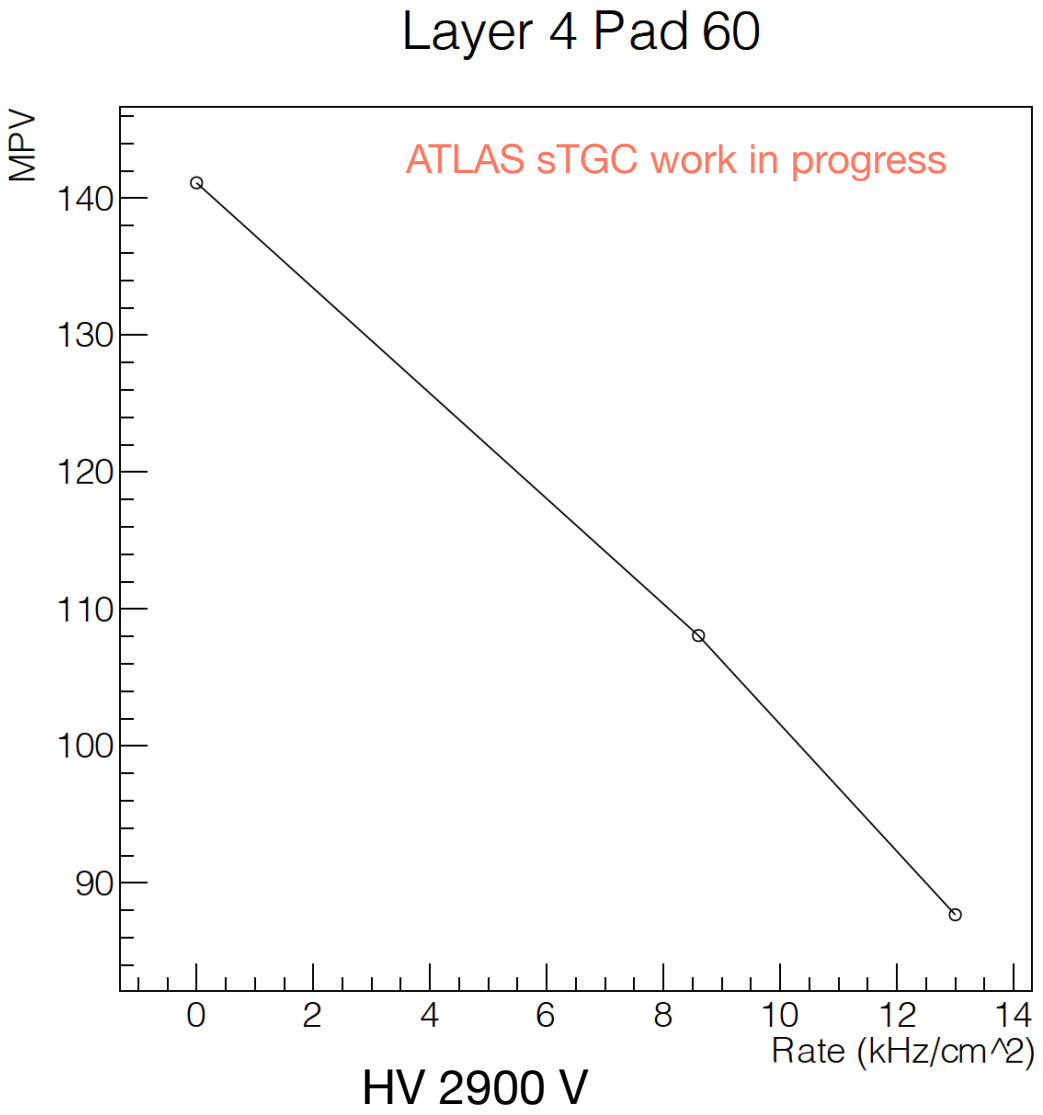
- MPV increases with voltage
- MIP produce larger signal at higher HV setting





Impact of background

- Increased background acts as effective voltage drop
- Source rate of 13 kHz/cm² is approximately the expected NSW background during HL-LHC
- sTGCs will need to run at higher voltage to compensate for background



Further Work

- Make conclusions about affect of high voltage and background from Landau studies of pads
- Study Landau peaks from strip clusters
- Test beam results will inform NSW operational settings

Instagram @atlasexperiment

Acknowledgements

sTGC Test Beam team and sTGC Collaboration

Reference

Pfeiffer et al., The radiation field in the Gamma Irradiation Facility GIF++ at CERN, Nuclear Instruments and Methods in Physics Research Section A **866**, 10.1016/j.nima.2017.05.045 (2017).