(A very brief introduction to)

ATLAS NSW sTGC Integration and Commissioning

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Outline

- The High Luminosity LHC
- The New Small Wheel
- The small-strip Thin Gap Chambers (sTGCs)
- sTGC Trigger Chain and Electronics
- Highlights from my Integration work
- Highlights from my R&D work
- Experiences and Travel

The High Luminosity (HL) LHC

- Luminosity ∝ to p-p collision rate.

$$L = \frac{1}{\sigma}\frac{dN}{dt}$$

- In order to increase the precision of measurements at the LHC, more data is needed ➔ need to increase the LHC's luminosity.
- Factor of 10 increase in luminosity planned.
- To accommodate the increase in hit rates, new muon detector technology is needed - the ATLAS New Small Wheel.

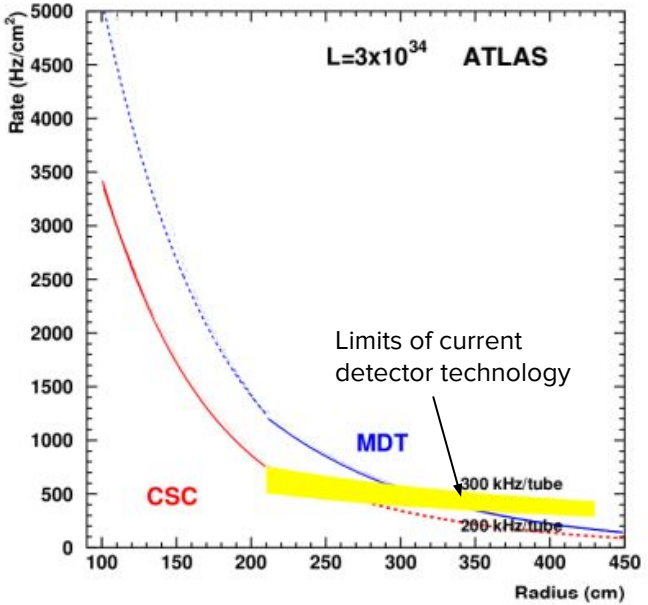


Figure 1: Projected HL-LHC SW event rate

The New Small Wheel

- NSW → new muon tracker to be installed in ATLAS.
- Two to be installed, A-side and C-side.

Figure 3: The A-side New Small Wheel

- Detector technology includes Micromegas (MM) and small-strip Thin Gap Chambers (sTGCs).

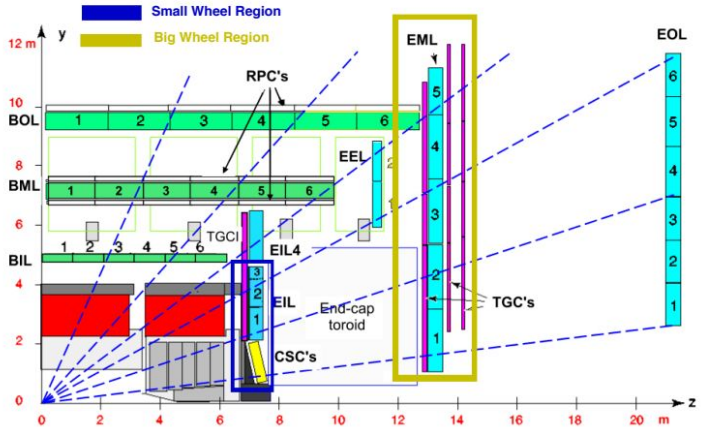


Figure 2: Small Wheel Location in ATLAS

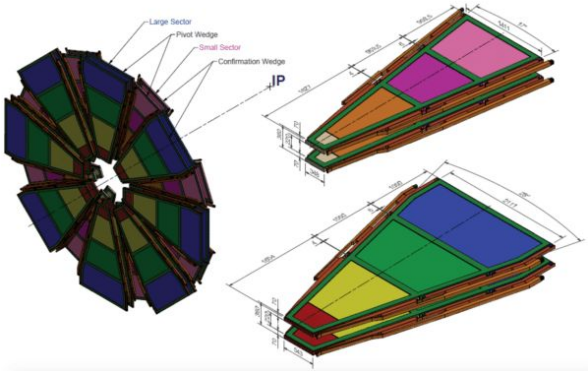


Figure 4: sTGC Chambers as seen in the NSW.

The small-strip Thin Gap Chambers (sTGCs)

- Multiwire proportional chambers ➔ gas chamber with potential difference between anode (wires) and cathode (pads, strips).

- Muon passes through ➔ gas is ionized ➔ electron avalanche reaches anode ➔ electric signal **proportional** to ionization.

Figure 5: An sTGC wedge

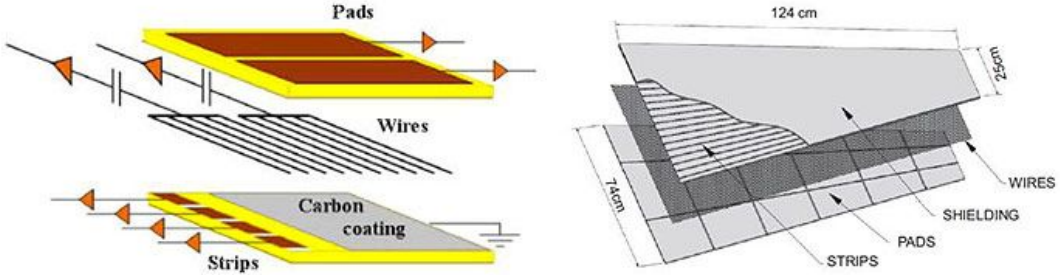
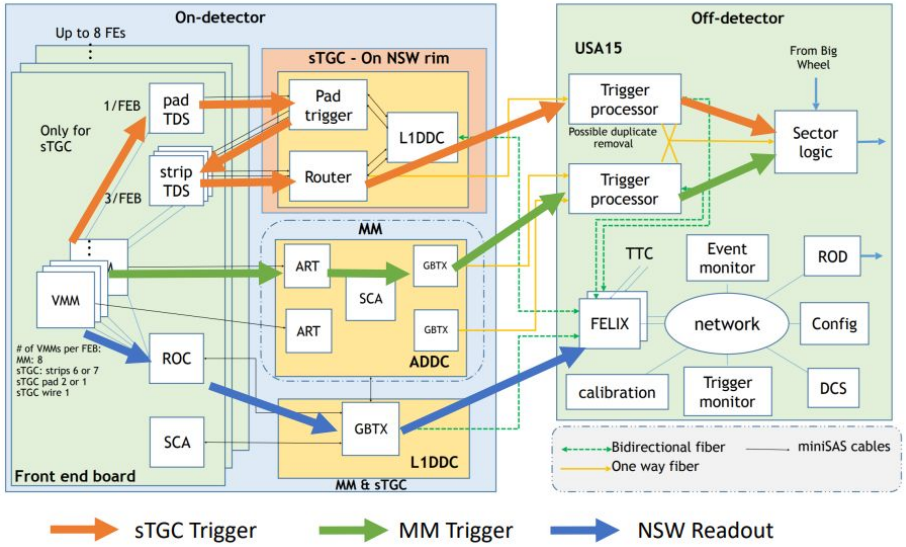


Figure 6: sTGC chamber geometry

sTGC Trigger Chain and Electronics

- **VMMs** are ASICs used to first read out data. Data then sent to **TDS** to be serialized.
- Serialized data sent to **Pad trigger**. If triggered, **strip TDS** reads out VMM and sends the data off-wedge through the Router and L1DDC for further triggering.
- **<u>If triggered</u>**, data is sent from the VMM through the **ROC** and **GBTX** and off-wedge to a **Trigger Processor.**
- All of this must happen **within one microsecond** and is all within the **ATLAS Level-1 muon trigger**. Data is then read out.

Figure 7: NSW electronics readout and trigger map



Highlights from my Integration work

- Mechanical assembly
  - Pre-organized cables for all 16 side-A small wedges and mounted cables onto wedge 3 & 4.
  - Troubleshot mechanical issues with FEB fitting, mounting of cooling, cooling pipe leakage, etc.

- Electronics testing and troubleshooting
  - Conducted pre-power mini-DAQ tests to detect and troubleshoot potential VMM issues.
  - Configured on-wedge chips and conducted baseline and threshold noise scans, eventually to troubleshoot issues.

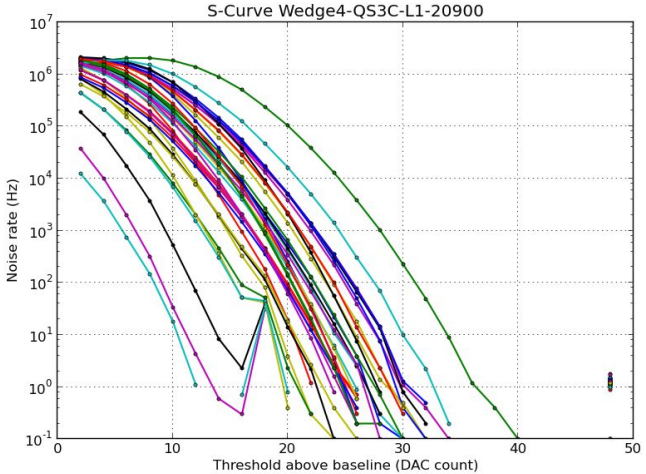


Figure 8: Plot showing S-curve noise scan

Highlights from my R&D work

- Developed a system and GUI to digitally obtain the sTGC SCA ID's and L1DDC & FEB mappings, as well as cross-check these mappings with old production logs for consistency.

- Developed a GUI to configure GBTXs. Refining the GBTX configuration process and developing system to detect potential issues.

- Currently figuring out a way to make wiring fit onto the large wedge without interfering the NSW alignment system.

Figure 9: The large wedge with wiring in progress

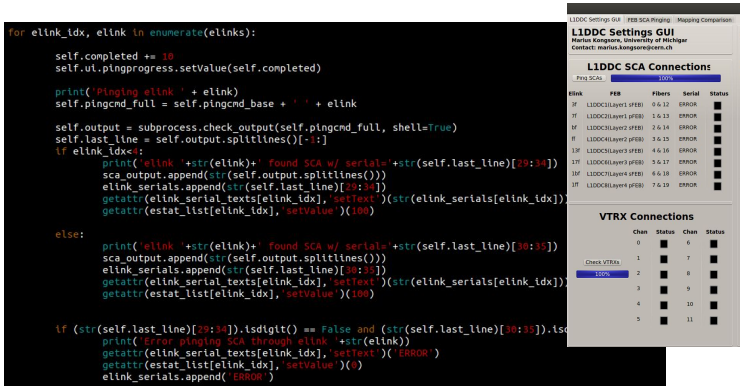
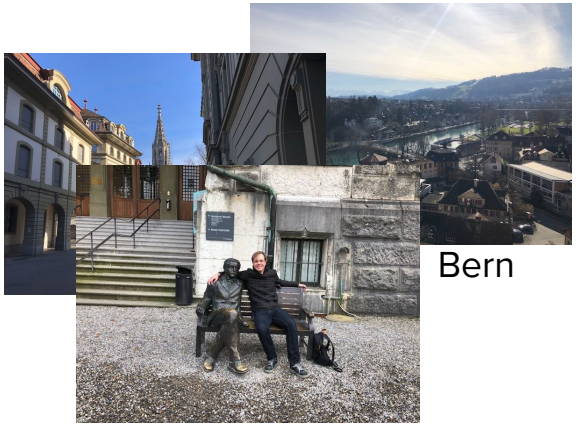


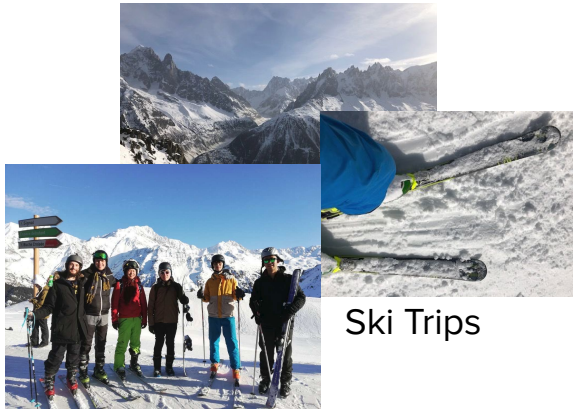
Figure 10: GUI snippet + code interfacing the L1DDC GUI with the SCA pinging script

Experiences & Travel

ATLAS



Bern



Ski Trips

Barcelona

Geneva

London

References

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  - “Technical Design Report for the Phase-II Upgrade of the ATLAS TDAQ System.” CERN Records, 2017, CERN-LHCC-2017-020
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- Stelzer, Bernd, and ATLAS Muon Collaboration.
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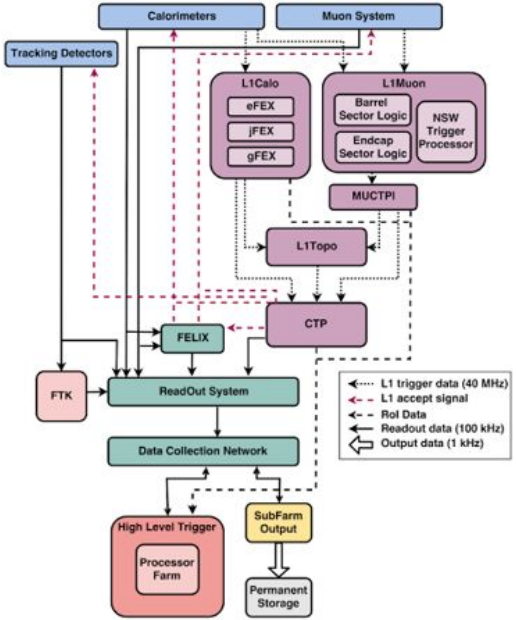
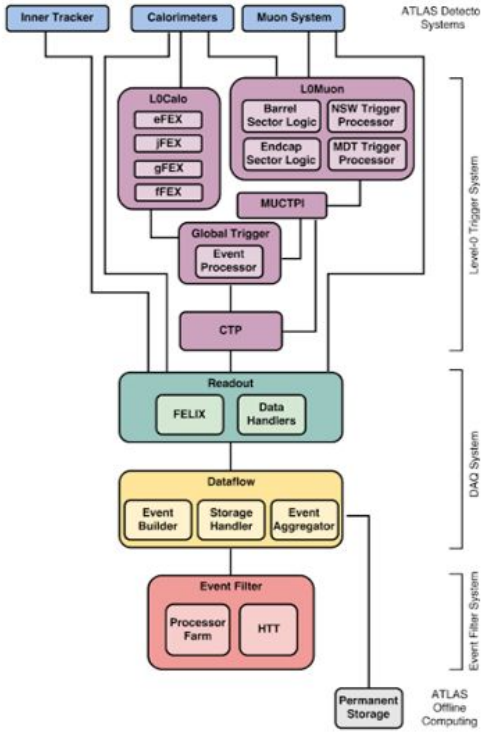
Backup I - ATLAS Muon Trigger System





Backup II - NSW in ATLAS and baseline noise scan