(A very brief introduction to)

ATLAS NSW sTGC Integration and Commissioning

Marius Kongsore,
Mentored by Siyuan Sun & Liang Guan
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 $\propto$ 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.
- Detector technology includes Micromegas (MM) and small-strip Thin Gap Chambers (sTGCs).

Figure 2: Small Wheel Location in ATLAS

Figure 3: The A-side New Small Wheel

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.

- **If triggered**, 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.
Highlights from my Integration work

- **Mechanical assembly**
  - Pre-organized cables for all 16 side-A small wedges and mounted cables onto wedge 3 & 4.
  - Troubleshoot 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

Spanish

Geneva

London
References

● The ATLAS Collaboration.

● Wang, Xu.

● Guan, Liang.
  ○ “Trigger Algorithms and Electronics for the ATLAS Muon NSW Upgrade.”
  https://indico.cern.ch/event/357738/contributions/848816/attachments/1161908/1701549/ATLAS_NSW_Trigger_LiangGuan_TWEPP_vf.pdf

● Stelzer, Bernd, and ATLAS Muon Collaboration.
Backup I - ATLAS Muon Trigger System
Backup II - NSW in ATLAS and baseline noise scan