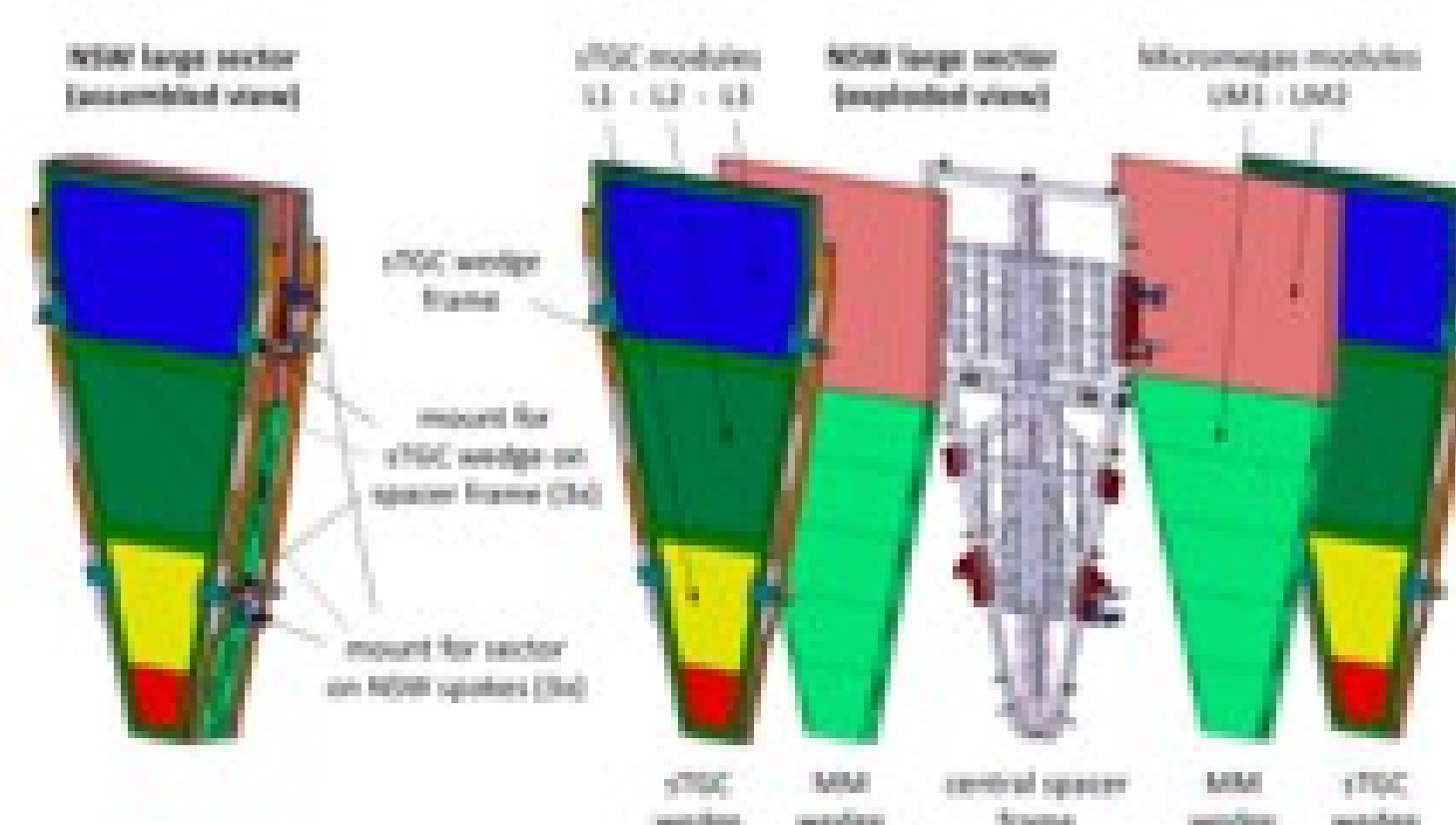
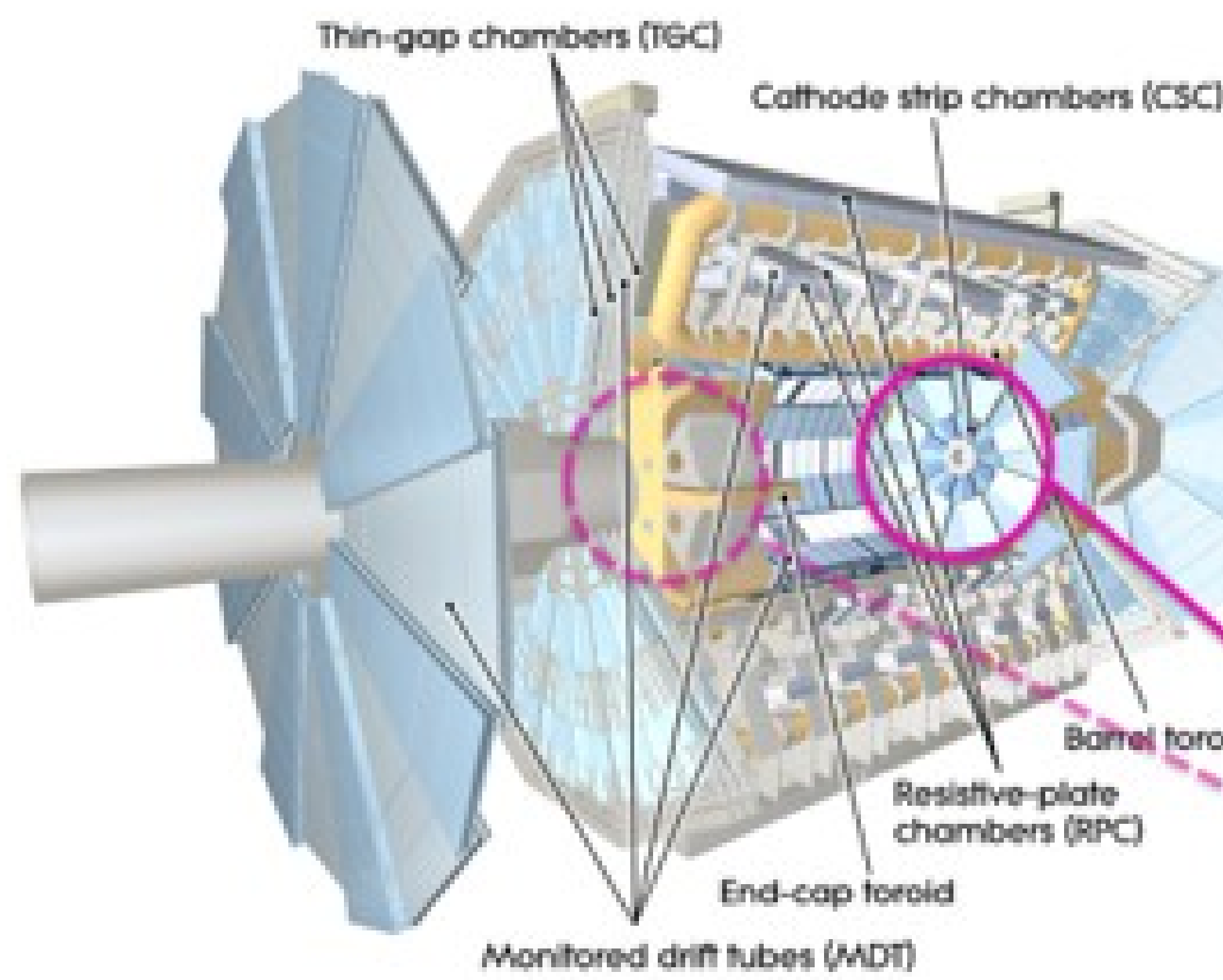


# NSW Upgrade of the ATLAS Detector

Callum McCracken- TRIUMF/UBC  
Damian Sheppard- TRIUMF/SFU

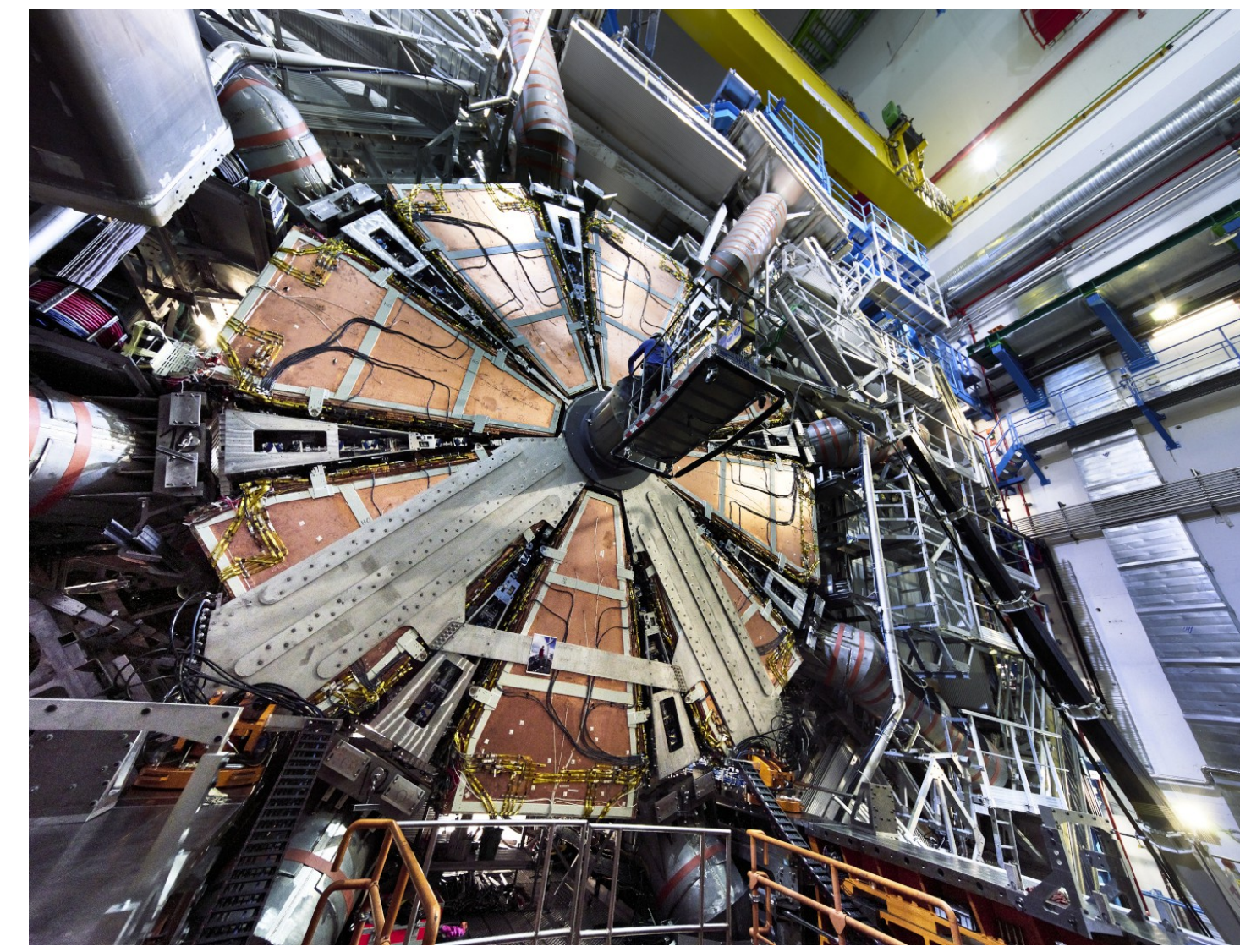
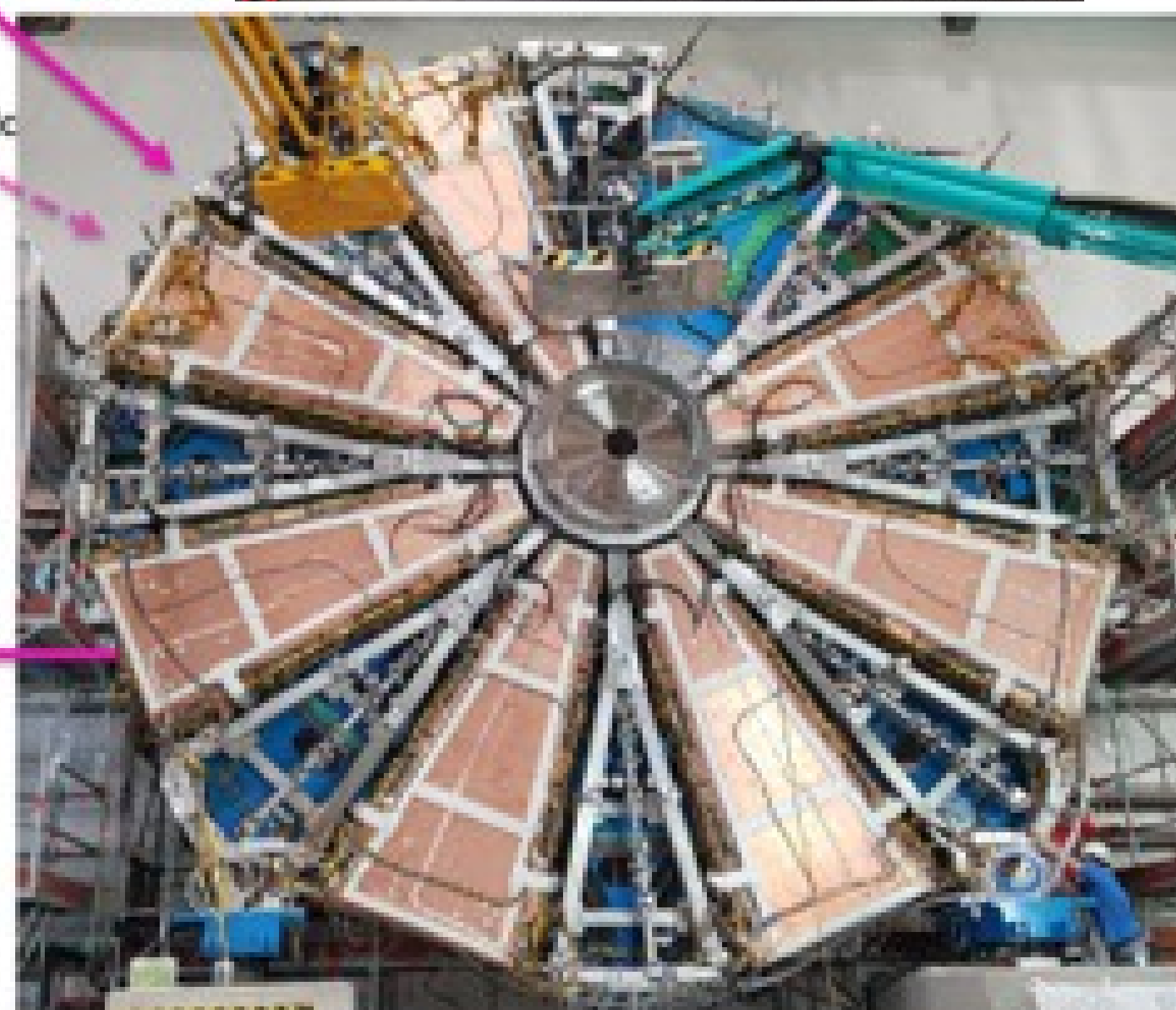
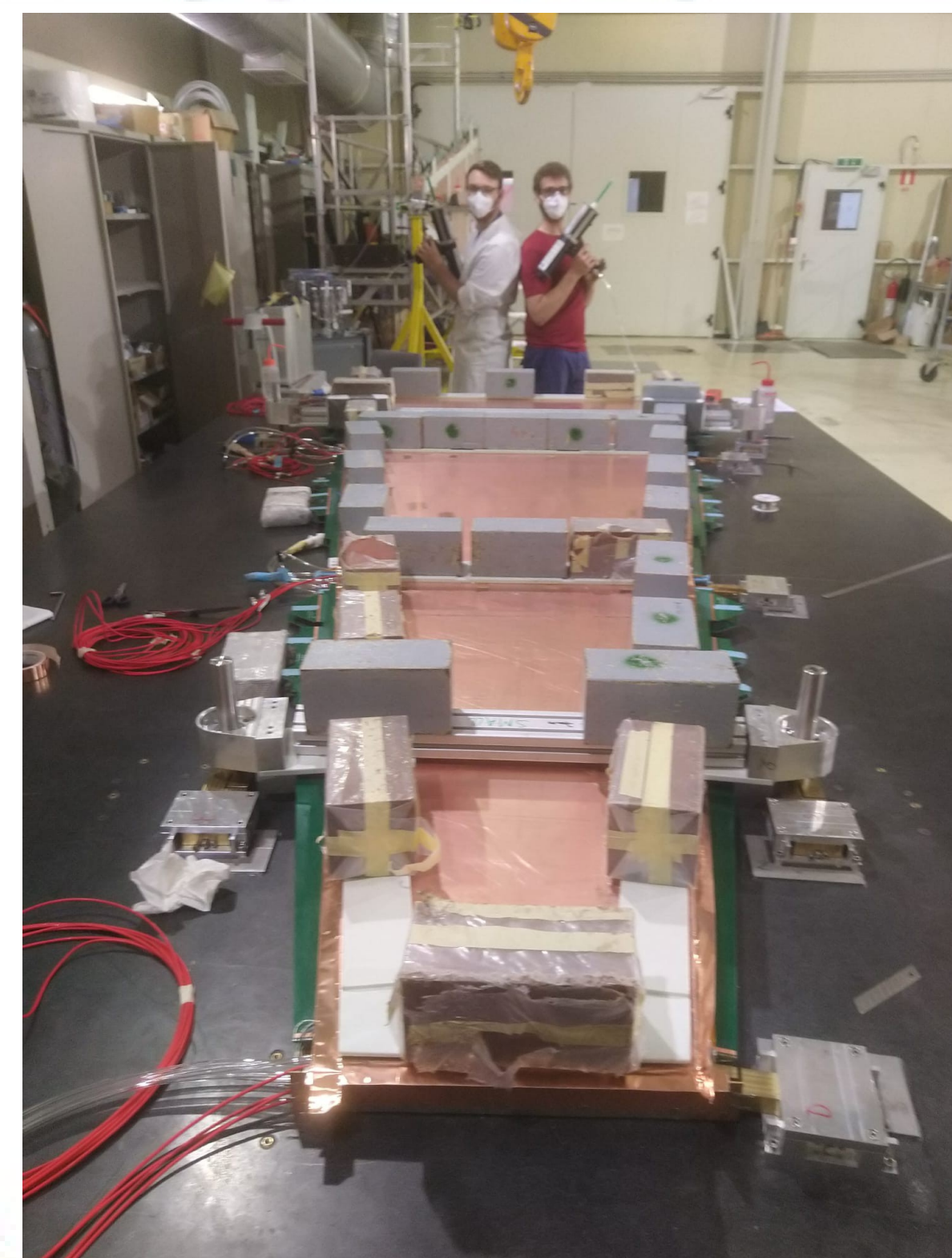
## What's a New Small Wheel?

- **Small Wheels:** Innermost station of the muon detection system
- **Fakes:** Currently, 90% of L1 trigger rate due to things which are not muons from collisions
- **High-Luminosity LHC:** Over the next decade the luminosity of the LHC will increase 5-7.5x from  $2 \cdot 10^{34} \text{ cm}^{-2}\text{s}^{-1}$  (Run II value) making the fake problem worse.
- **Requirements:** reduce L1 fakes, 95% online muon track reconstruction efficiency,  $< \sim 100 \mu\text{m}$  resolution for offline reconstruction,  $< 1 \text{ mrad}$  for online matching with Big Wheel

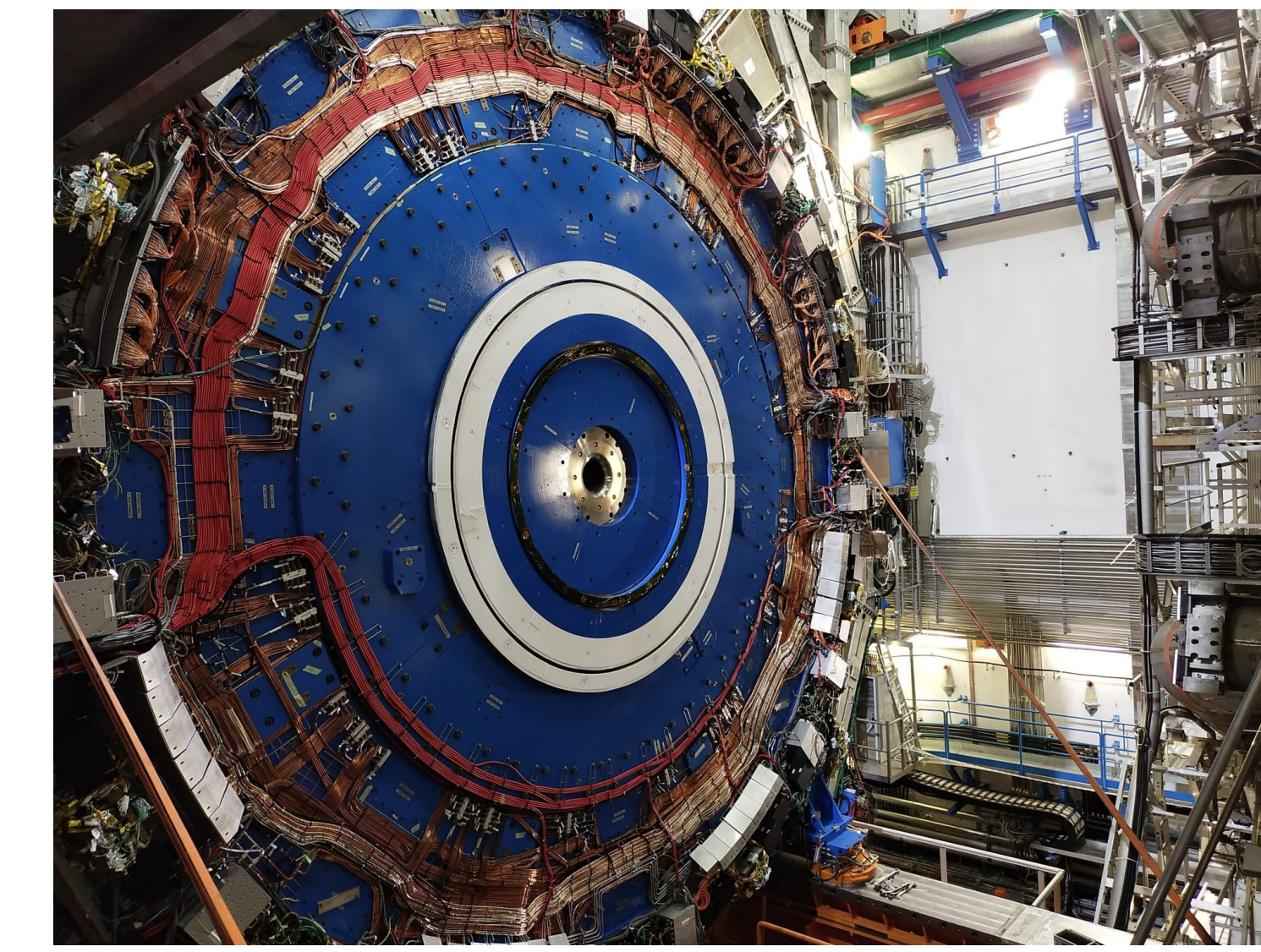


How the NSW are built:

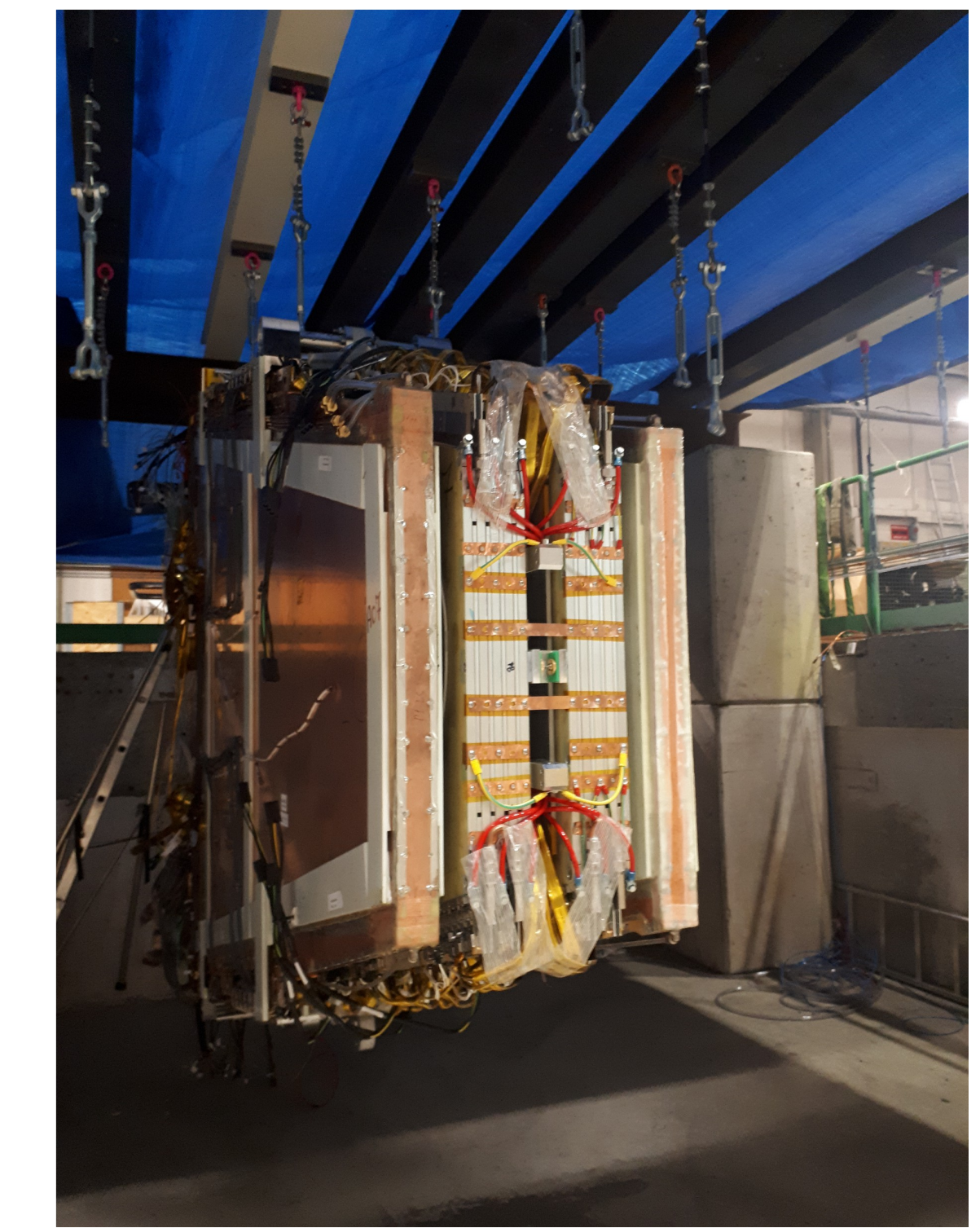
- 1) Components quality control:** Check precisely thickness and dimensions.
- 2) Part cleaning:** Use acetone and isopropyl-alcohol on strip boards and assembling parts to remove oily pollutants. Remove dust with dry air.
- 3) Cathode board preparation:** Laminate 0.1 (0.2) mm pre-prep on readout copper layers.
- 4) Spacer gluing and wire winding:** Glue wire frame and internal support spacers using epoxy lacquer.
- 5) Single layer assembling:** Place clean cathode boards with wire planes on a granite table (flatness deviations of less than  $20 \mu\text{m}$ ). Close chambers with strip boards using precision pins for alignment. Apply vacuum on two sides.
- 6) Doublet, quadruplet assembling:** Glue two single planes on granite table (with honeycomb supports). Check for flatness.



NSW Wheel A in ATLAS cavern



NSW Wheel C in ATLAS cavern

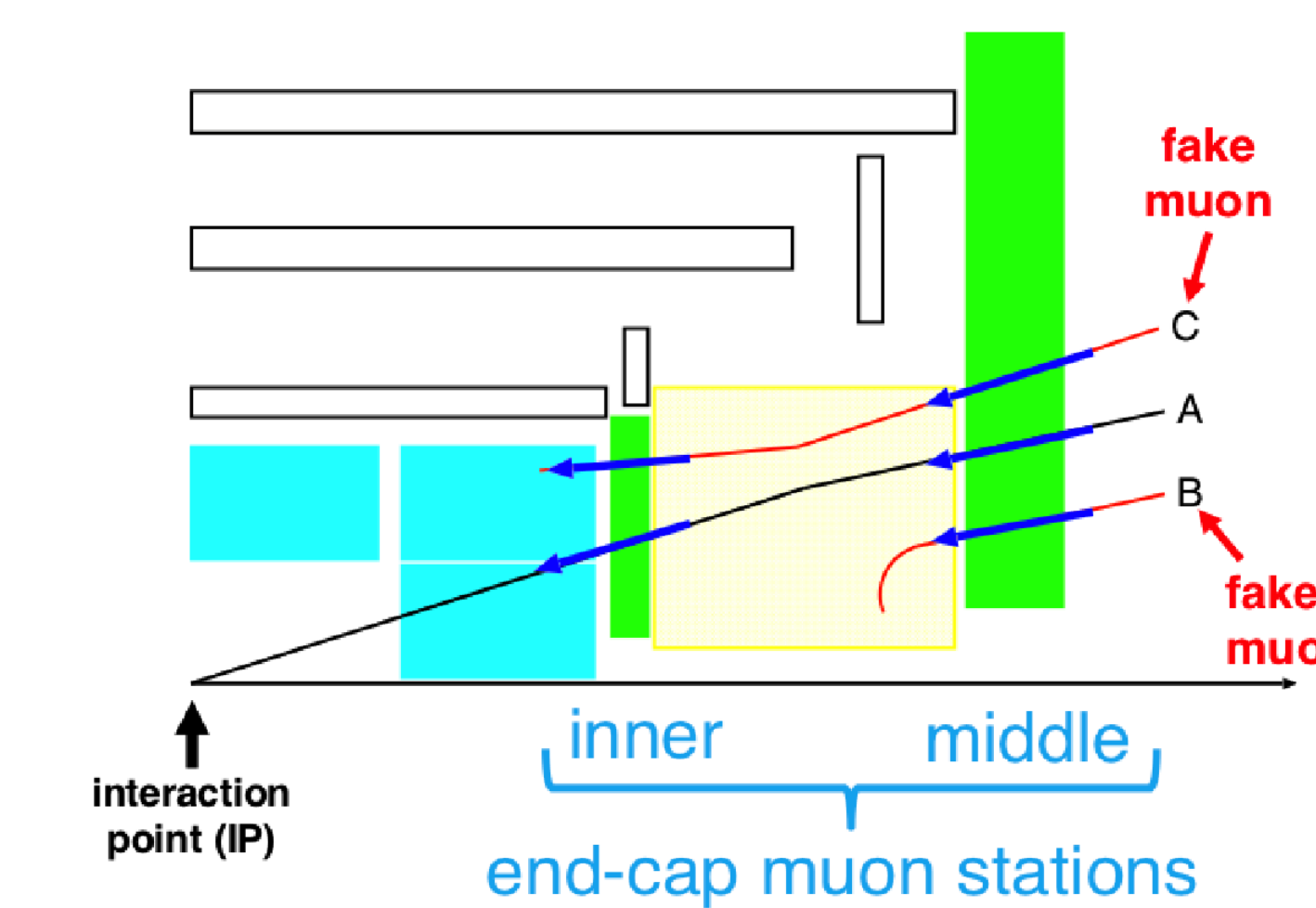
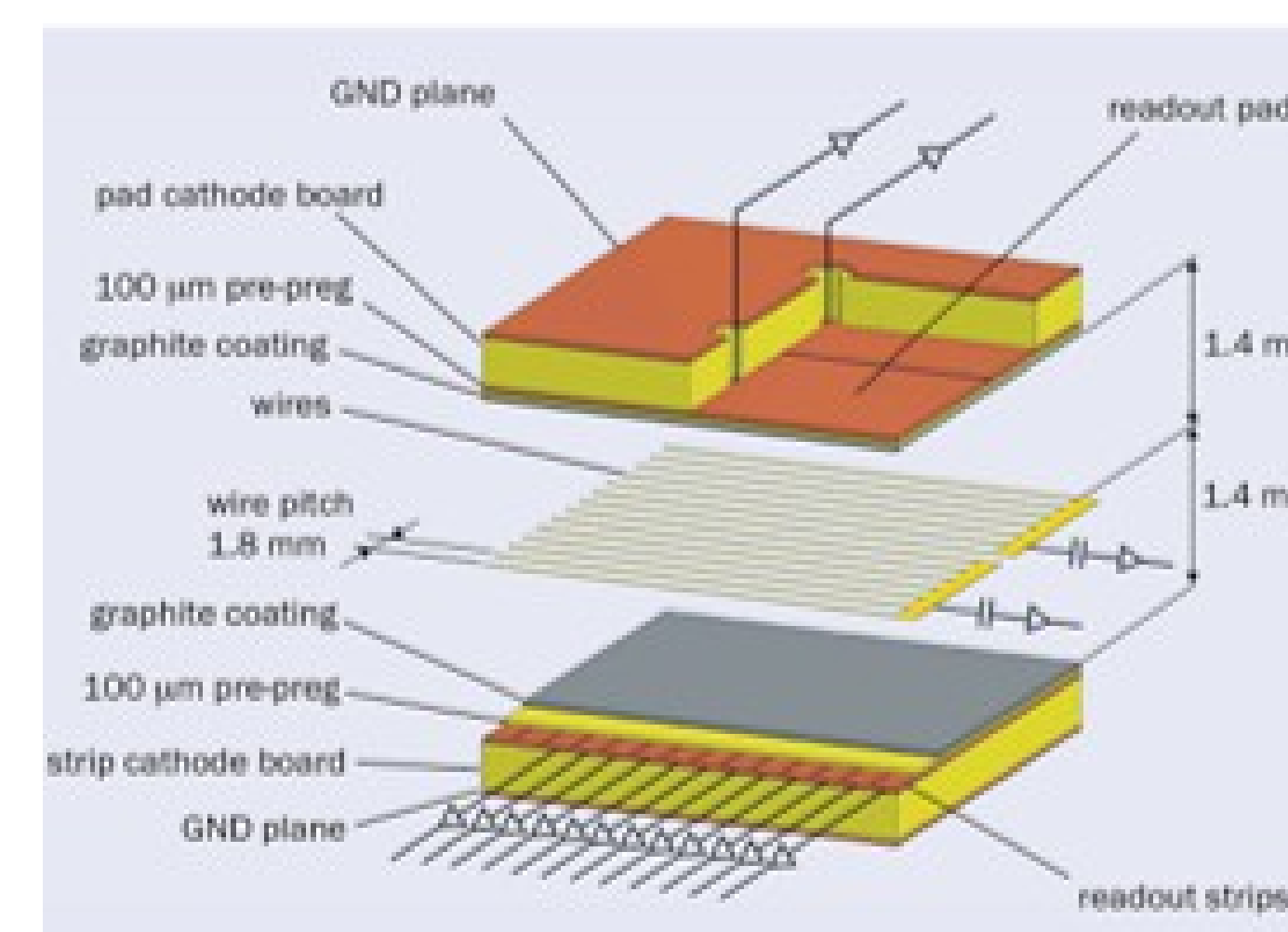


## NSW Integration and Quality Assurance

- **During assembly of the sectors.**
  - **Pre inspection testing.** Physical damages, leak test,
  - **Electrical and mechanical testing.** Electrical shorts, pulser test,
  - **Long term testing.** High Voltage, High Radiation Test (Cs 137 isotope)
- **During assembly of the wheel.**
  - **Conductivity test**
  - **RIM crate assembly**
  - **Fibre attenuation loss measurements**
  - **Temperature and magnetic field sensor installation and testing**
  - **LV/HV to power the sectors and readout boards**

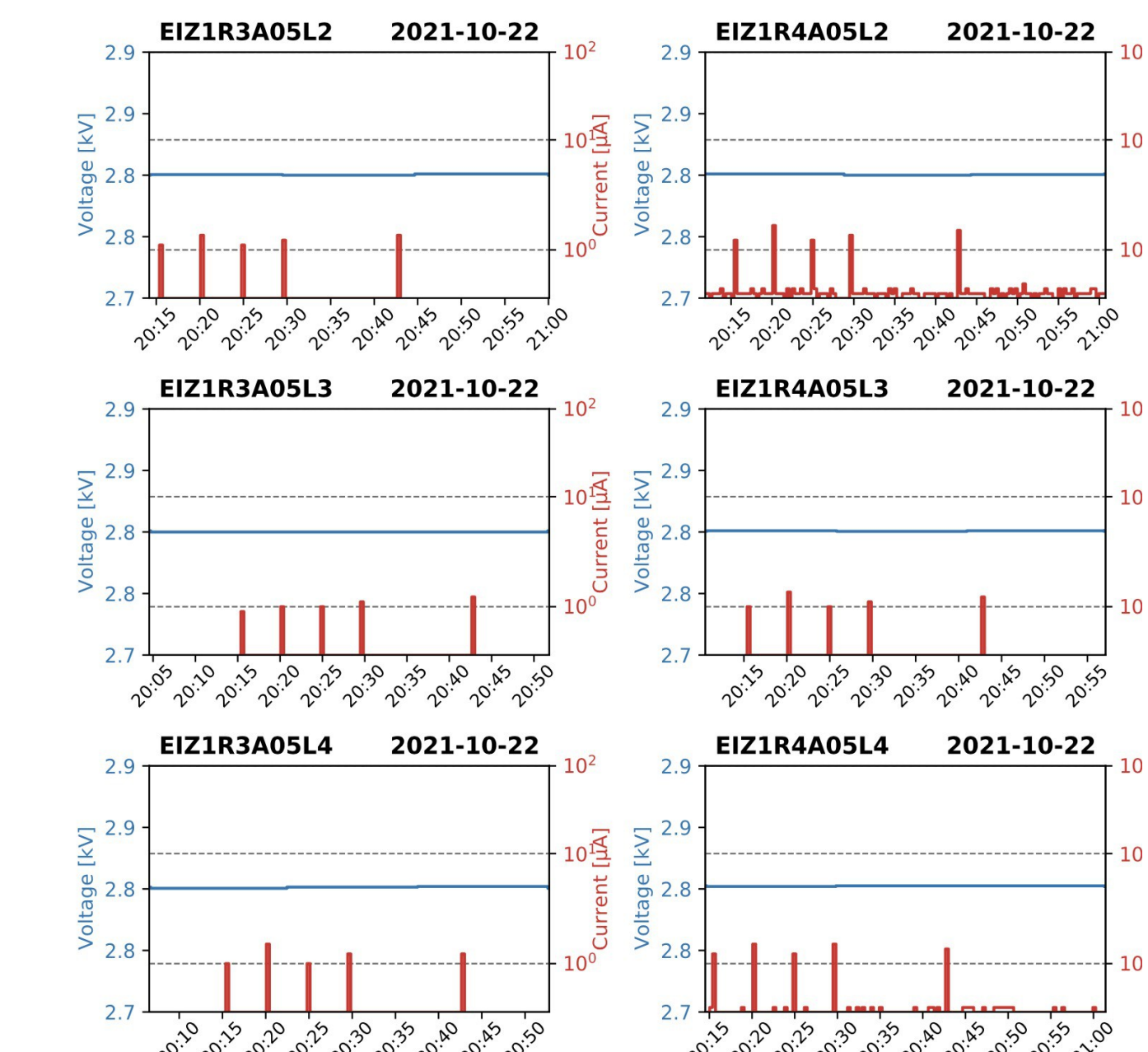
## Status of Project

- Wheel A lowered and installed into ATLAS cavern July 2021
- Wheel C lowered and installed into ATLAS cavern November 2021
- Recorded pilot beam splashes November 2021 in both MM and sTGC technologies



## How The NSWs Detect Muons

- **Gaseous Ionization Detectors:** muons pass through gas, knock off electrons, which allow us to read out a current pulse
- **Two complementary detector systems, sTGC primarily used for trigger and MicroMegas primarily used for tracking**



Beam splash event from pilot run, showing signals detected by sTGCs

## What's Next?

- Run III beams should be injected into the LHC at 6.8 TeV in March of 2022
- Commissioning of the NSWs
- Continued Run II analysis and transition into analysis for Run III data