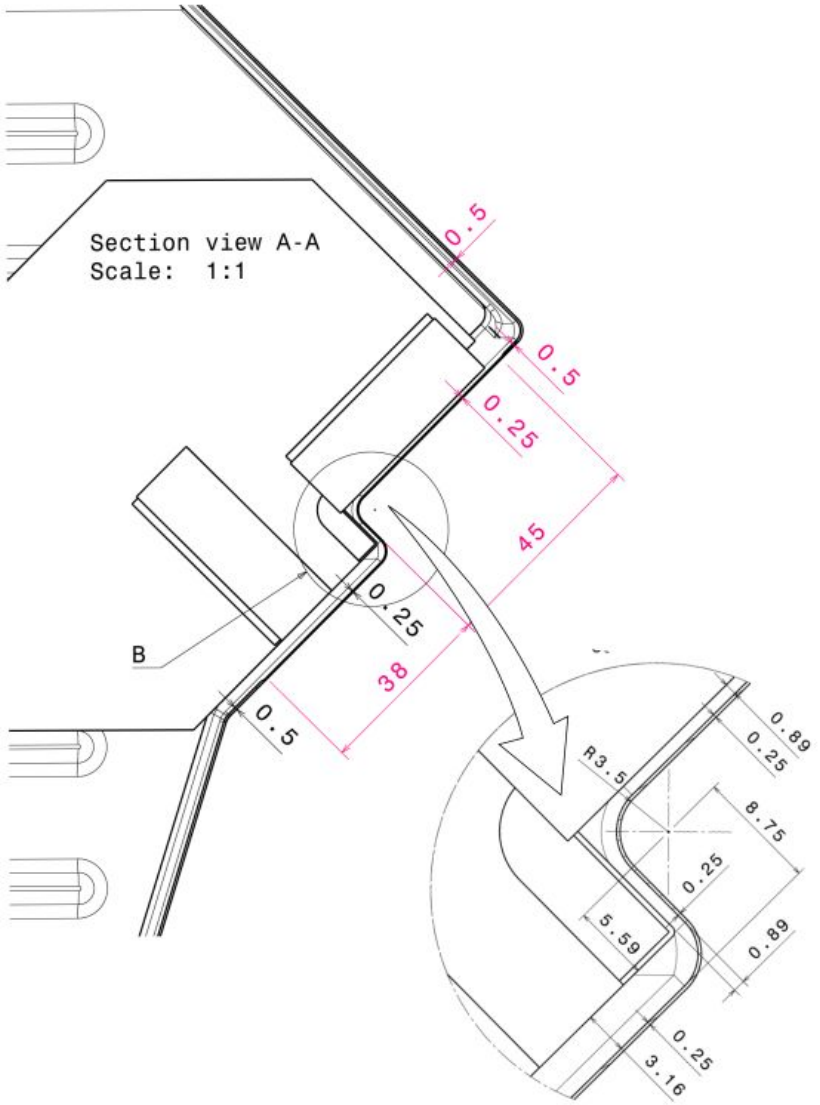
VeLo Commissioning Status and Plan

Victor Coco (CERN) for the Velo group

Velo project institutes:

What is still needed to close the VELO?

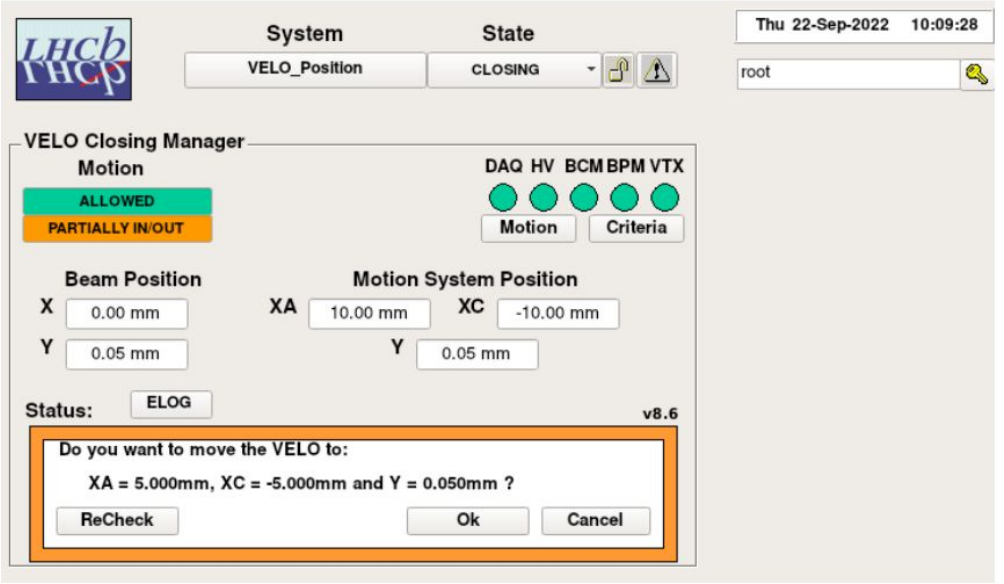


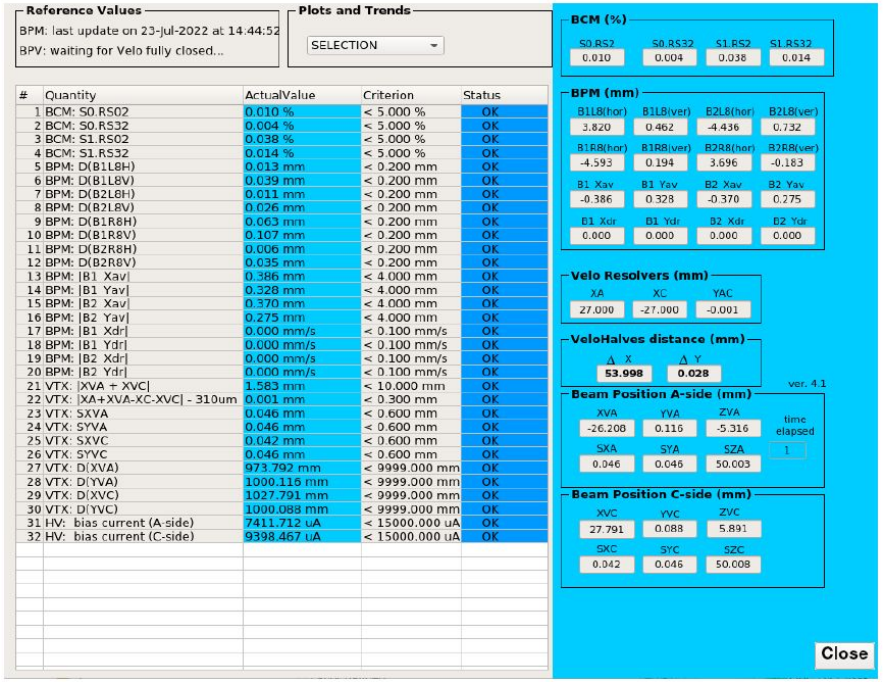
- **Check temperature and vacuum behaviour during closing**
  - checking SMOG / RFFoil temperatures and vacuum evolution
  - time spent in closed position to see temperature evolution
    ⇒ Intensity ramp-up

- **Cross-checked of detector alignment and metrology with particles**
  - The RFfoil is closest element to the beam
  - Metrology performed on-site to be confirmed by tomography from reconstructed hadronic interaction with the material
    ⇒ **Partial closure at 2mm before going to full closure**

Partial Closure

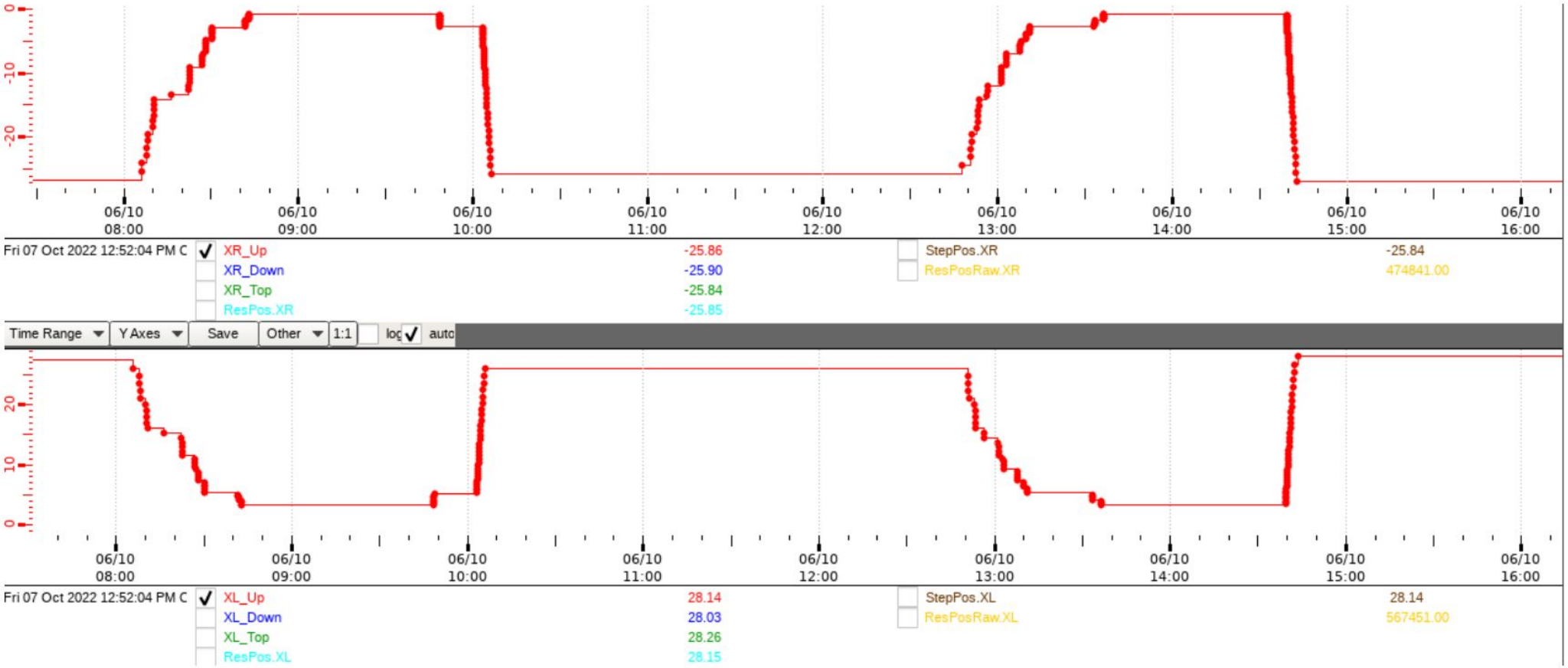
- **Sept 30th, rehearsal behind closed position @1200b**
  - moved between 29.7mm and 25mm
- **Tuesday Oct 4th:**
  - power cut in data center at FLAT TOP
  - could not get back 40% of the VELO ⇒ asked to postpone
- **Thursday Oct 6th:**
  - Fill 8232, 12b
  - Fill 8233, 300b ⇒ 218b (injector issue)
- **Used the final closing manage (with manual handshake)**
  - check DAQ states, HV current, vertex reconstruction, compatibility with BPM, …
  - check in parallel the monitoring (position of vertices, currents) to verify validity of inputs
- **No Y movement:**
  - Offset in vertex reconstruction understood from metrology but prefered to check with data at various x to validate.



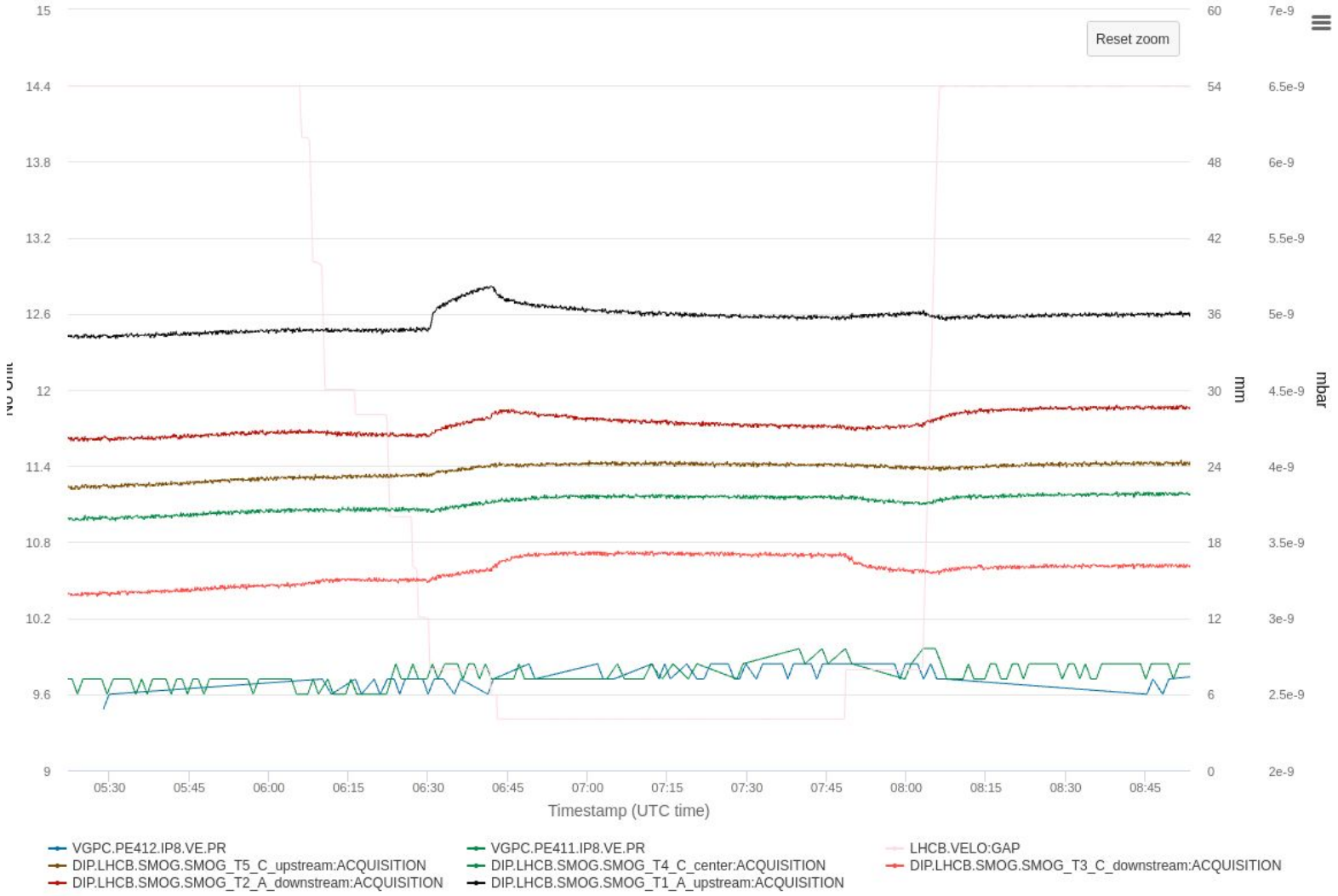


Partial Closure

- **Several steps**
  - 27mm jaw position ⇒ 25mm centered on beam (check mechanism works)
  - ⇒ 20mm ⇒15mm ⇒ 10mm ⇒ 8mm ⇒ 6mm ⇒ 5mm [only @218b] ⇒ 4mm [stayed ~15min] ⇒ 3mm ⇒ 2mm [stay 1h] ⇒ 4mm [only @ 12b] ⇒ 27mm



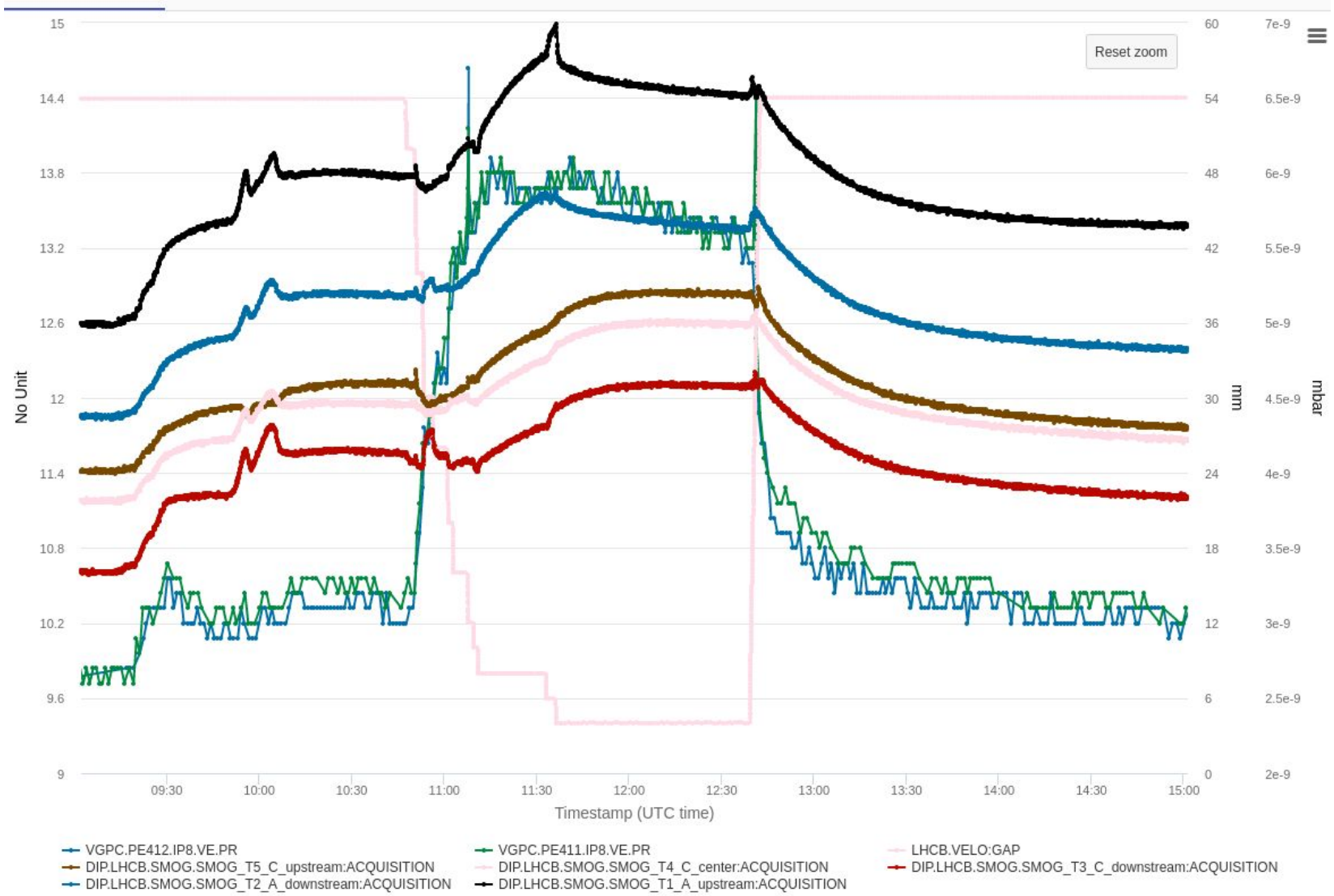
Temperature and vacuum evolution



- **Temperature increase @4mm**
  - ~0.3K
  - Fast then slower and quickly less when moving to 3mm
- **Small vacuum increase at some point during closure**
  - ~1e-10 mbar

RFfoil temperature decrease by ….

Temperature and vacuum evolution



- **Temperature increase still @4mm**
  - ~1K, not scaling with intensity
- **Vacuum increase when moving**
  - 3e-9 to 6e-9 mbar
  - scaling with intensity?
  - Probing some temperature increase elsewhere?
  - Decrease when movement is idle (linked to movement itself?)
  - Sharp decrease when moving out.

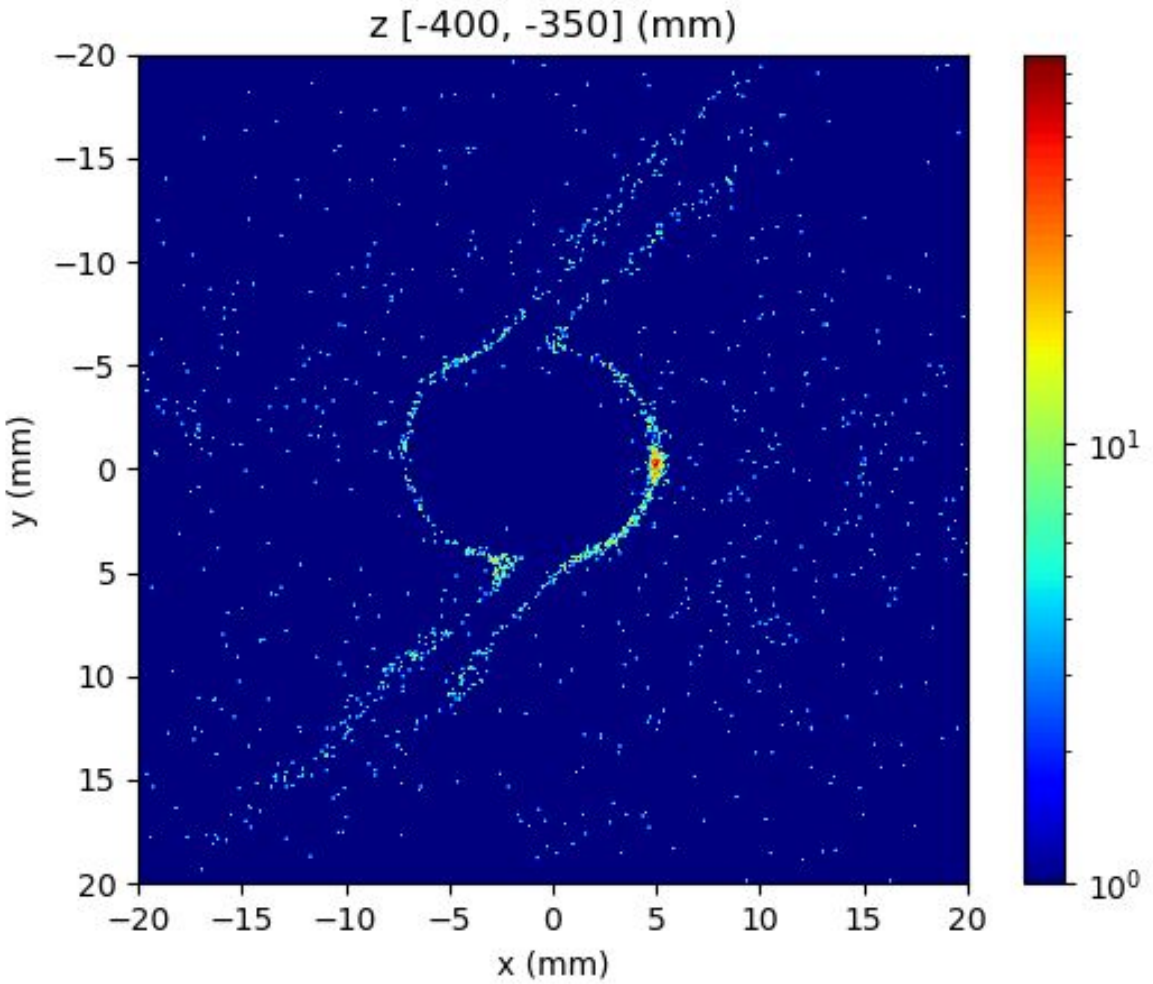
Foil (and SMOG) opening

- **Foil temperature drops while closing**
  - cooling of the foil by the foil

Hadronic interaction

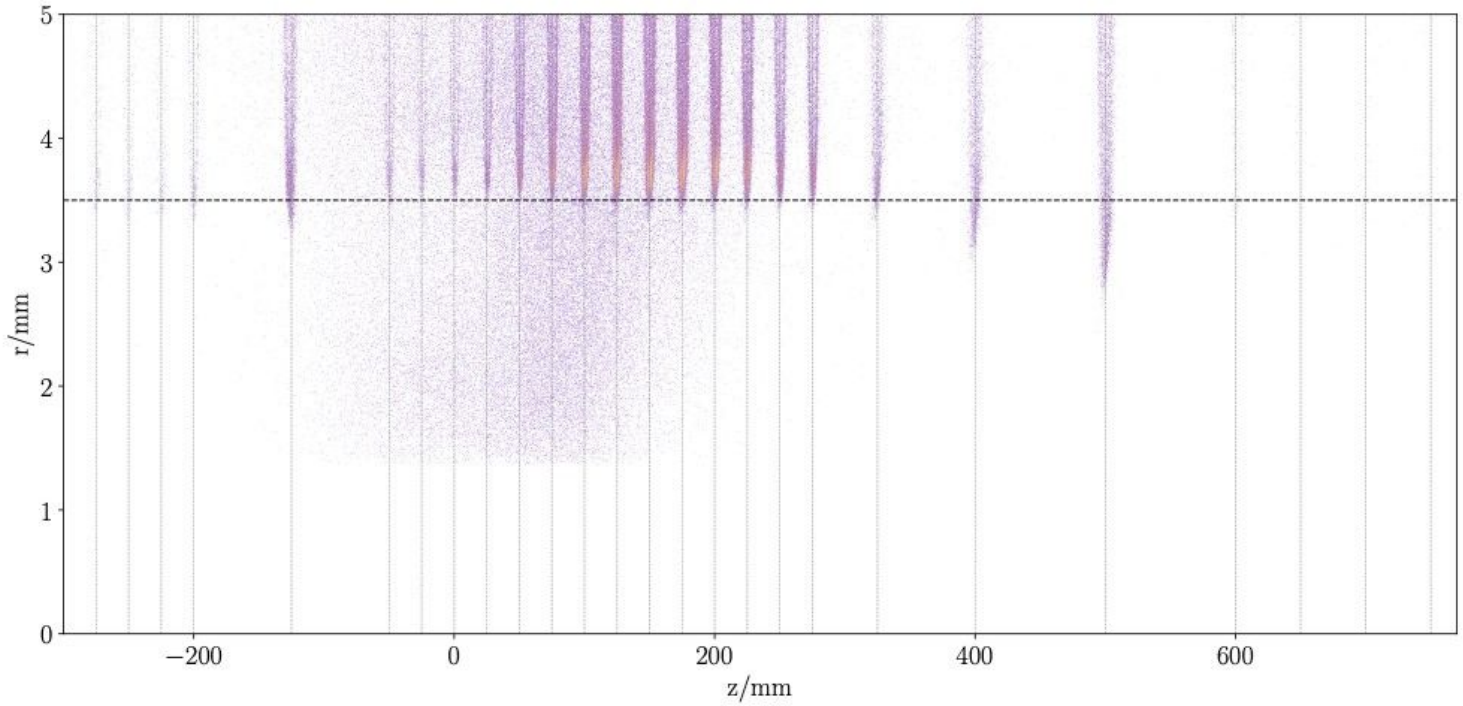
- **Using interaction with material to check the position of the foil**
  - reconstruct tracks
  - reconstruct vertex from the tracks
    ⇒ pp interaction and interaction with material

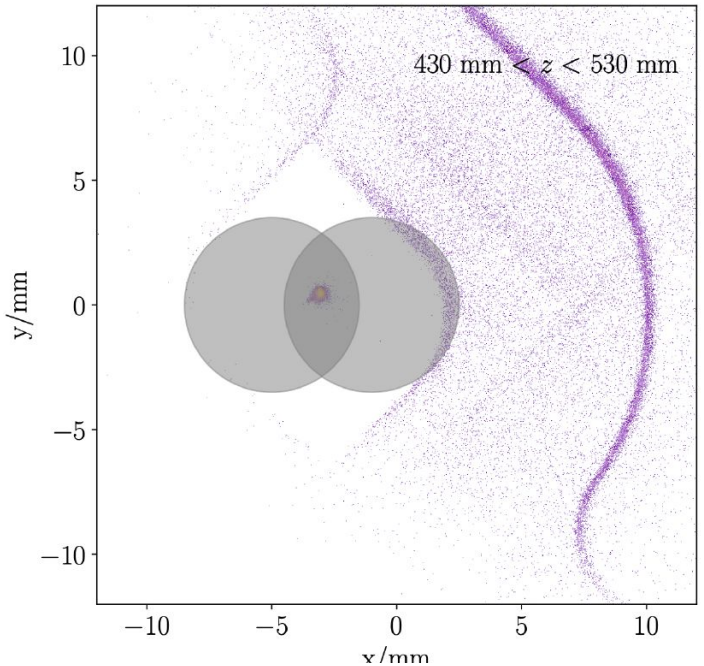
- **Analysis on going**
  - interplay with alignement (rotation/translation of modules wrt. foil can be seen as rotation/translation of the foil wrt. the global frame)
  - local (from halves) vs. global (wrt. beam position) studies
  - A-side foil seen from C-side modules and opposite give as little bias information as possible

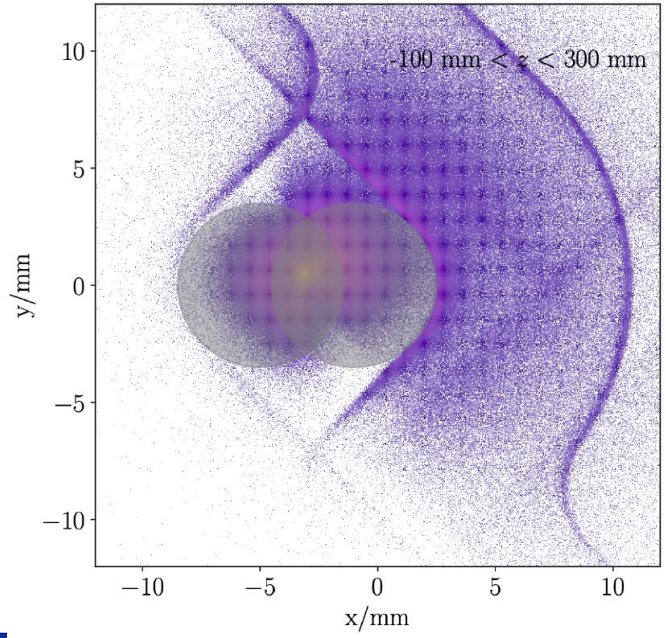


Hadronic interaction

- **Bulging compatible with metrology results**
- **Should still understand the positioning of the halves**
- **Effective aperture radius may be reduced by ~0.5-0.7mm (really still preliminary, to be confirmed)**



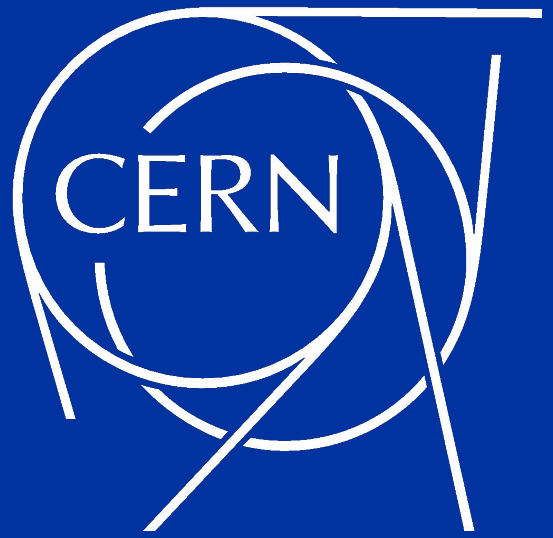




Conclusion

What are the next steps?

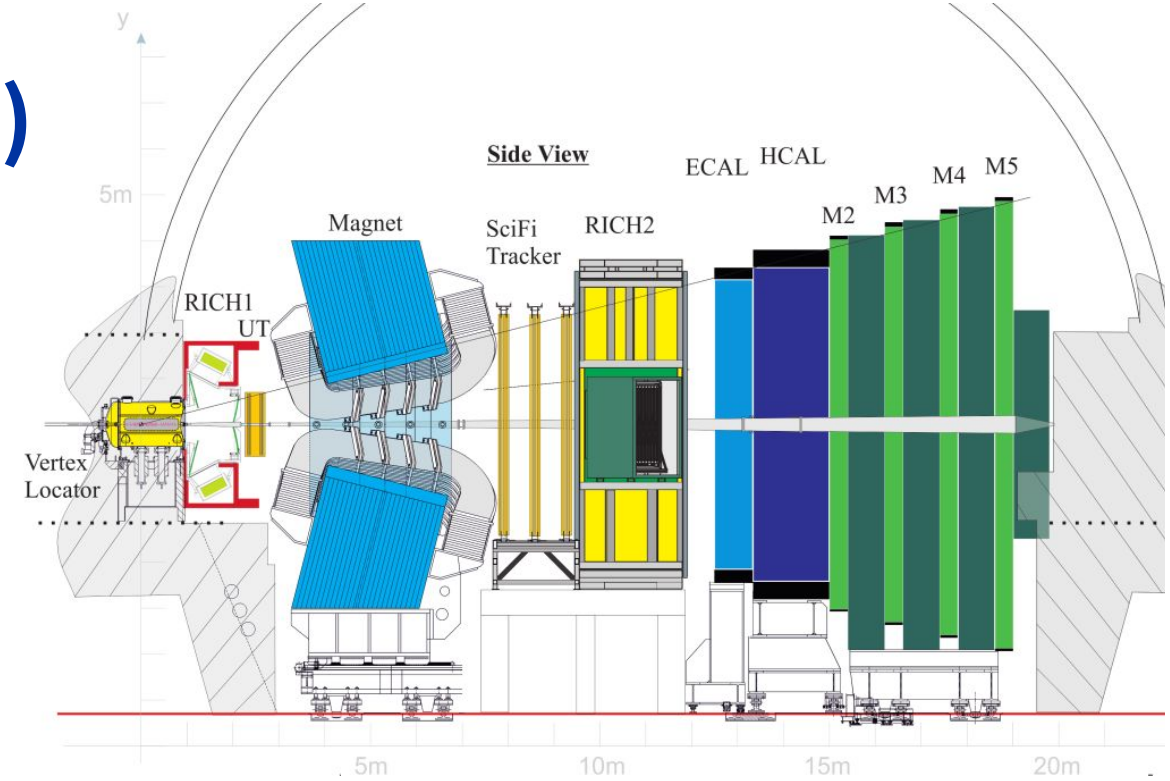
picture from Paula Collins


CERN

The LHCb Vertex Locator (VeLo)

- **LHCb and the VELO were upgraded during LS2**
  - Instantaneous luminosity $4.10^{32} \rightarrow 2.10^{33} s^{-1} cm^{-2}$
  - Increase in luminosity needed 40MHz readout with full software trigger

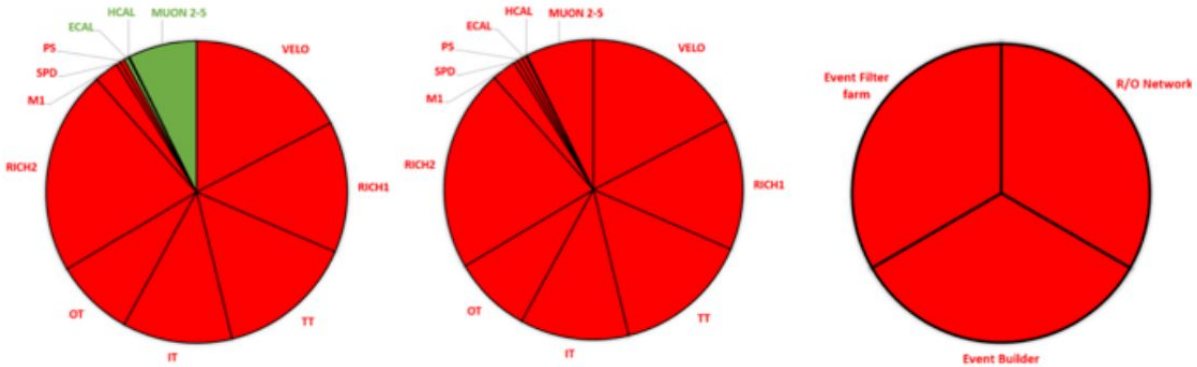
  ⇒ Full upgrade of the DAQ and readout electronics as well as of the tracking detectors and RICH



- The VELO allows LHCb to **reconstruct with high precision the trajectory** of charged particles and their **origin vertices**

  ⇒ key instrument for **B,D hadron reconstruction**

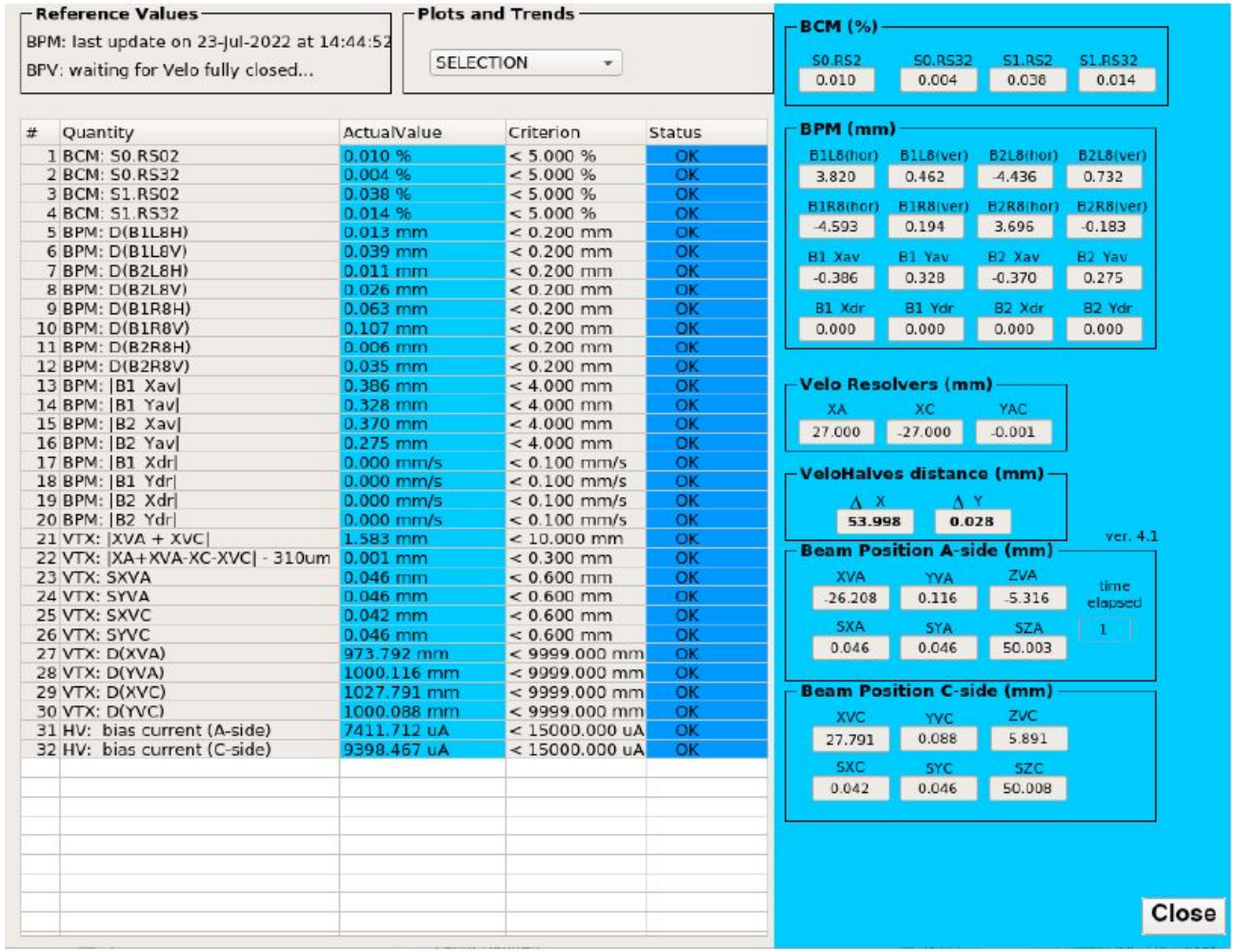
With respect to Run 1&2 LHCb: to be upgrade/ to be kept



Detector **R/O electronic** **DAQ**

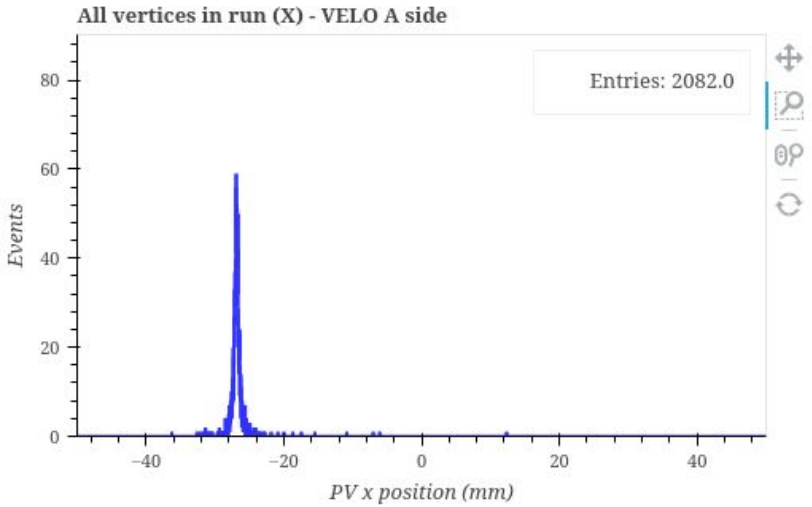
VeLo commissioning
Towards automatic closure

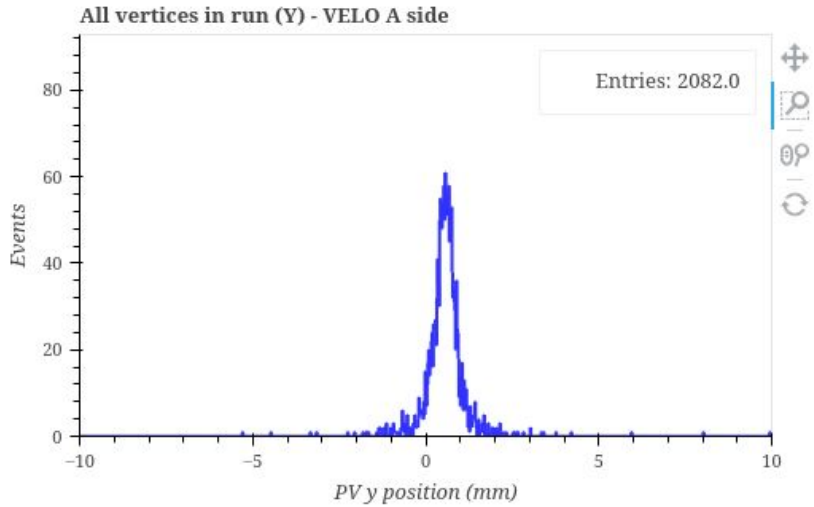
- Repeat the sequence with automatic closure procedure but manual handshake between steps for a few times
- Need for the detector to be in global mode… probably not routinely before TS1
- Move from online monitoring to dedicated task out of Hlt1 selected events.
- Software side of the procedure tested with MC injection
  - communication computing farm → winCC → motion system

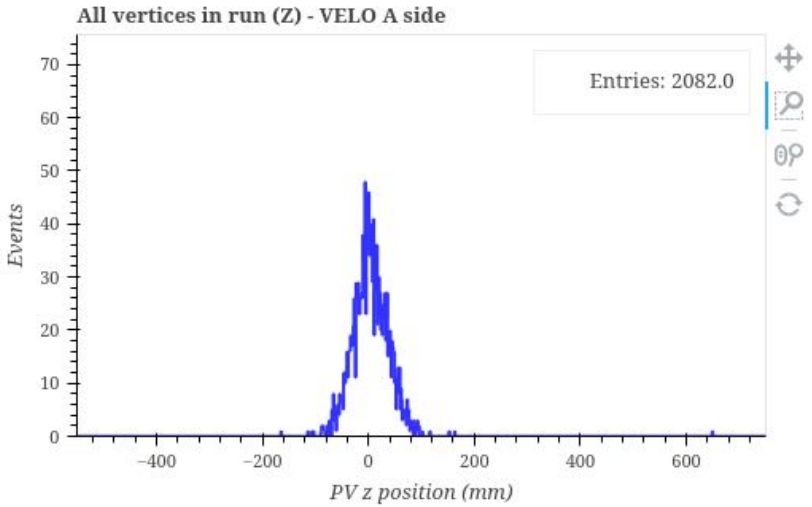


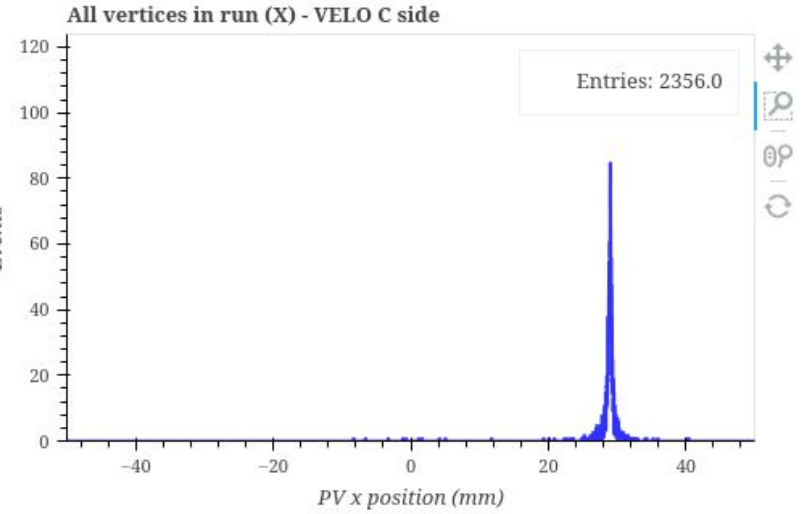
#	Quantity	ActualValue	Criterion	Status
1	BCM: S0.RS02	0.010 %	< 5.000 %	OK
2	BCM: S0.RS32	0.004 %	< 5.000 %	OK
3	BCM: S1.RS02	0.038 %	< 5.000 %	OK
4	BCM: S1.RS32	0.014 %	< 5.000 %	OK
5	BPM: D(B1L8H)	0.013 mm	< 0.200 mm	OK
6	BPM: D(B1L8V)	0.039 mm	< 0.200 mm	OK
7	BPM: D(B2L8H)	0.011 mm	< 0.200 mm	OK
8	BPM: D(B2L8V)	0.026 mm	< 0.200 mm	OK
9	BPM: D(B1R8H)	0.063 mm	< 0.200 mm	OK
10	BPM: D(B1R8V)	0.107 mm	< 0.200 mm	OK
11	BPM: D(B2R8H)	0.006 mm	< 0.200 mm	OK
12	BPM: D(B2R8V)	0.035 mm	< 0.200 mm	OK
13	BPM: |B1 Xav|	0.386 mm	< 4.000 mm	OK
14	BPM: |B1 Yav|	0.328 mm	< 4.000 mm	OK
15	BPM: |B2 Xav|	0.370 mm	< 4.000 mm	OK
16	BPM: |B2 Yav|	0.275 mm	< 4.000 mm	OK
17	BPM: |B1 Xdr|	0.000 mm/s	< 0.100 mm/s	OK
18	BPM: |B1 Ydr|	0.000 mm/s	< 0.100 mm/s	OK
19	BPM: |B2 Xdr|	0.000 mm/s	< 0.100 mm/s	OK
20	BPM: |B2 Ydr|	0.000 mm/s	< 0.100 mm/s	OK
21	VTX: |XVA + XVC|	1.583 mm	< 10.000 mm	OK
22	VTX: |XA+XVA-XC-XVC| - 310um	0.001 mm	< 0.300 mm	OK
23	VTX: SXVA	0.046 mm	< 0.600 mm	OK
24	VTX: SYVA	0.046 mm	< 0.600 mm	OK
25	VTX: SXVC	0.042 mm	< 0.600 mm	OK
26	VTX: SYVC	0.046 mm	< 0.600 mm	OK
27	VTX: D(XVA)	973.792 mm	< 9999.000 mm	OK
28	VTX: D(YVA)	1000.116 mm	< 9999.000 mm	OK
29	VTX: D(XVC)	1027.791 mm	< 9999.000 mm	OK
30	VTX: D(YVC)	1000.088 mm	< 9999.000 mm	OK
31	HV: bias current (A-side)	7411.712 uA	< 15000.000 uA	OK
32	HV: bias current (C-side)	9398.467 uA	< 15000.000 uA	OK

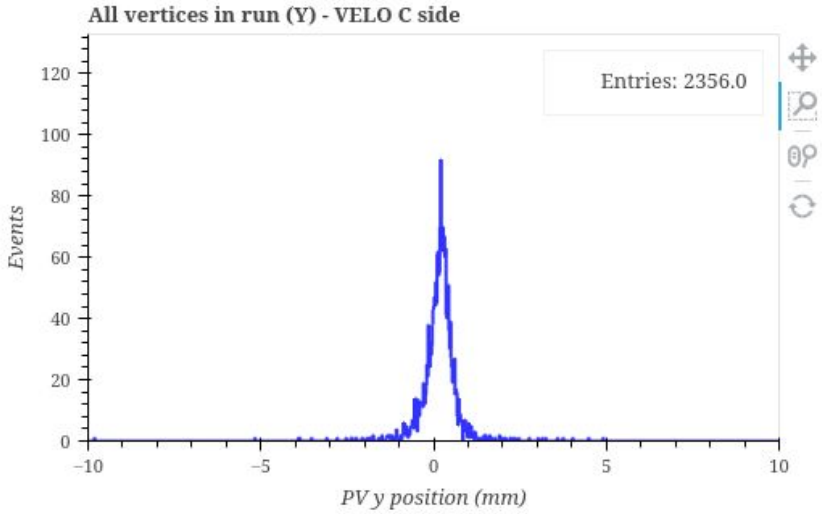
VeLo commissioning
Readout and reconstruction

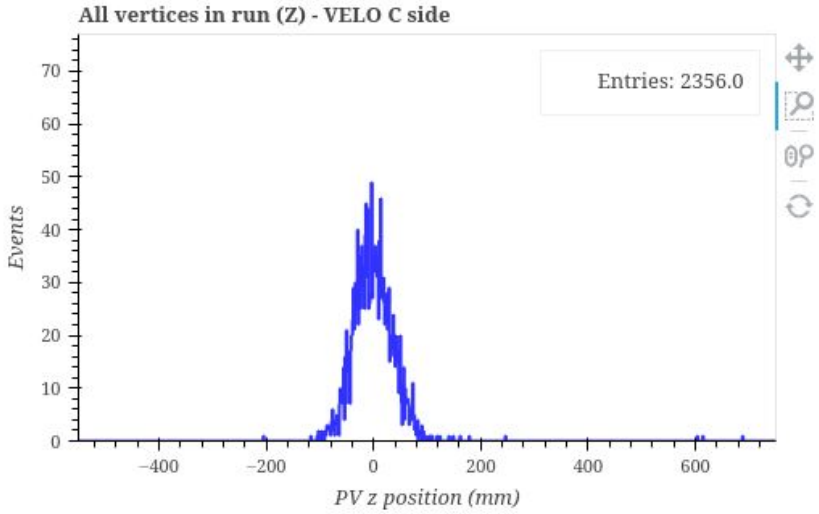




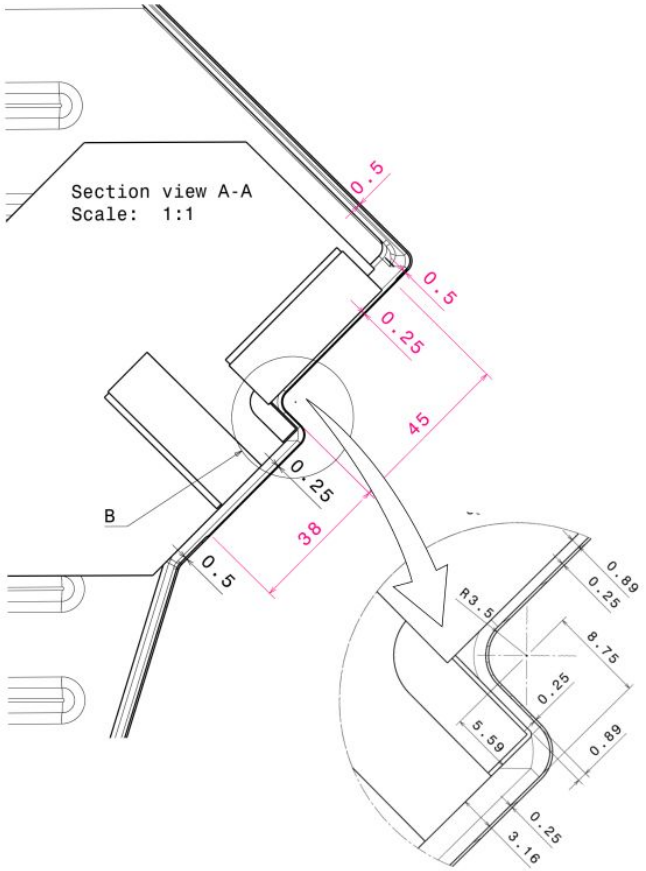






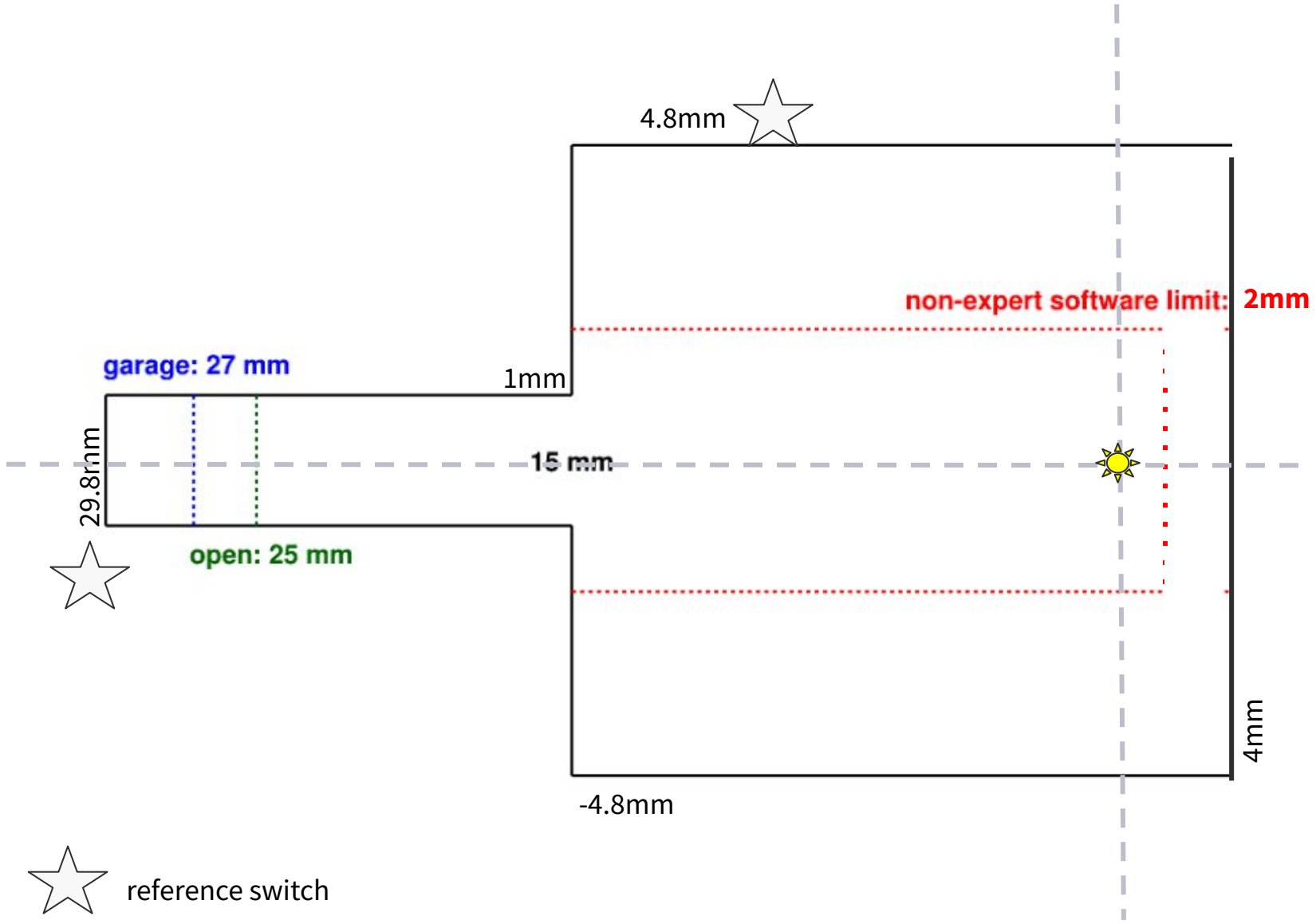


RF-foil



- New foil shape wrt. Run1&2
- Same mechanical system for the motion (motors,position measurement, …)but new control HW

Motion system limits



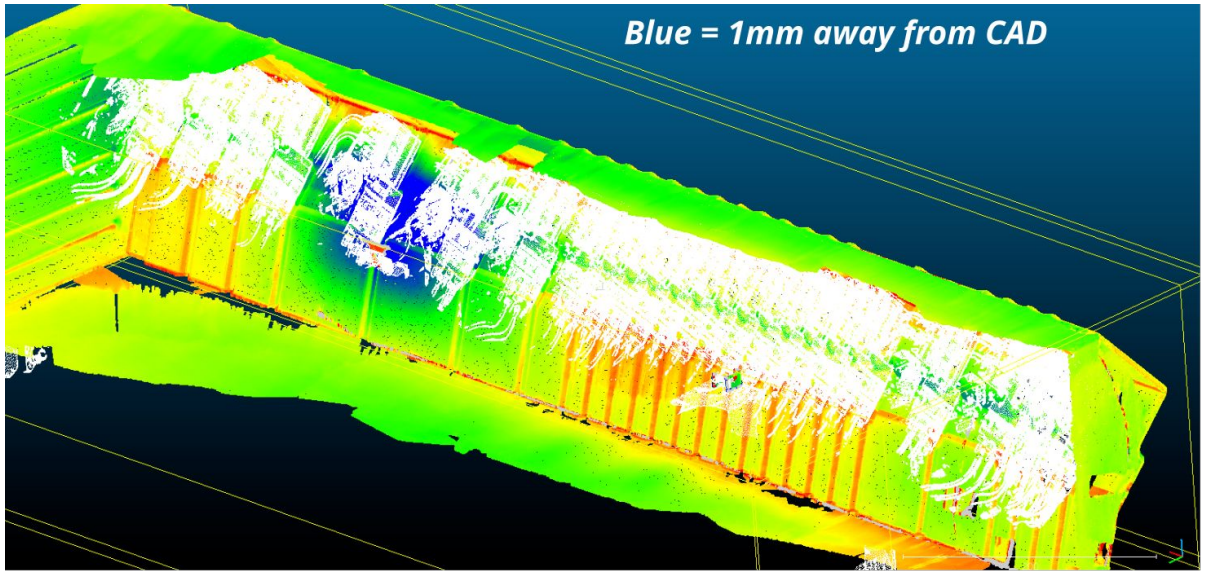
reference switch

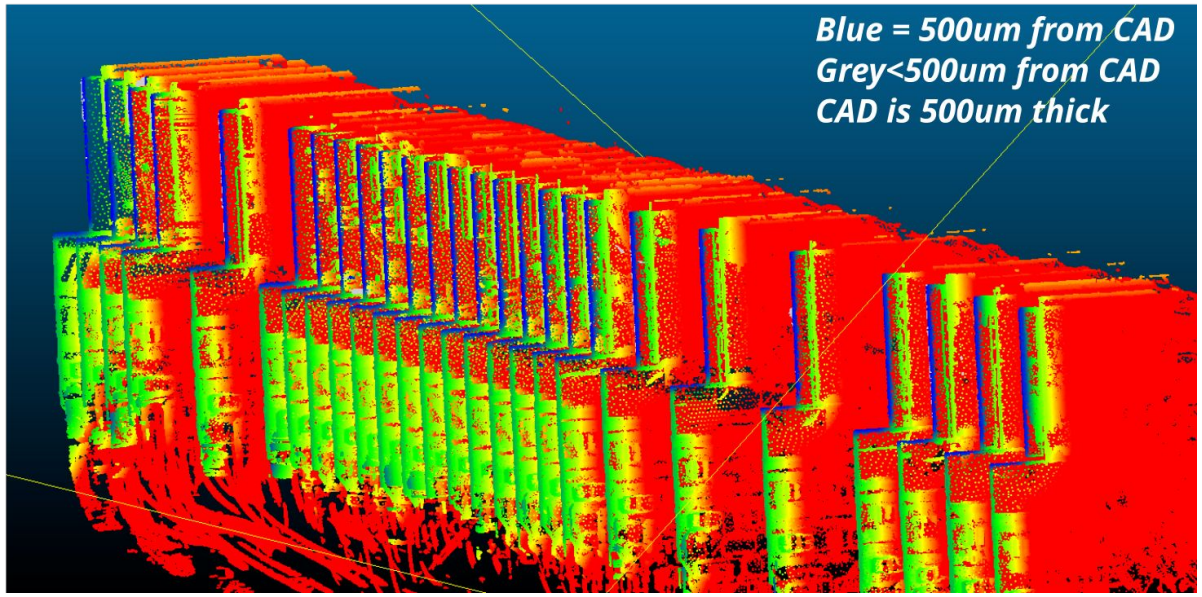
A-side surface test

April 30th to May 9th

- **Mechanical preparation**
  - installation of removable shims
  - base plate removal
  - test of balancing

- **Metrology**
  - 3D laser scan in horizontal position
    ⇒ absolute position at room temperature
  - check for collision with RFFoil 3D laser scan
  - with Liv. metrology data provides reference for alignment

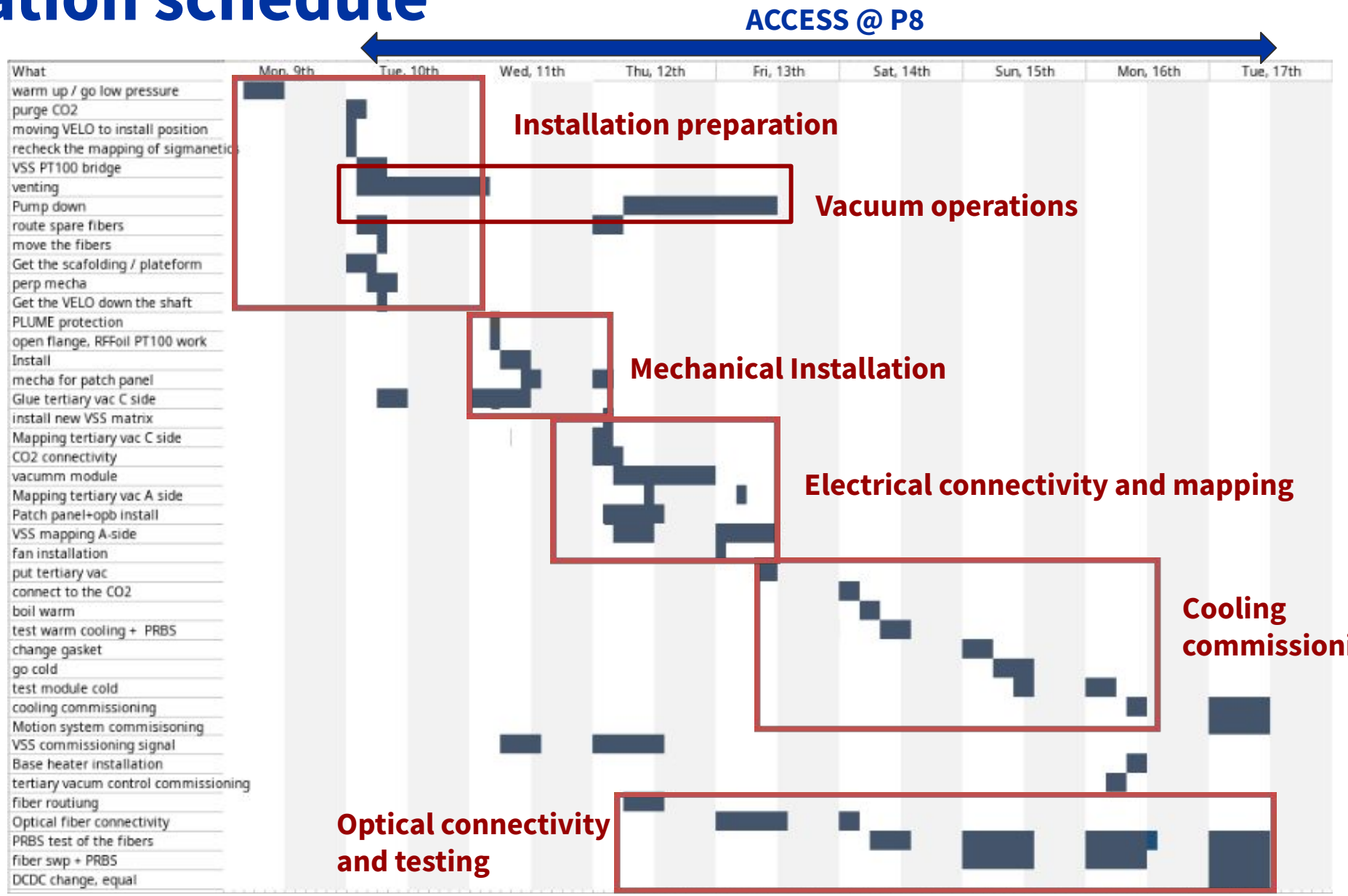




A-side installation schedule

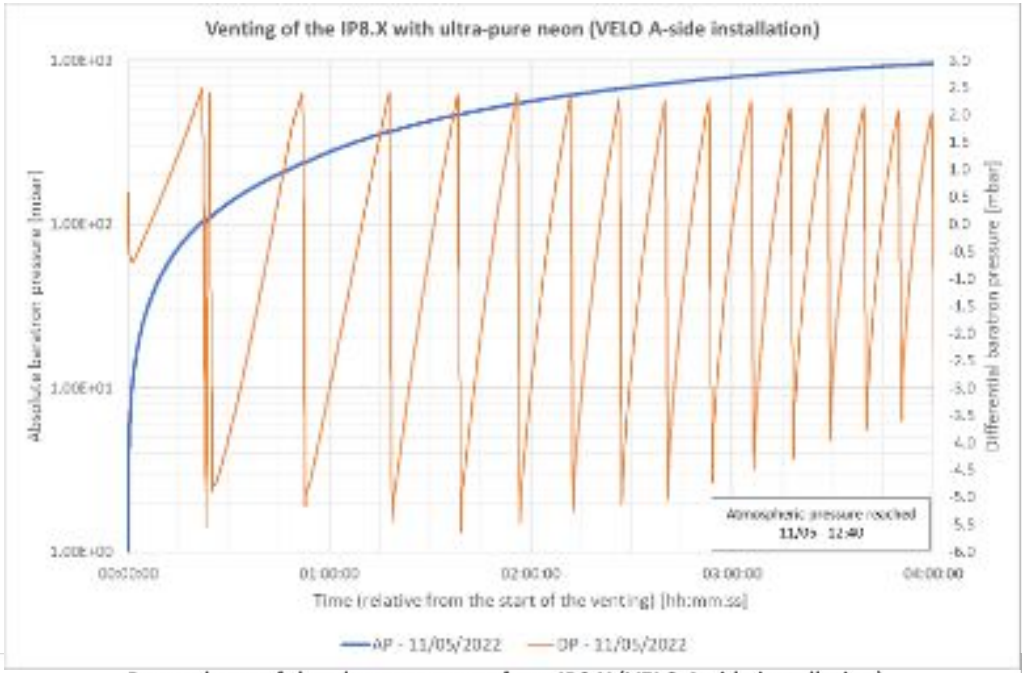
May 10th to 17th

- Team from Nikhef, Manchester, Santiago, Liverpool, Warwick, Oxford at CERN to help with installation
- Support from the pit infrastructure team
- Huge thanks to the LHC team to have organised a week of access to allow for installation!

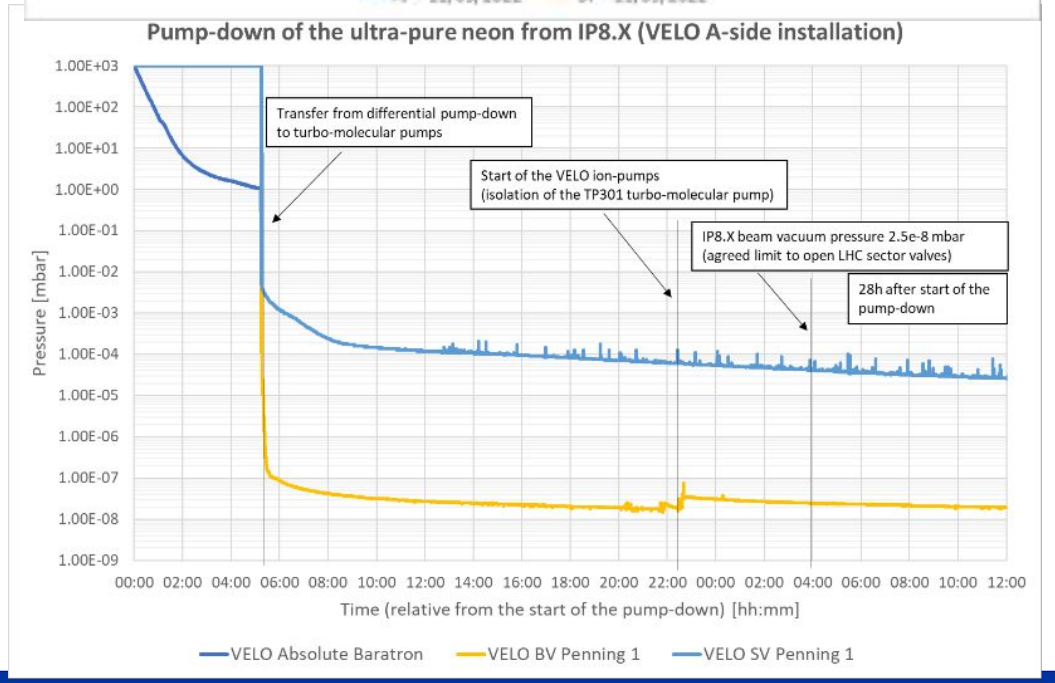


Vacuum operations
May 10th to 12th and May 25th

- **Venting to allow for VELO insertion**
- **Pump down on Thursday morning, 2.3x10^{-8} mbar in primary and 6.5x10^{-5} mbar in sec. achieved after 24h**
- **Last week first part of SMOG injection commissioning**
  - test with **open VELO** no beam
  - useful to provide particles out of stable beam interaction
  - next test withopen VELO and beam during a period of “quiet” beam
- **Many thanks to TE-VSC group for the support during installation and in getting SMOG system commissioned**



From Josef Sestak



A-side electrical connectivity

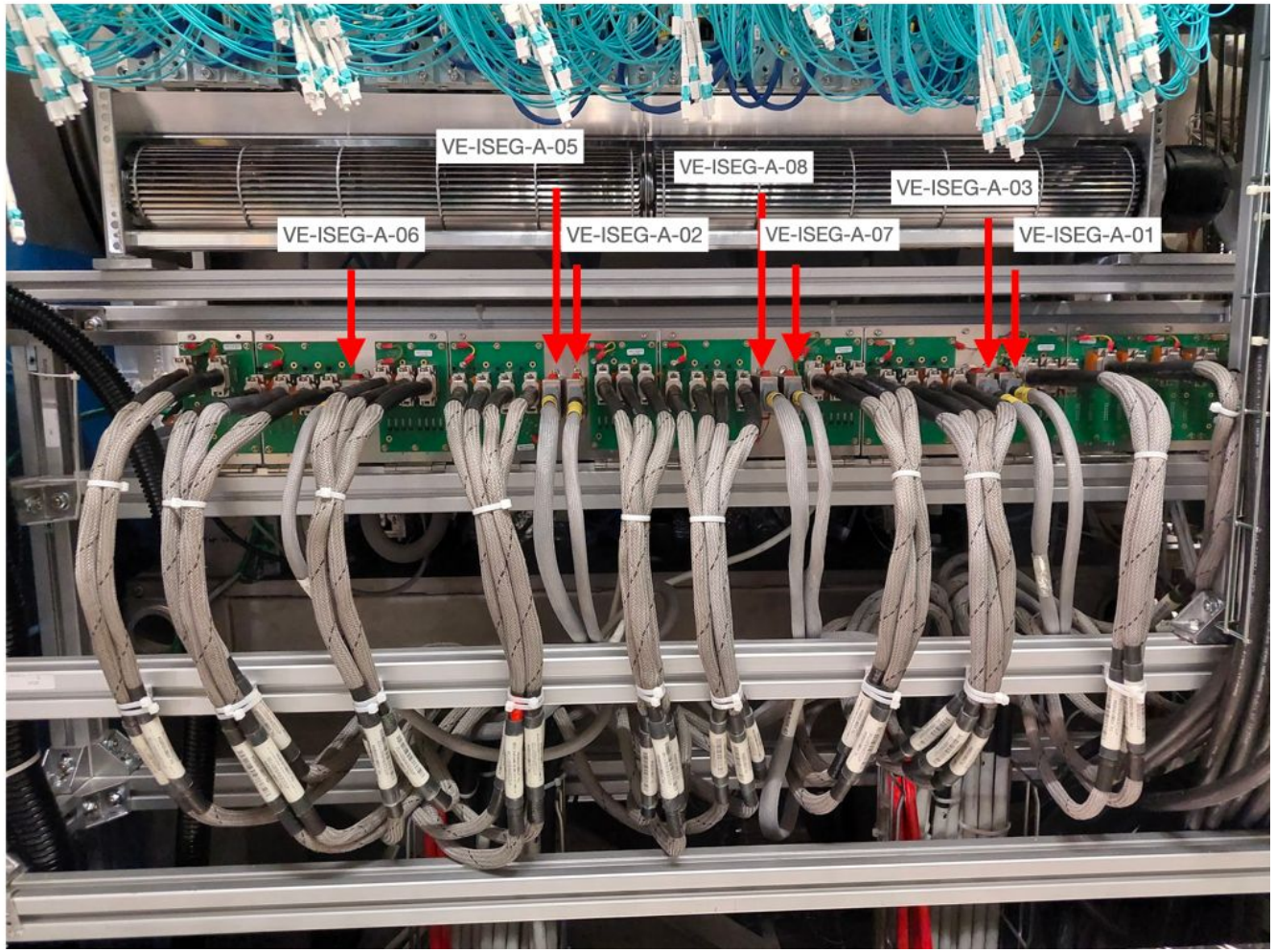
May 12-13th

- **Cabling following mechanical installation**
  - Installation of the optoelectronic boards
  - Routing of the LV and temperature sensor cables
  - Connection to the detector patch panel

- **Checked mapping of ~350 temperature measurements**
  - 4 not working ⇒ 3 fixed, one redundant sensor not recoverable

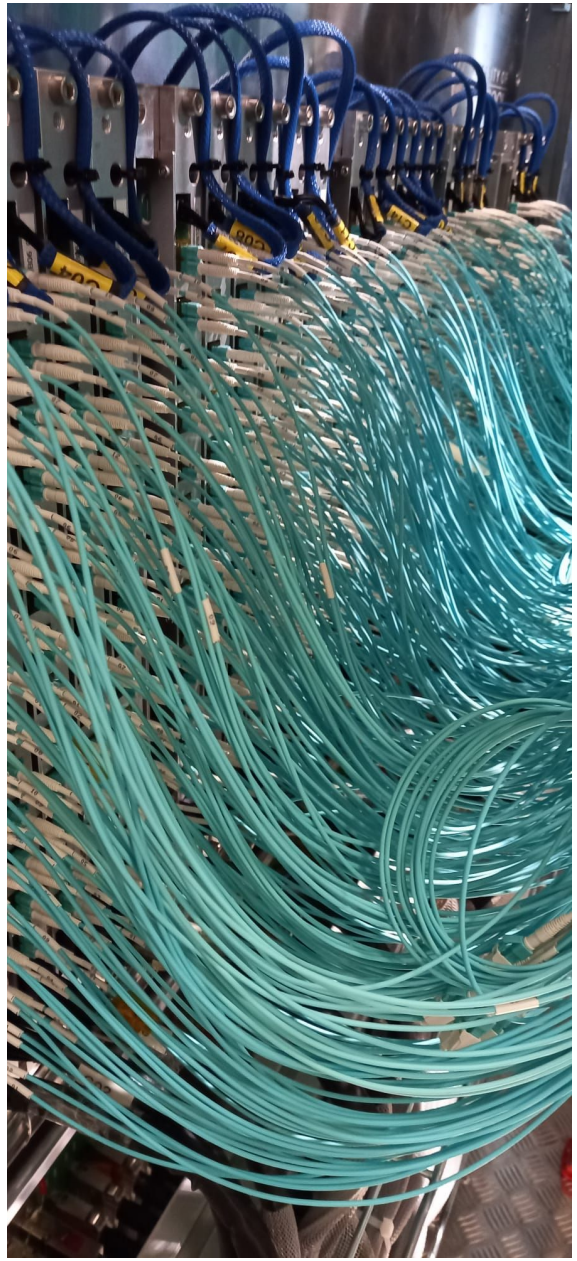
- **Validation of the safety system mapping**
  - full VSS system installed
  - As for C-side checked that each temperature sensor above limit trigger the proper LV/HV interlock
    ⇒ ready to put CO_2 and power-up

- **Gluing of C-side tertiary vacuum PT100**



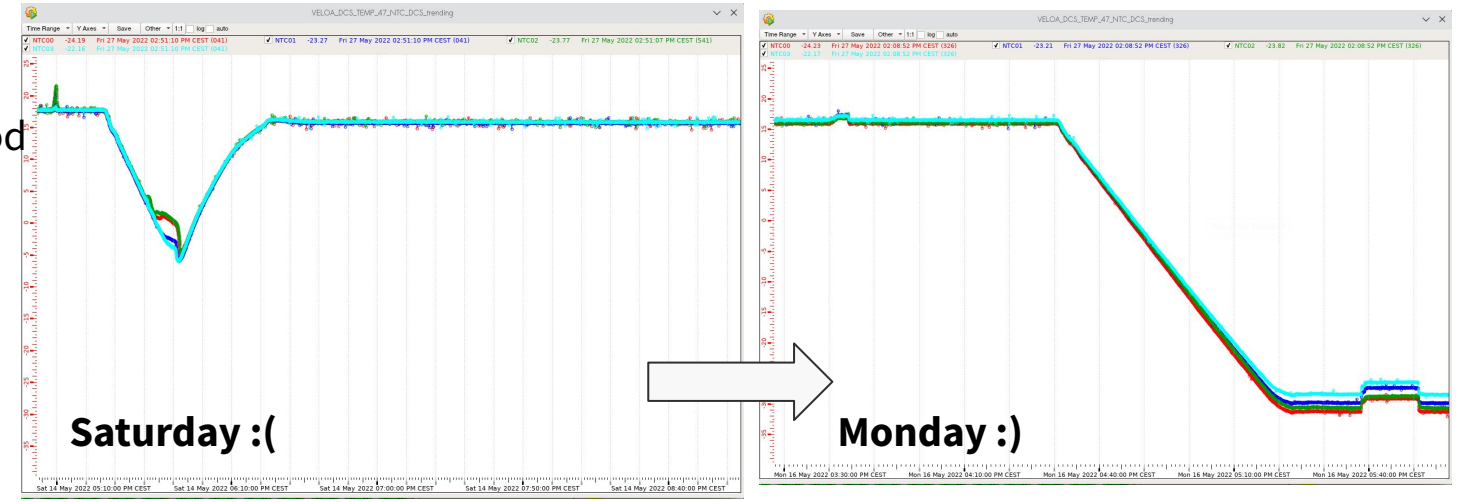
A-side fiber connectivity
May 13th

- **Connection of the fibers to the patch panel done in April.**
- **A and C-side spares routed during installation**
- **676 LC connections on the A-side**
  - Two teams of 2 persons for 10h
  - Checked cleanness with microscope and connect
- **Optical link quality test**
  - run PRBS test to quantify the quality of the link and check presence of light
  - a few MPO swap to fix in the data center
  - a few swap of LC on the detector
  - a few LC needed to be recleaned
  - for several modules DCDC convertor replaced to higher values
    - not an optical link issue but some GBTx recieves too low voltage and link can't be tested



A-side cooling commissioning
May 12-16th

- **CO_2 connection to local box completed on Thursday**
- **Module under vacuum for 24h**
  - while finalising the safety system testing
- **Connection to the plant on Saturday**
  - boiling at warm setpoint
  - tested powering modules and quality of optical links
  - going cold prevented by dry-out in one module
- **Intervention to replace gasket of module 47**
  - Sunday vented tertiary vacuum and removed hood
  - replaced gasket
    - gasket itself obstructed by a flake (composition to be determined)
  - Cold on Monday
  - ***All module could be powered!***



Alignement from metrology
preliminary