ATLAS Forward Proton
Detectors and Commissioning

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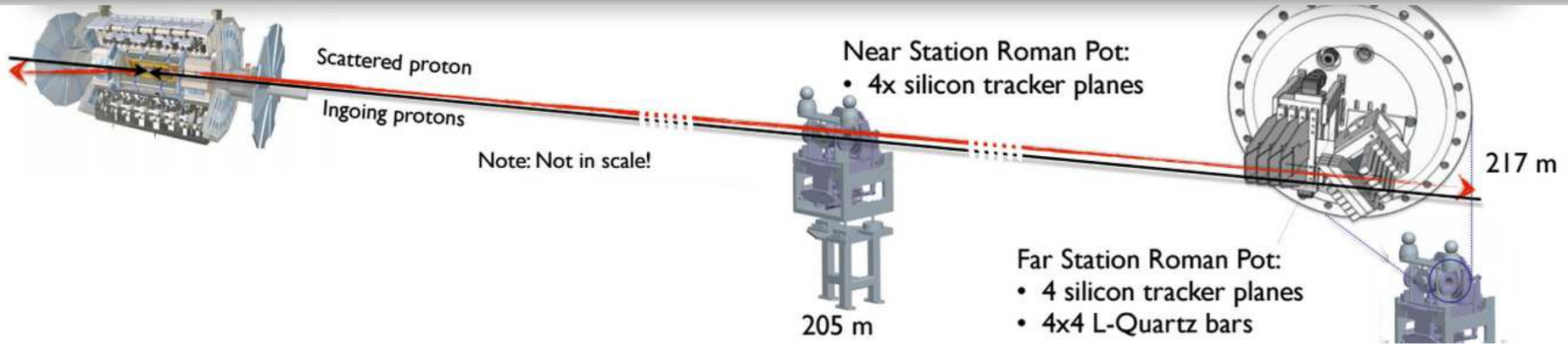
CERN, 15th March 2016

AFP Detectors



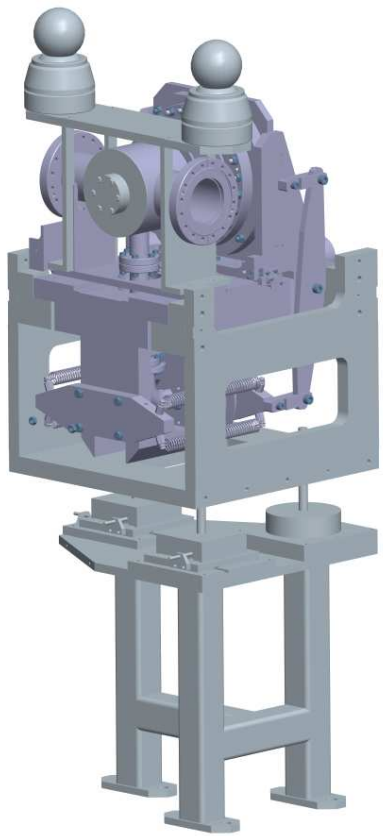
AFP TDR: CERN-LHCC-2015-009, ATLAS-TDR-024

Phase-1: AFP0+2 (2016)

- 2 horizontal Roman Pot stations at 205 and 217 m in A6R1 – installed!
- study beam background in low and high intensity runs
- measure diffractive and exclusive events with one tag (see talk by Rafal)

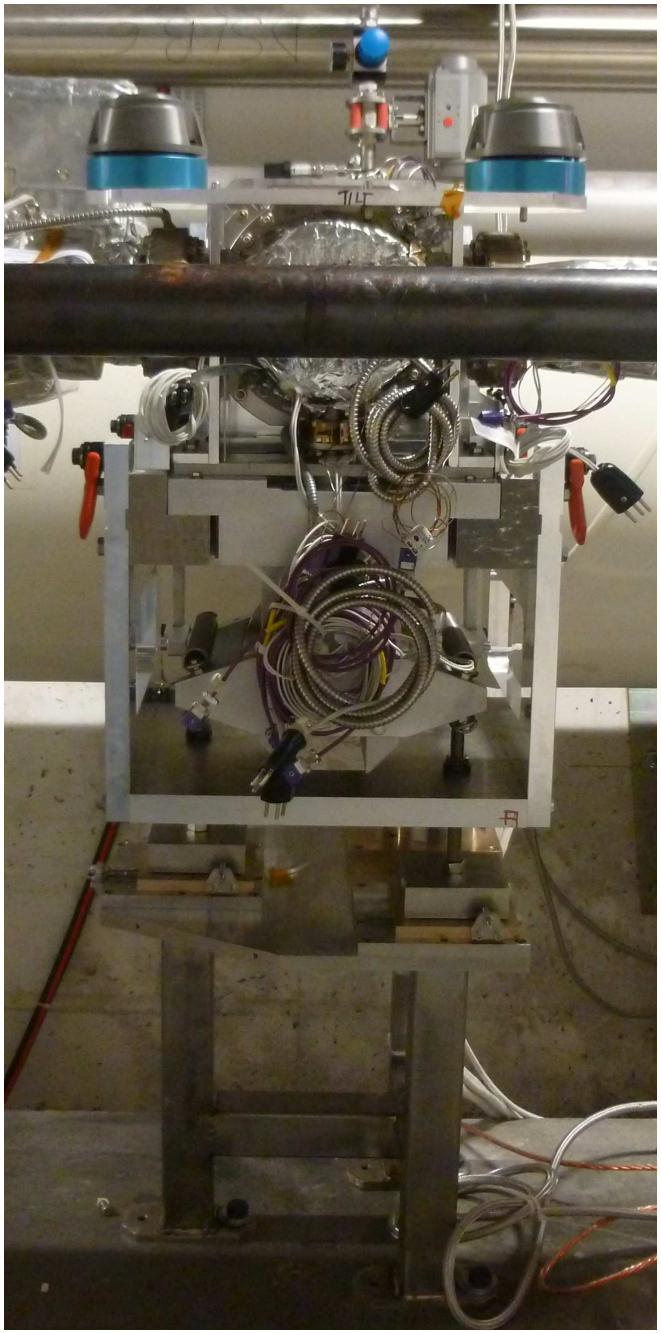
Phase-2: AFP2+2 (2017+)

- add 2 horizontal RPs at 205 and 217 m in A6L1
- install time-of-flight detectors in far stations on both sides (see talk by Tom)
- measure double tagged diffractive and exclusive events
- deliver diffractive triggers to ATLAS

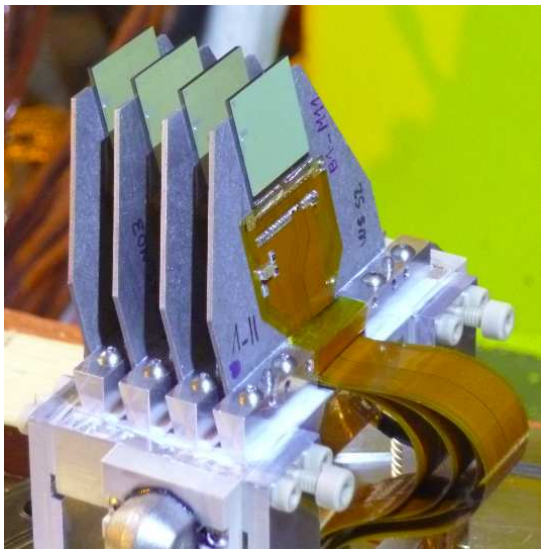


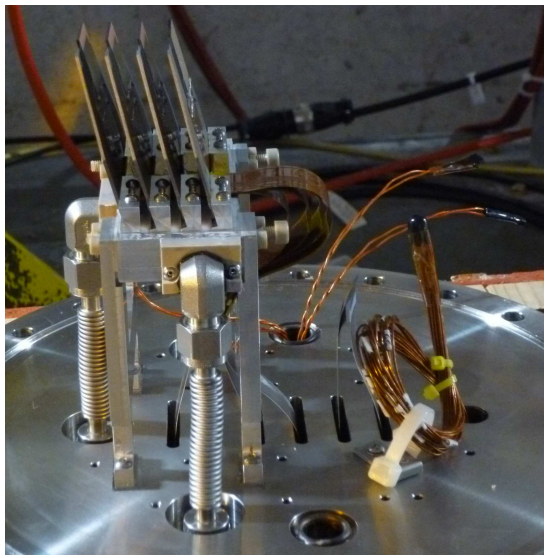
Station

- based on the CMS-PPS/TOTEM horizontal stations
- two stations installed 18^{th} Jan. on side C
- under LHC vacuum and baked-out since 3 Feb.
- **status: connected and fully operational**

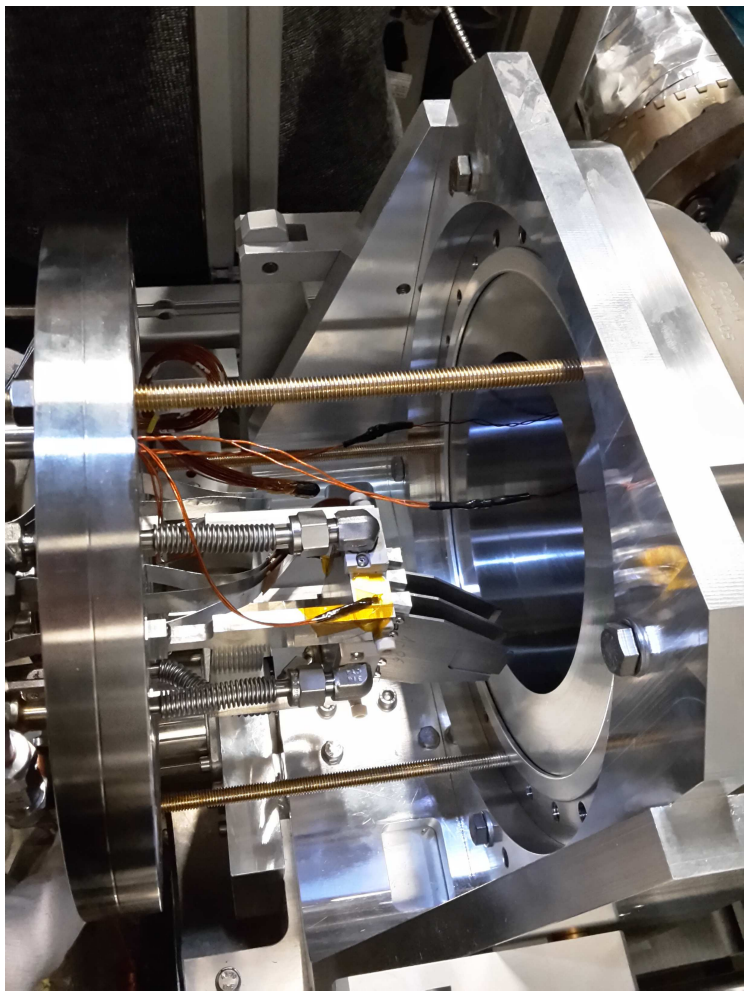


Position Detectors





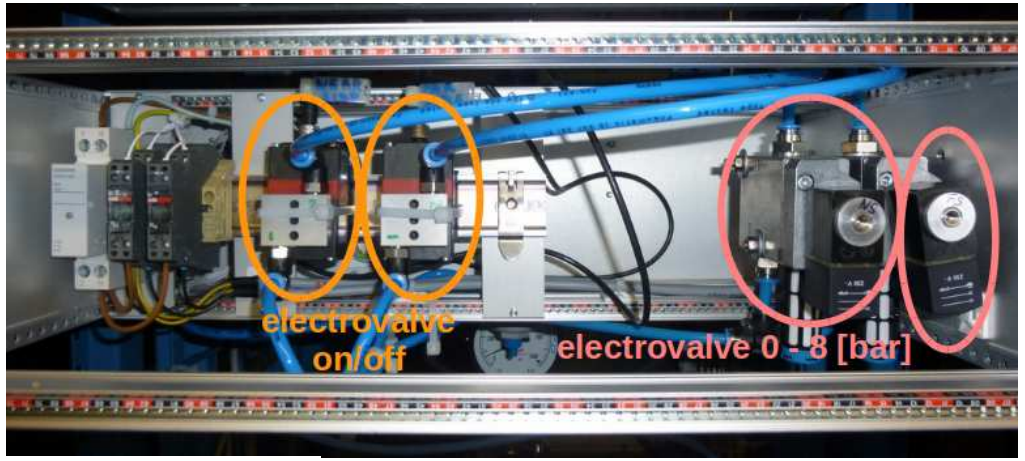
- technology: ATLAS IBL pixel sensors bonded with FE-I4 readout chips
- 4 detectors in each station
- pixel size: 50x250 μm^2
- single layer resolution: $\sim$6 μm in x (see talk by Joern)

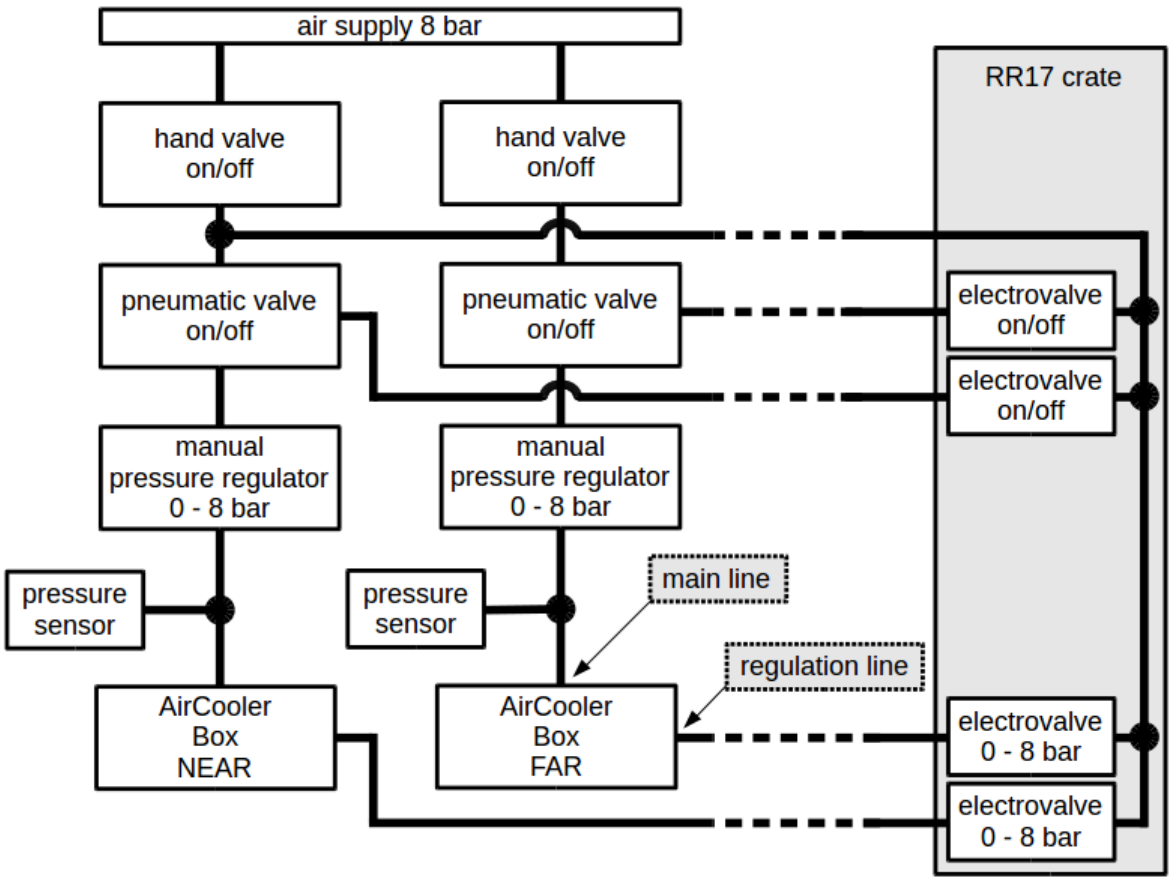


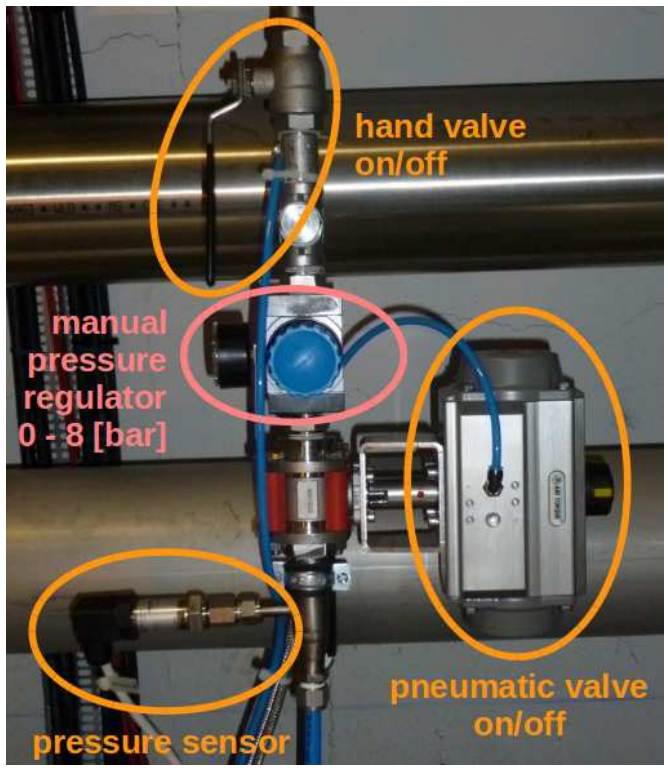
Vacuum System

- Each RP is kept under secondary vacuum:
  - reduce stress of thin window,
  - allows cooling below 0 deg. (prevents icing of detectors).
- Two vacuum pumps (P1, P2) per arm located in RR17 alcove.
- Four operating modes:
  - mode 1: alternating between P1 and P2,
  - mode 2: use P1, if problem switch to P2,
  - mode 3: use P2, if problem switch to P1,
  - mode 4: use both pumps.
- Small leak observed in near station. Overall leak rate: ~ 0.01 mbar / s.

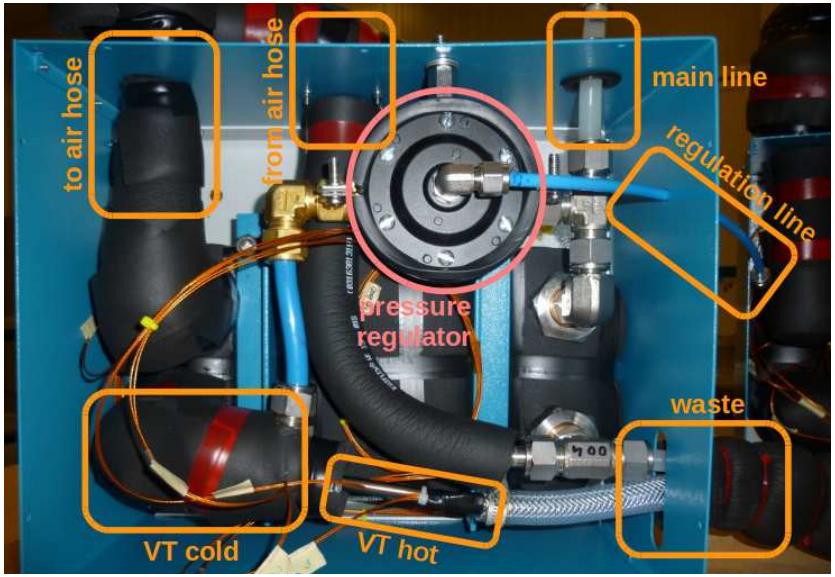
Vortex cooling technology – system runs purely on compressed air.

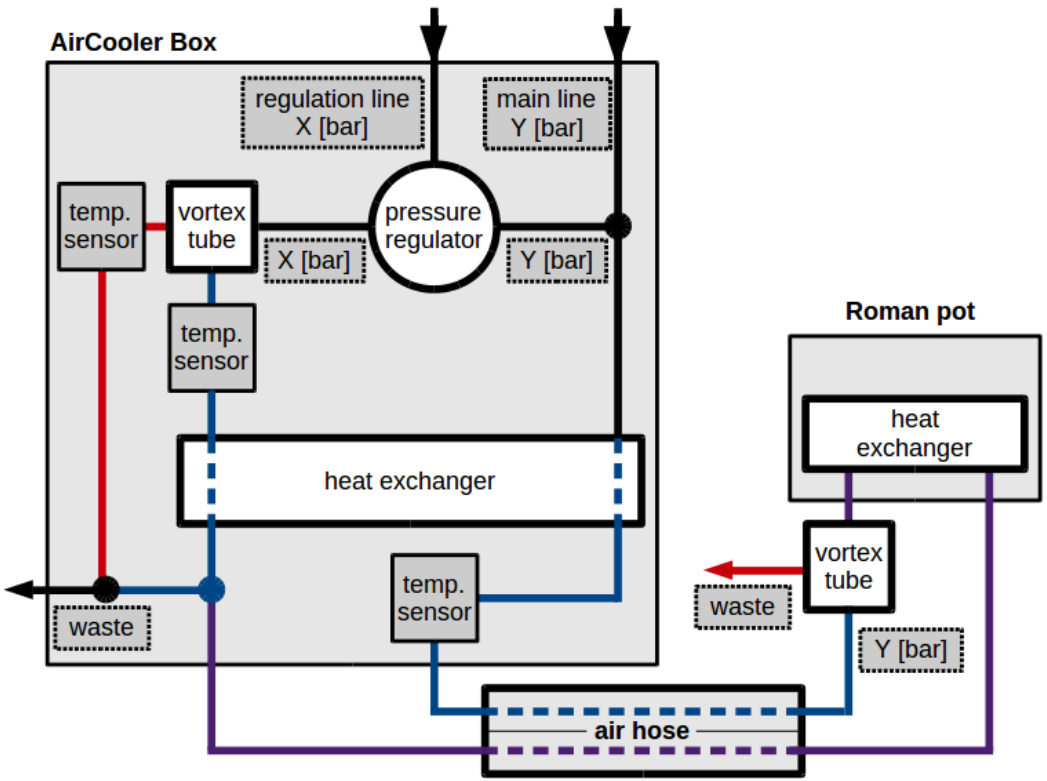






Cooling System – Station





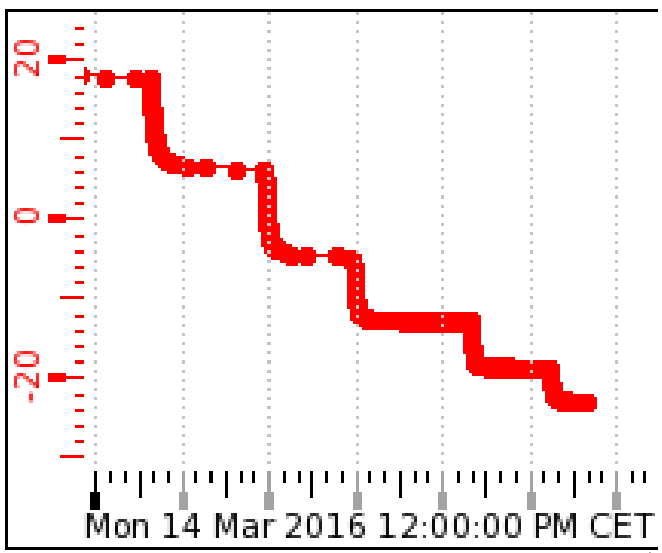
Staged approach:

- precooling of input air in AirCooler box,
- coooling with Vortex tube installed on RP.

Efficient cooling: temp. down to -30 ^{0}C with detectors powered on.

Operational requirements: -10 ^{0}C.

Online temperature regulation.

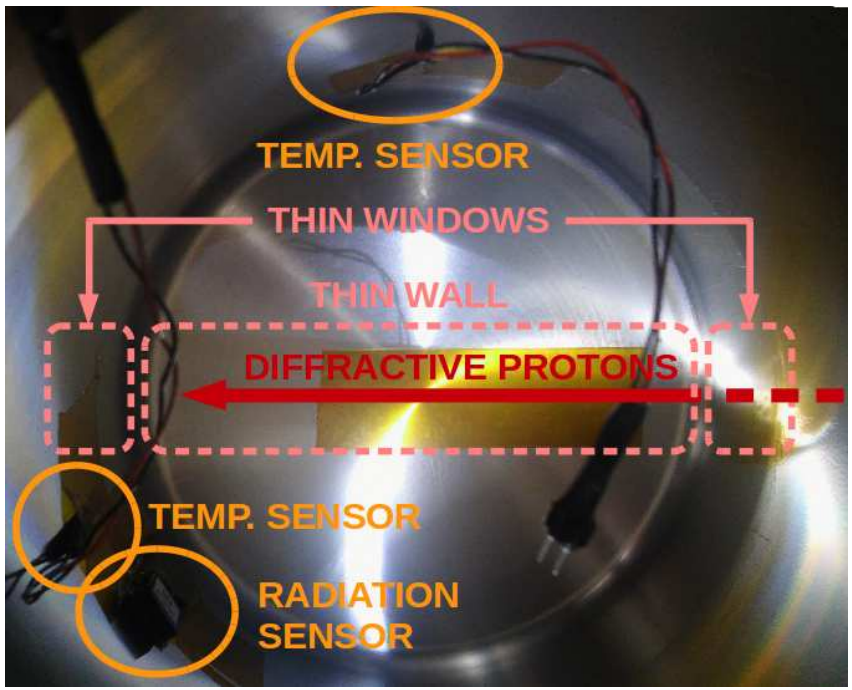


Temperature sensors (NTC):

- each station:
  - each detector plate (on flex),
  - heat exchanger (NTC + PT1000),
  - pot wall (up + under second thin window),
  - flange (cold output of Vortex tube + HV for ToF),
  - LTB.
- VReg. crate.
- AirCooler box:
  - hot output of VT,
  - cold output of VT,
  - output of box.

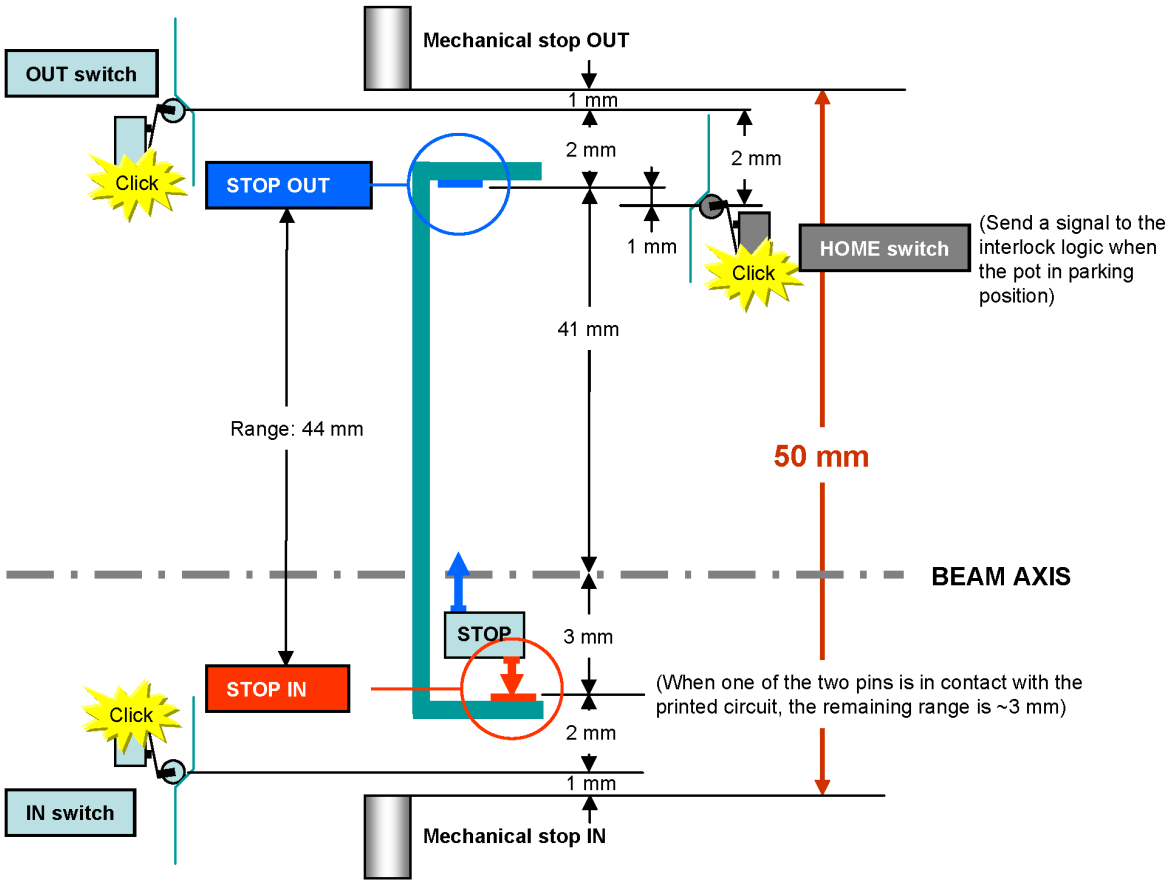
Radiation sensors:

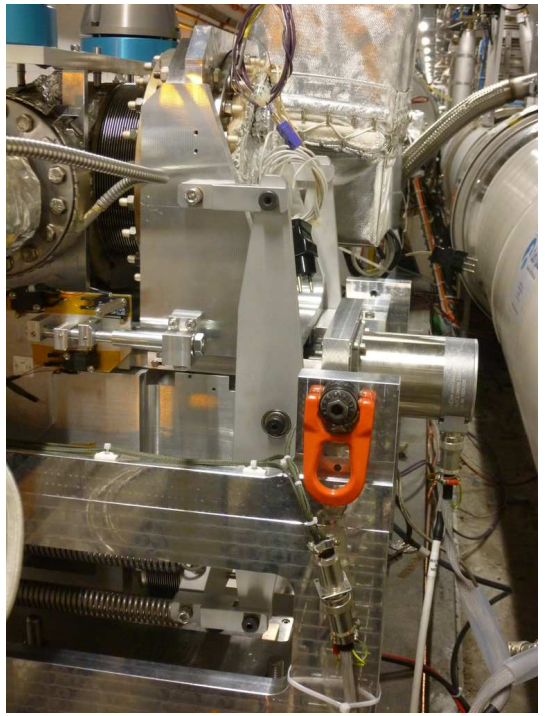
- bottom of each pot,
- VReg. crate,
- far station LTB,
- RR17 alcove.

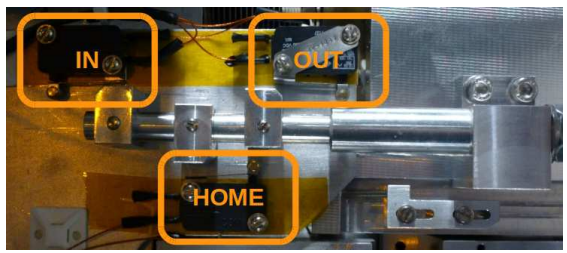


For details see talk of Elżbieta.

,,Specification and Validation of the Motion Control System of the ATLAS Forward Proton Roman Pots"

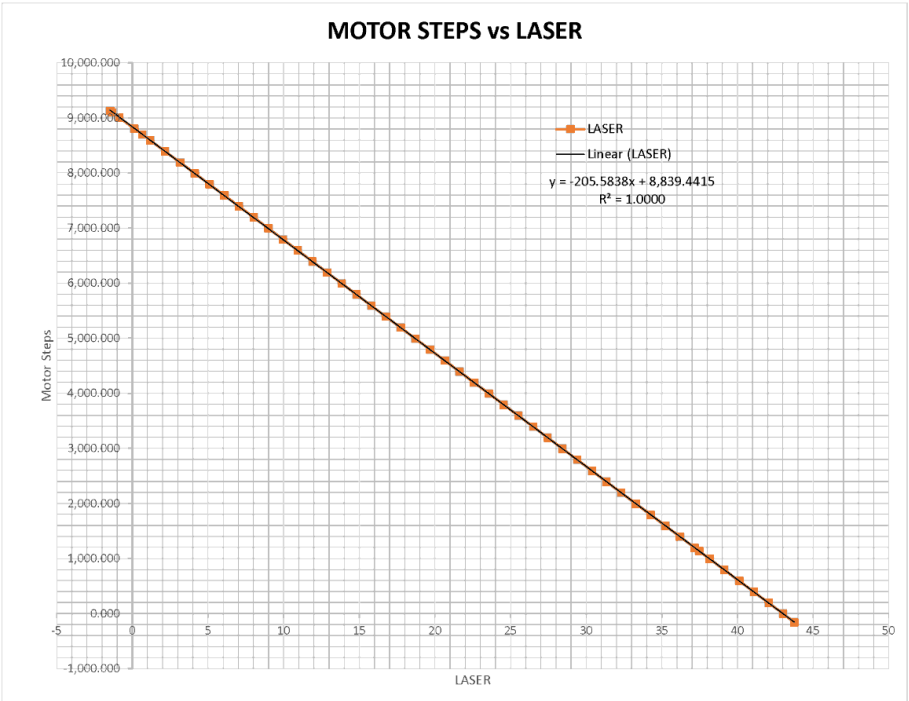


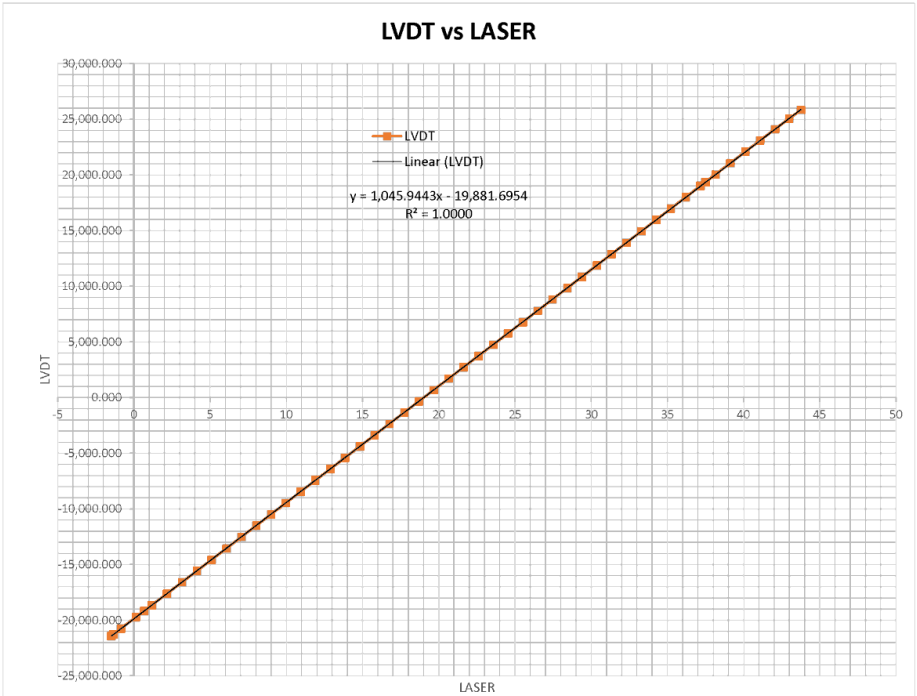


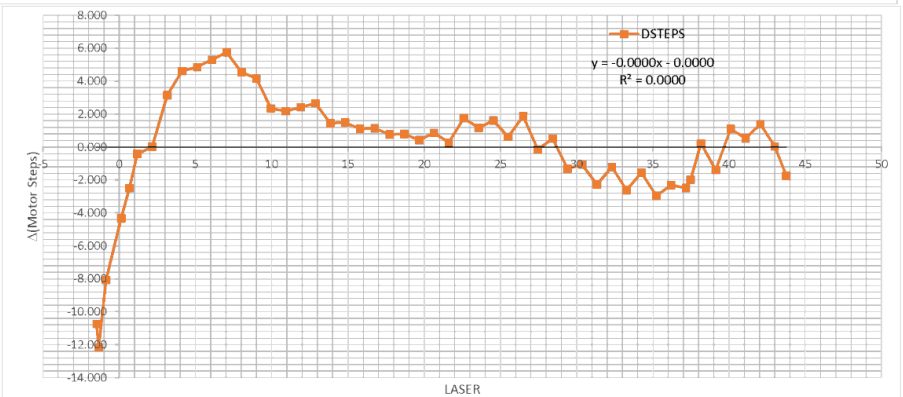


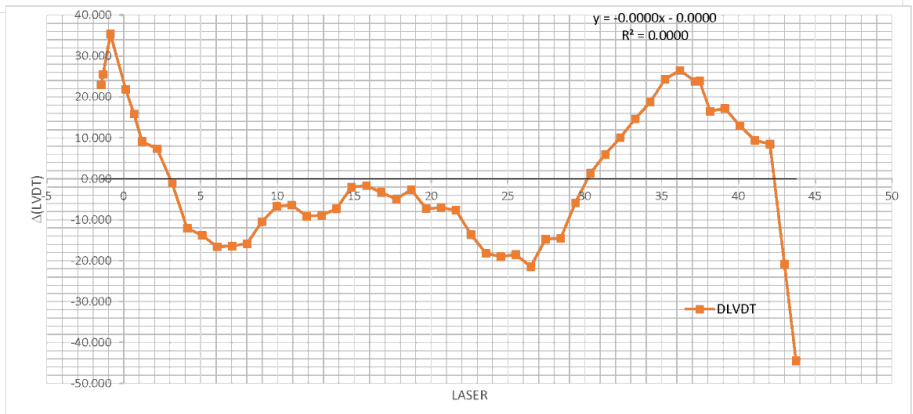
- mechanical stops installed to prevent damage of fragile electrical stop
- retraction with springs to the HOME position tested
- positions of IN, OUT, and HOME switch and Electrical Stop were set according to the laser measurements

Both stations calibrated (18 Feb.)



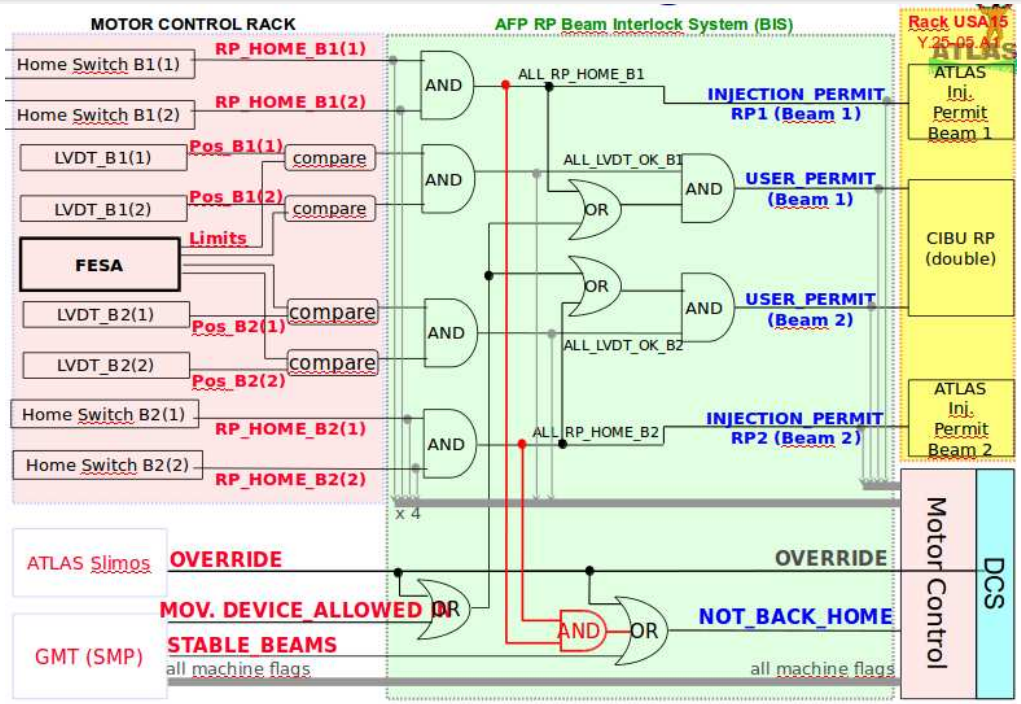






AFP Beam Interlock System

- copy of ALFA BIS
- AFP Beam Interlock System successfully commissioned from the central DCS up to the LHC interface (CIBU)



- hardware commissioning tests related to the position control of the 2 AFP Roman Pots done:
  - correct mapping and signal distribution of the LHC flags between the AFP Interlock and AFP position control system
  - signal integrity of the HOME SWITCH signal from RP station to AFP interlock and the transmission of the COPY HOME switch back to the PXI
  - EXTRACTION RP SWITCH and OVERRIDE signals from the ATLAS control room
  - HOLIDAY MODE KEY
- **status**: system is ready for the final production software deployment for PXI+FESA+CCC+DCS, to proceed with the final commissioning tests

Ultimate Goal: measure forward protons with AFP detectors for the study of diffractive processes with ATLAS (see talk by Rafał)

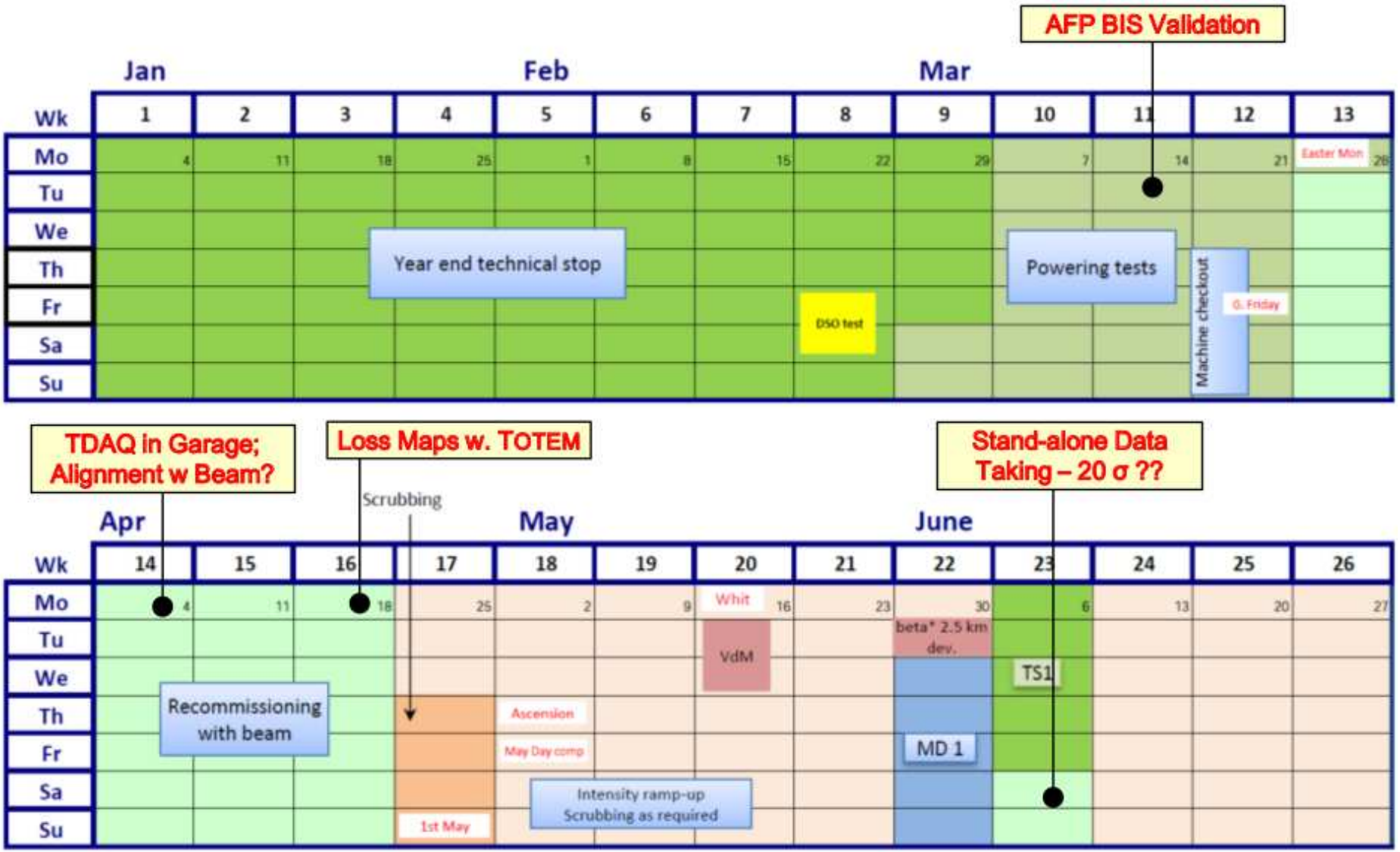
Commissioning:

- commissioning of AFP Beam Interlock System during no-beam (mid-March):
  - motorization control and interlock documentation (draft version available)
  - contact with MPP, participate in relevant meetings
- beam-based alignment (Mid-End April)
- loss maps with first beam (Mid-End April)
- parasitic stand-alone running (in garage) for detector commissioning (NO pot insertion) (End-April)

Data taking:

- **after commissioning:**
  - participate parasitically in low-μ runs
  - stand-alone data taking with tentative insertion up to 20 σ
  - **time period: May-June 2016**
- **after LHC and ATLAS approvals:**
  - participate parasitically in a few end-of-store runs (standard optics)
  - stand-alone data taking with tentative insertion up to 20 σ
  - **time period: before September 2016**
- **after ATLAS review and approvals:**
  - participate in a few standard runs with ATLAS+AFP TDAQ with tentative insertion up to 20 σ
  - **time period: before mid-November 2016**

Commissioning – Schedule

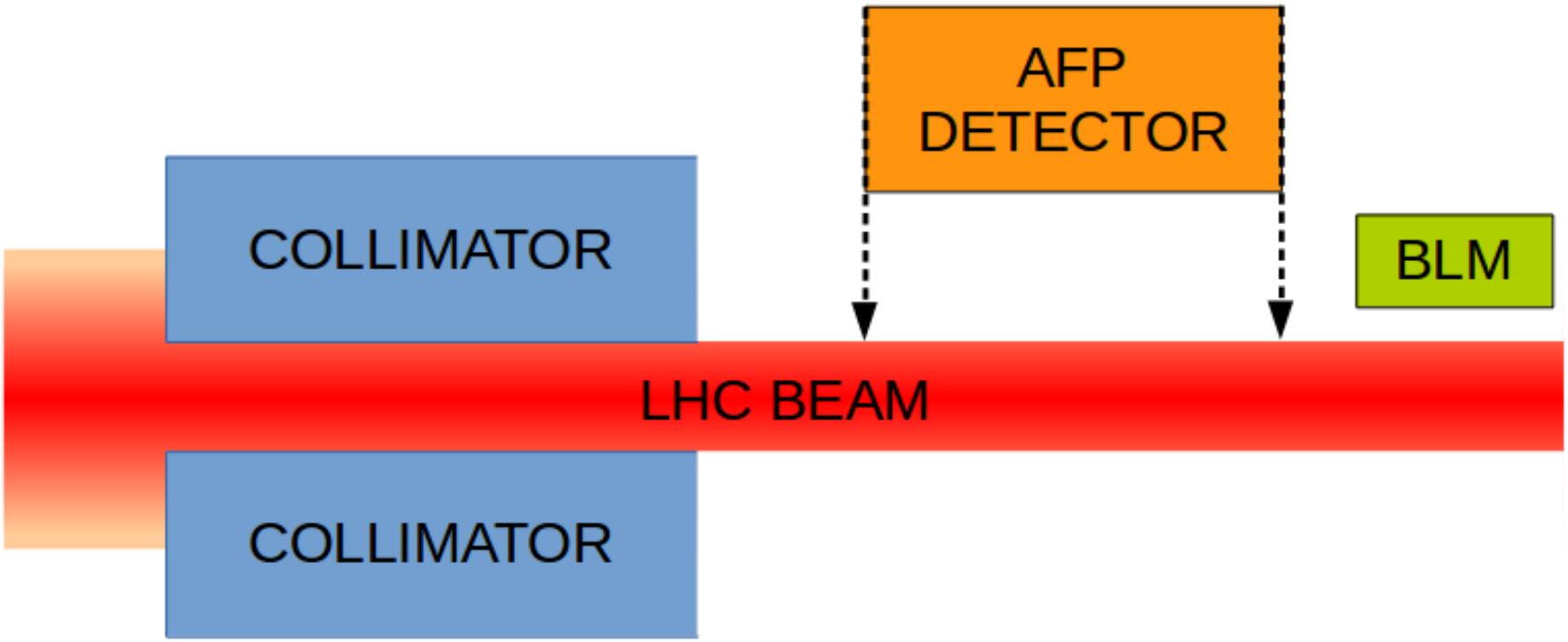


BIS Validation

Following ATLAS-ALFA tests from 2015 (EDMS 1515678), but a bit more simple (2 stations instead of 8):

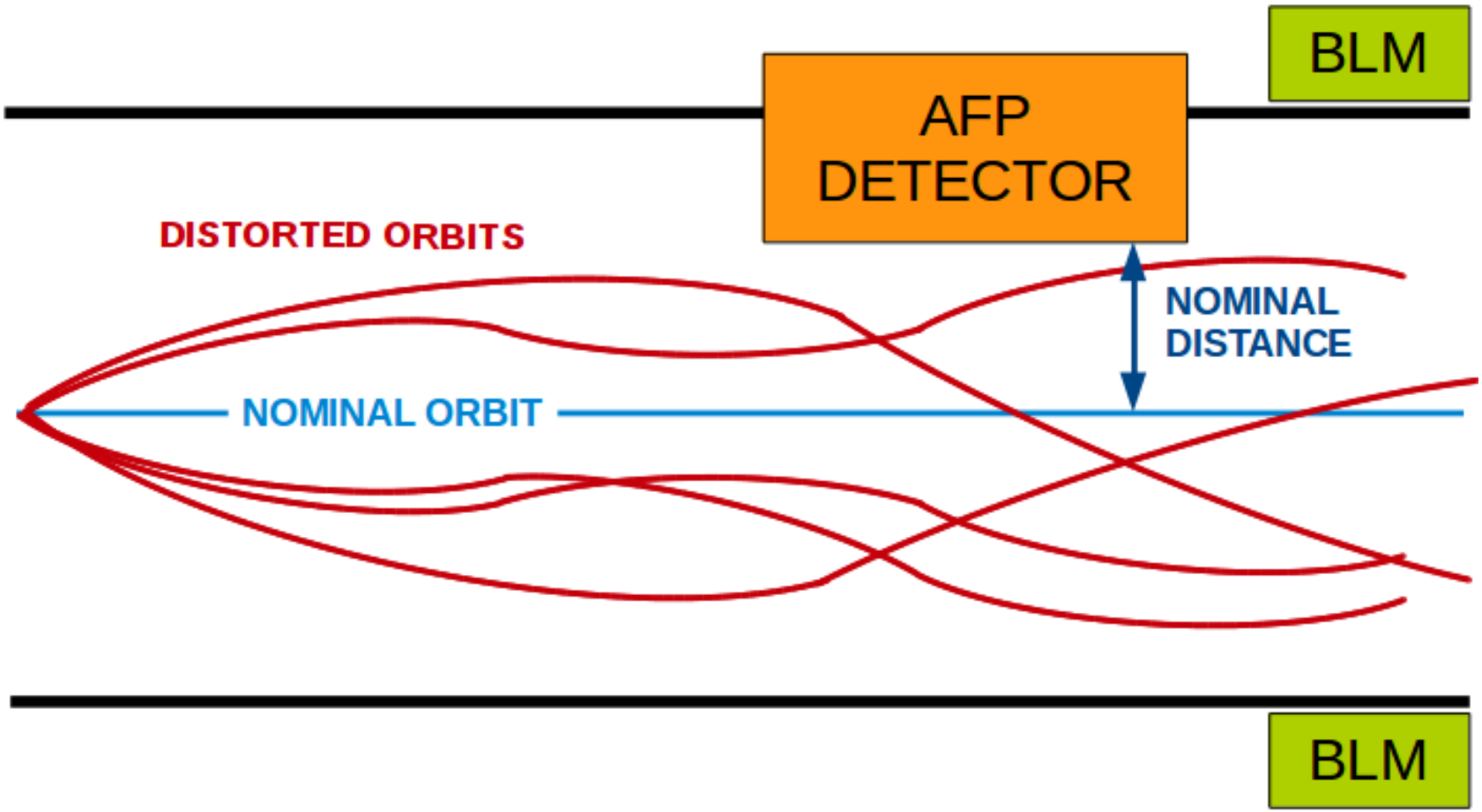
- INJECTION PERMITs
  - Removal of the INJECTION PERMIT by a Pot leaving HOME
- Response to the LVDT-to-Limits Comparison (ALL LVDT OK)
- Test of USER PERMIT1 and Automatic Pot Extraction as a Function of All Input Flags
- LVDT Bypass Box
  - Failure during the Run
  - The Forbidden Use Case
  - The Holiday Mode
  - CCC Night-call – Failure while Detector is in Standby
- Hardware and Software Buttons
  - Extraction by DCS
  - Disabling by DCS
  - Emergency Extraction by Hardware Button

Beam-based Alignment



- Scraping: close collimator to trim the beam.
- Approach the beam with detector.
- Monitor rates in BLMs and AFP – sudden increase marks the beam position.

Loss Maps



- Move detectors to the operational position (*e.g.* 20σ).
- Distort beam trajectory.
- Observe rates in BLMs and AFP – beam should not touch the Roman pot.

AFP 0+2 was installed ...

... is now in the commissioning phase ...

... with rich physics programme on the way!

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