EMC Backward Endcap Status report

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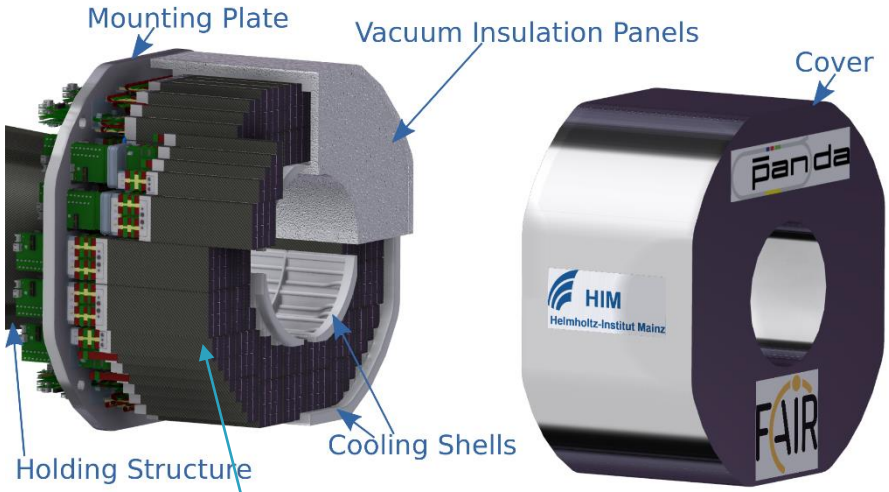
EMC Meeting Bochum, 6. 2. 2024

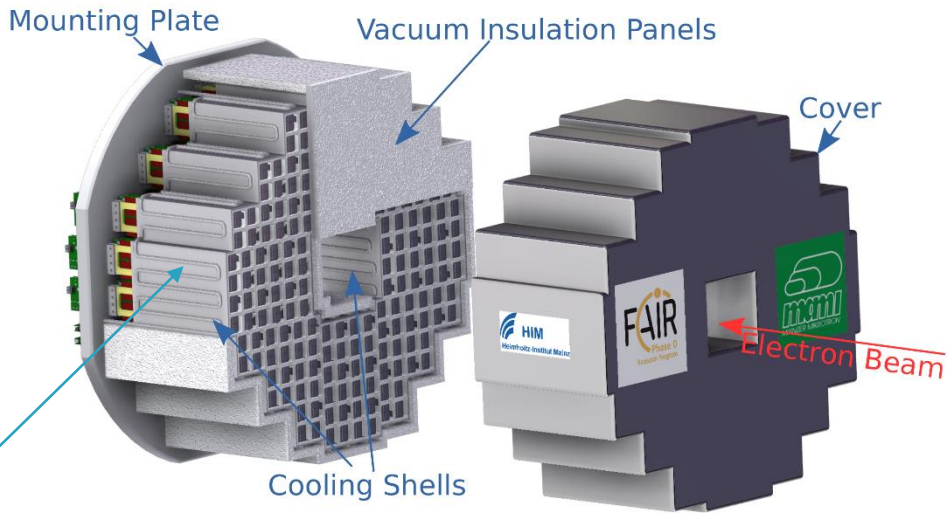
Outline

- Submodule Production
- Submodule calibration status
- Slow control
- Mechanical status
- Summary

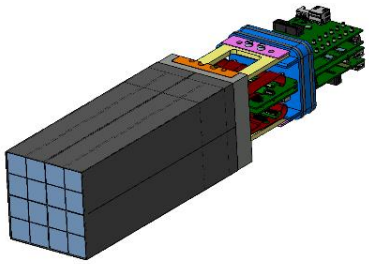
PANDA Backward Endcap



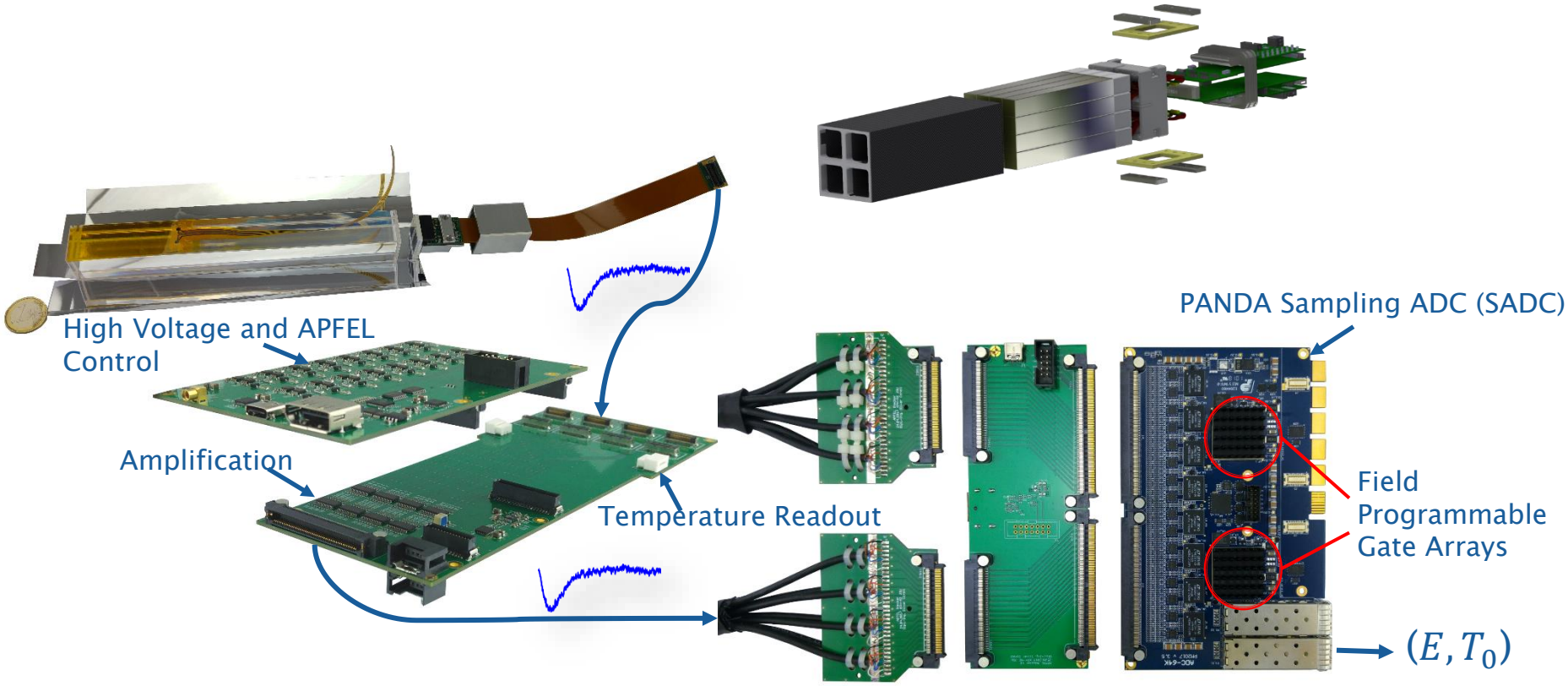
Panda Version



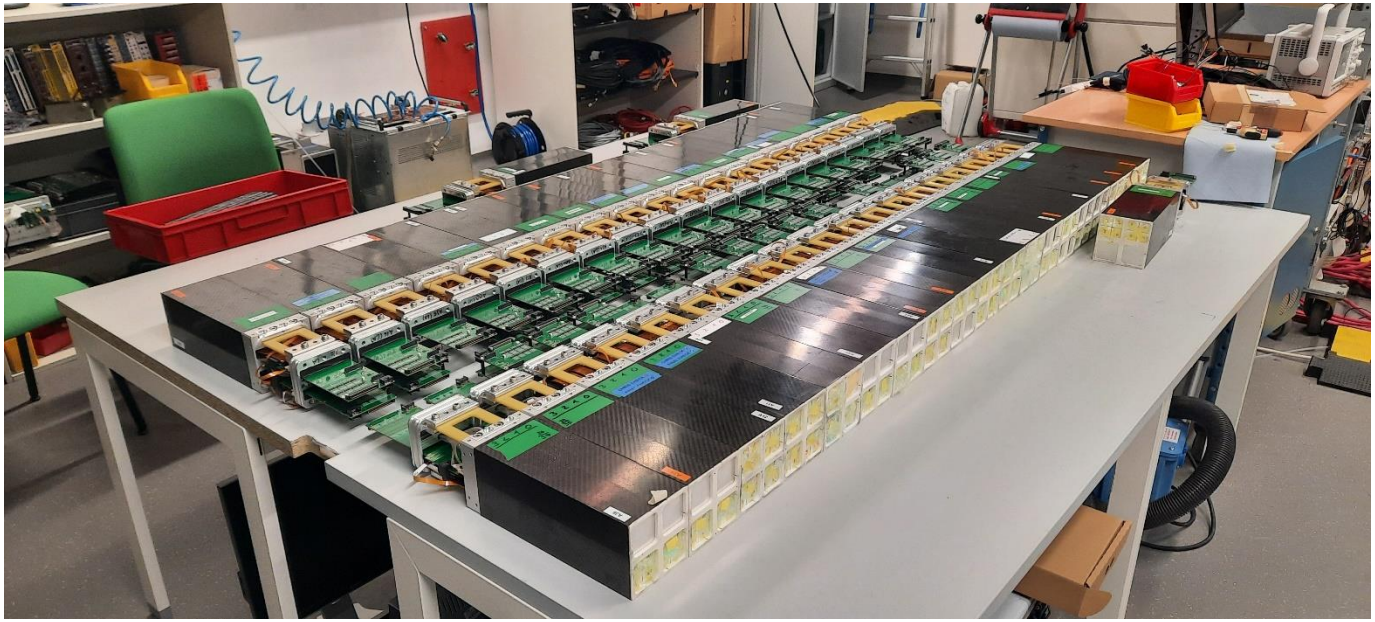
Phase-0 Version



PANDA Backward Endcap



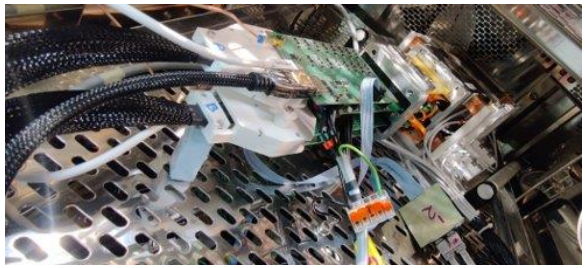
Submodule Production



- Submodule production: finished
- Disassembled one prototype EMC to build final 2 half subunits
- 32/32 Full subunits
- 16/16 Half subunits

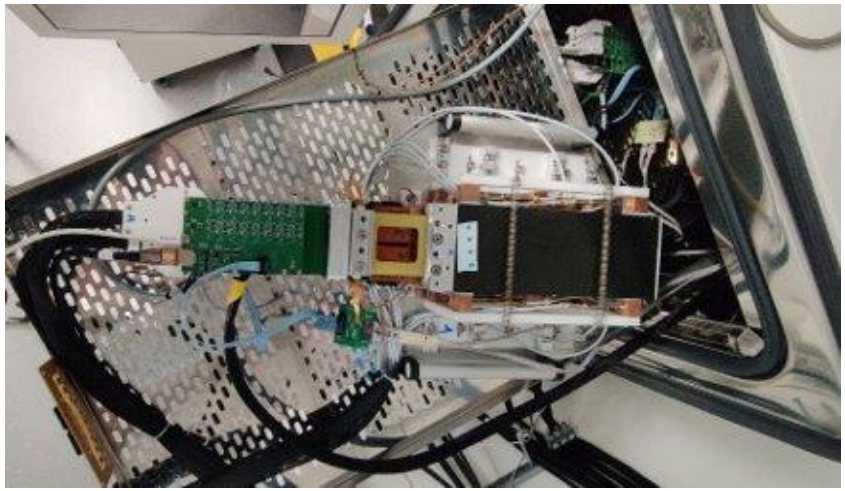
Submodule Calibration

- Fully automated calibration in climate chamber of:
  - Temperature sensors
  - APD gain curve
  - Energy calibration with cosmics

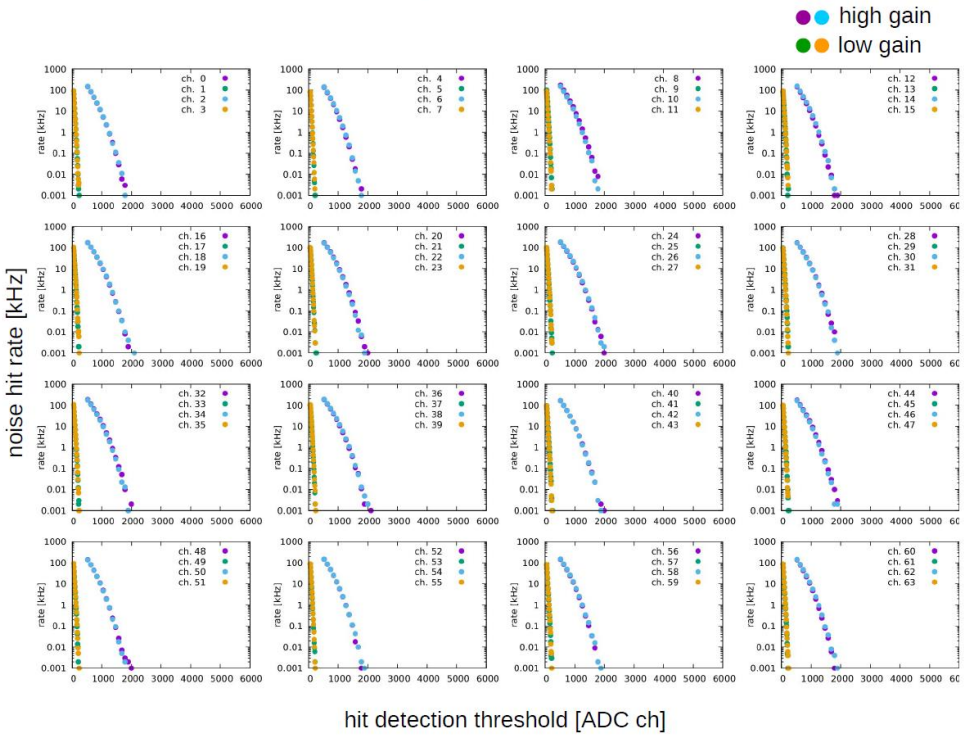


- All submodules through calibration process

- Analysis of calibration data and calibration in progress



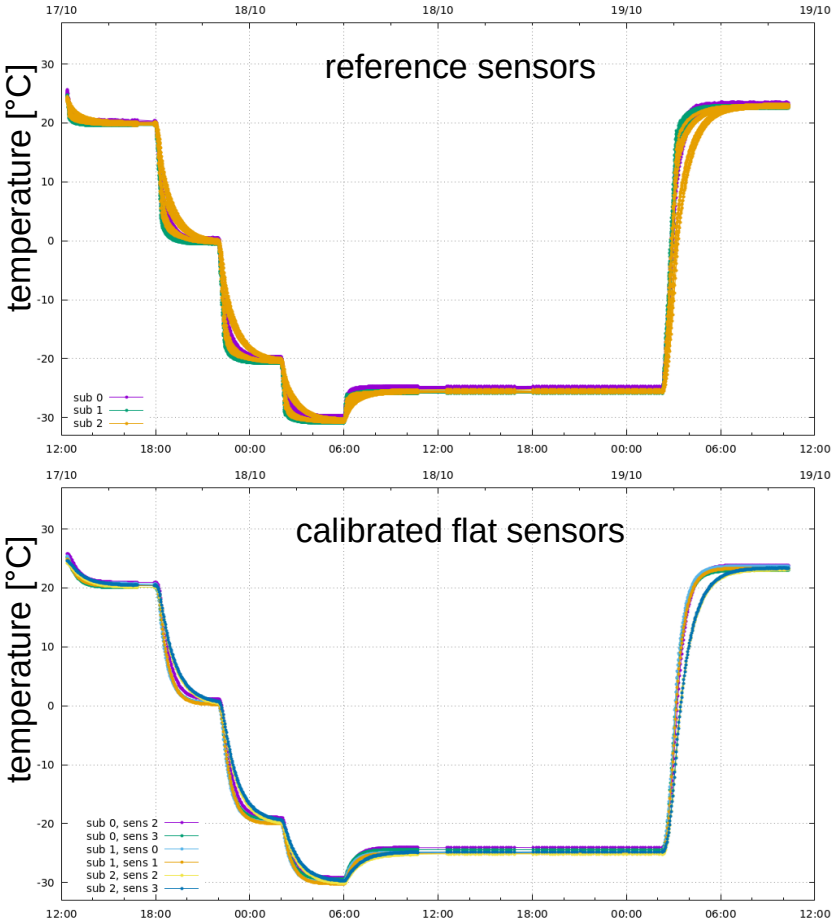
Submodule Calibration: noise



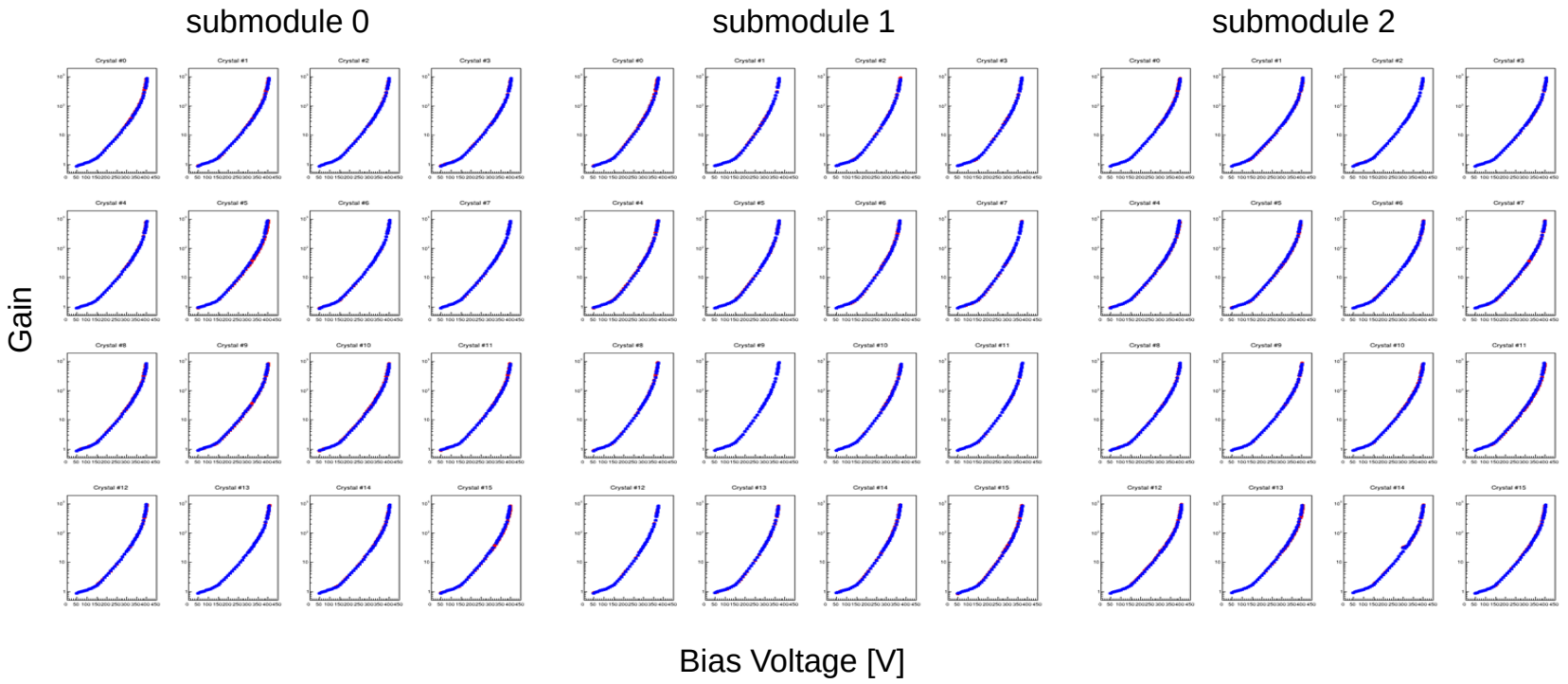
- Noise characterisation by scanning the hit rate as a function of sadc threshold
- Identification of missing contact between APD and APFEL-ASIC
  -> exclude channels from HV scan to not damage APFEL

Submodule Calibration: temperature

- 4 flat home-made pt100 per submodule to be calibrated
- 10 reference sensors around each submodule
- climate chamber set to 6 different temperatures: 20°C, 0°C, -20°C, -30°C, -25°C, 23°C
- reference values interpolated to the position of the flat sensors
- linear R(T) function calculated with two points (typically +20°C and -25°C)
- other data points used to check the accuracy
- typical accuracy: 0.1 to 0.2°C



Submodule Calibration: HV scans

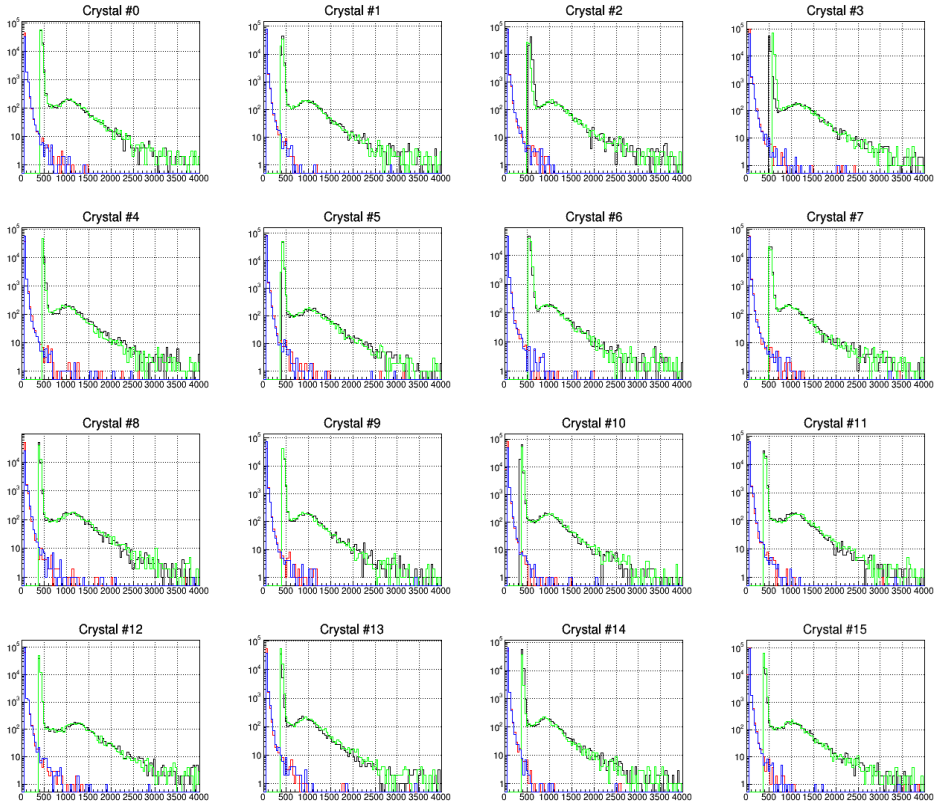


- HV scans at +20°C and −25°C
- Measurement of gain/voltage characteristics of every APD with pulsed light
- Absolute gain determination to be fixed with cosmics data
- Results approximately compatible with Bochum characterization
- Example: scan data at −25°C, three submodules,
  one plot per crystal containing the curve of both APDs

Submodule Calibration

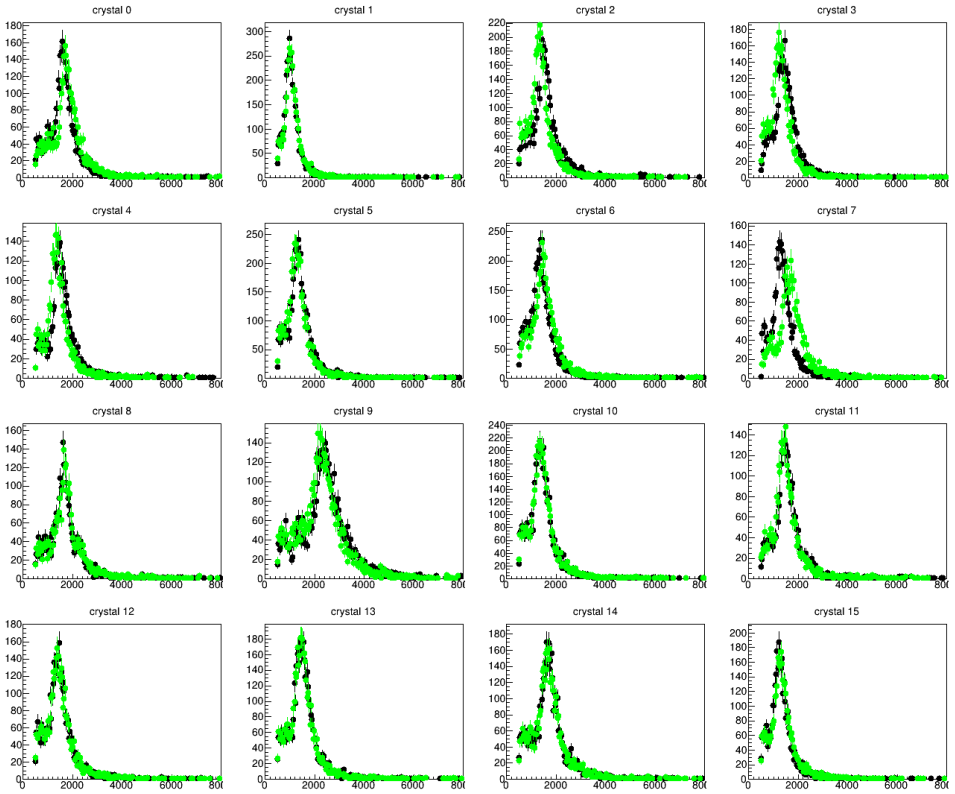
- Cosmics data at -25°C with gain 200 and gain 400
- Absolute gain determination by using cosmic peak (~25 MeV)
- Here: raw data without event reconstruction
- Example: ~3 hours run at gain 400

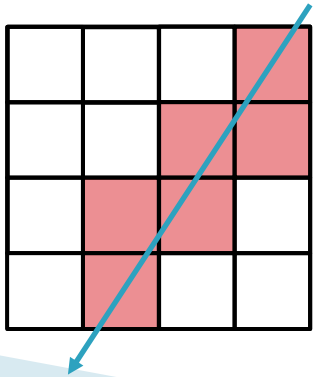
  (colours: blue+red=low gain, black+green=high gain)



Submodule Calibration

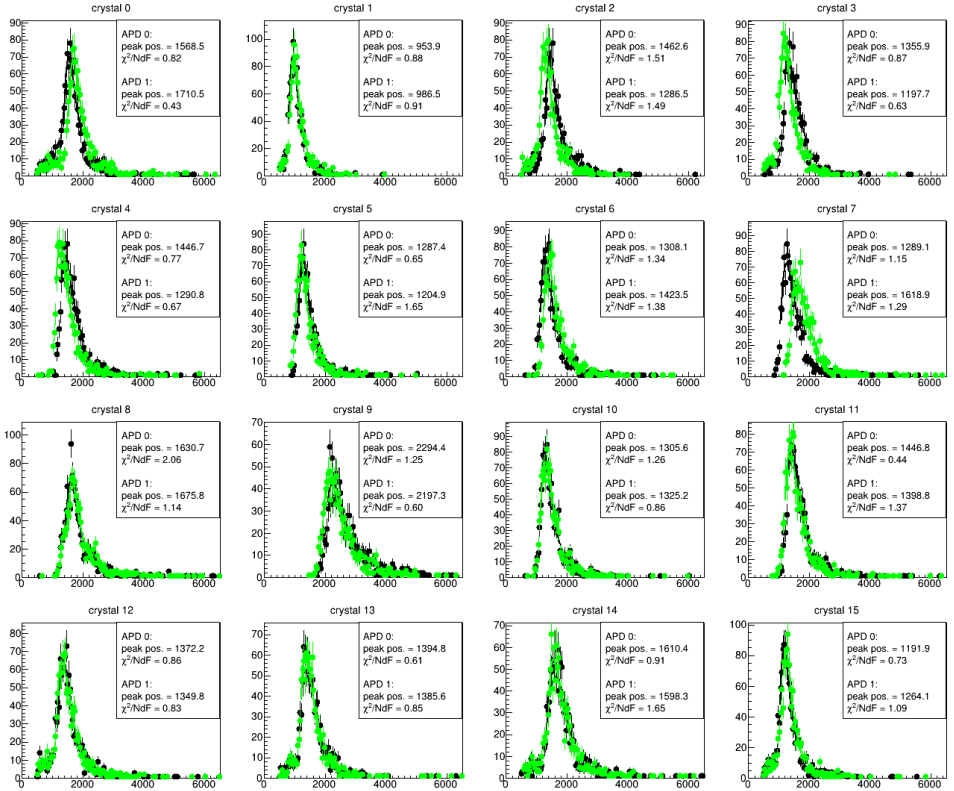
- Data at gain ~400
- With event reconstruction
- At least one hit per row required
- Large reduction in noise by requiring e.g. signal in both APDs
- But: no clean landau distribution as expected, probably due to angled tracks

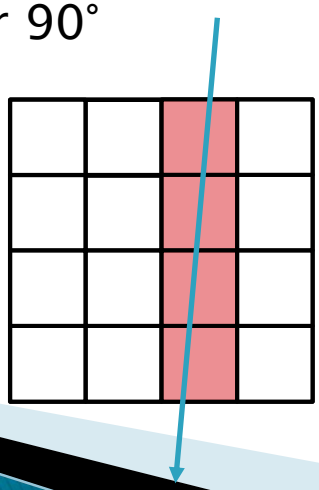




Submodule Calibration

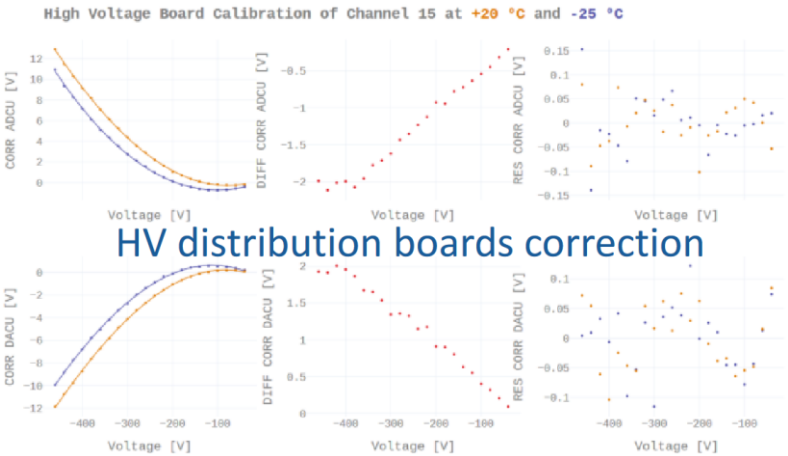
- Exactly 4 hits required in a column pattern
- Fit with landau distribution
- Calibration of energy/ADC channel with 25 MeV peak
- Absolute calibration of gain-bias curve of each APD
- Next steps:
  - Analyse and calibrate all submodules (gain 200 and 400)
  - Once full detector is setup, repeat cosmics measurement
  - Additional energy point by turning the detector 90° (~200 MeV)

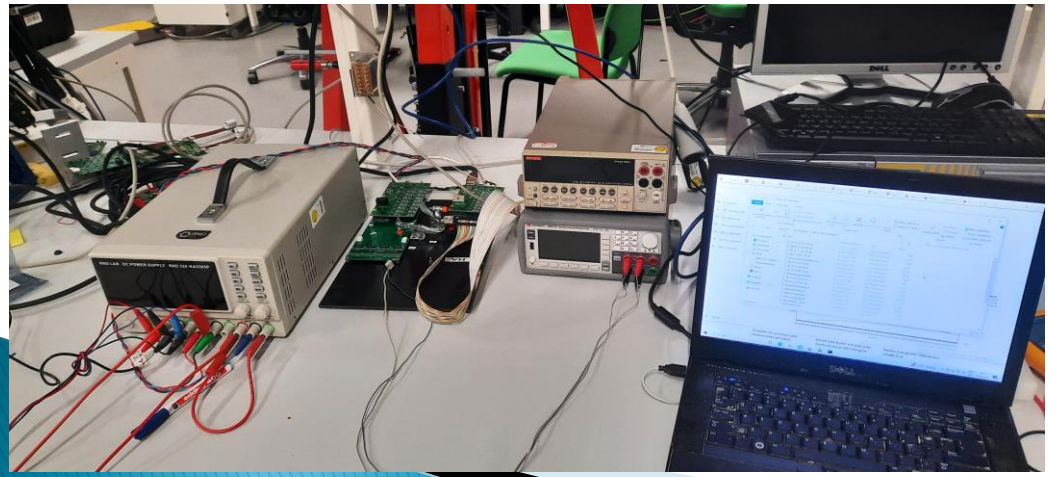




HV distribution boards

- HV distribution boards:
  - All boards produced (only 94/100…)
  - Small issue: 2 capacitors missing on boards -> Apfel communication not working properly
  - Boards currently in “repair”
- Calibration status:
  - Calibration of HV DAQ and ADC values done
  - Current calibration delayed due to aforementioned issue





Slow control

- Epics integration:
  - Fully integrated:
    - Control of high voltage crate
    - Control of low voltage crate
    - Light pulser
    - Control of Apfel preamplifier
    - Control of high voltage boards

Slow control

- Epics integration:
  - Fully integrated:
    - Control of high voltage crate
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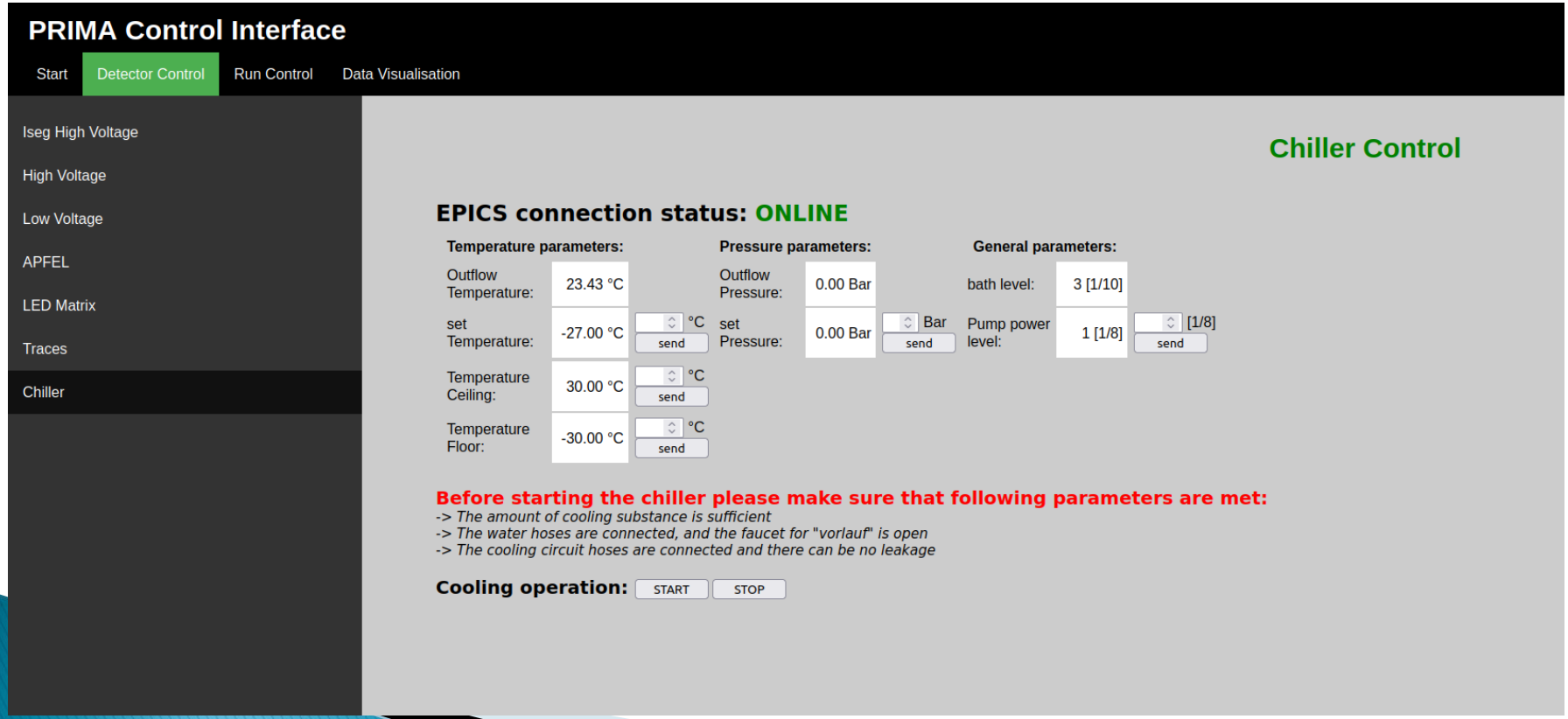
    - Light pulser
    - Control of Apfel preamplifier
    - Control of high voltage boards
    - Chiller

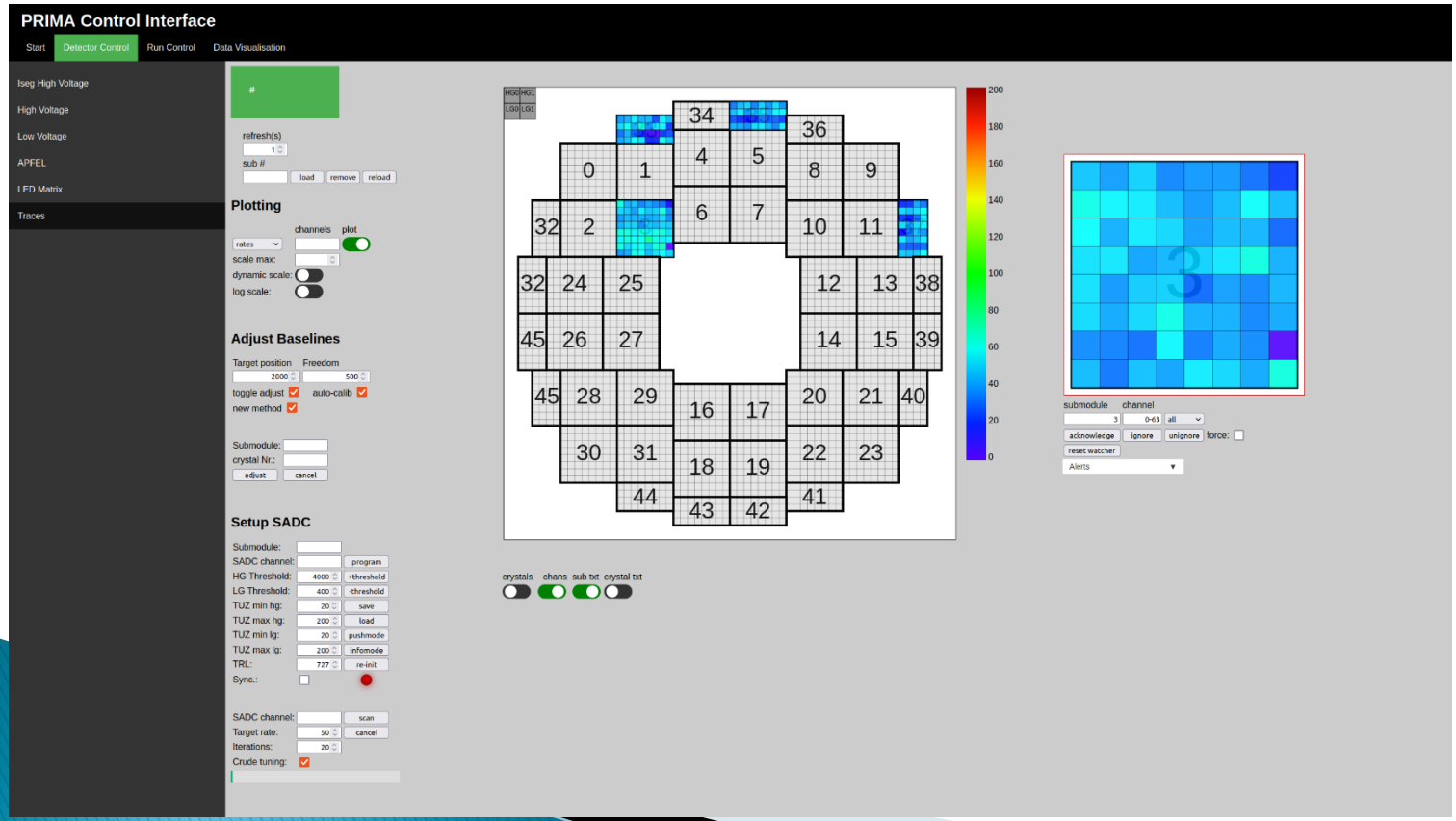
Slow control

- Epics integration:
  - ➢ Fully integrated:
    - Chiller
- Integration of chiller control into web interface



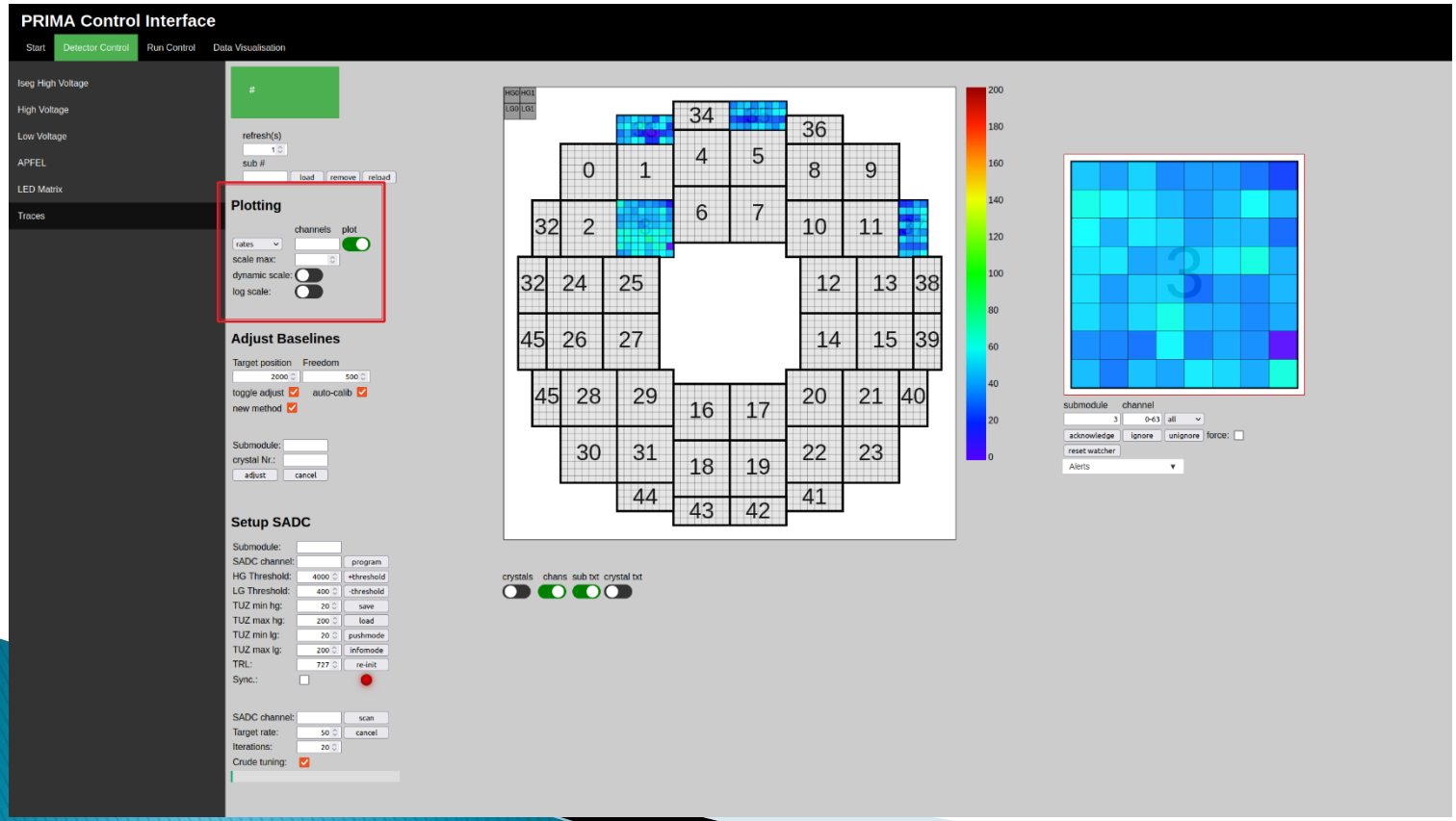
Slow control

- Detector overview implemented for:
  - Traces (baselines)
  - HV control (work in progress)
- Example: traces app, tested with 1 Full subunit (external setup) and 3 half subunits (climate chamber)



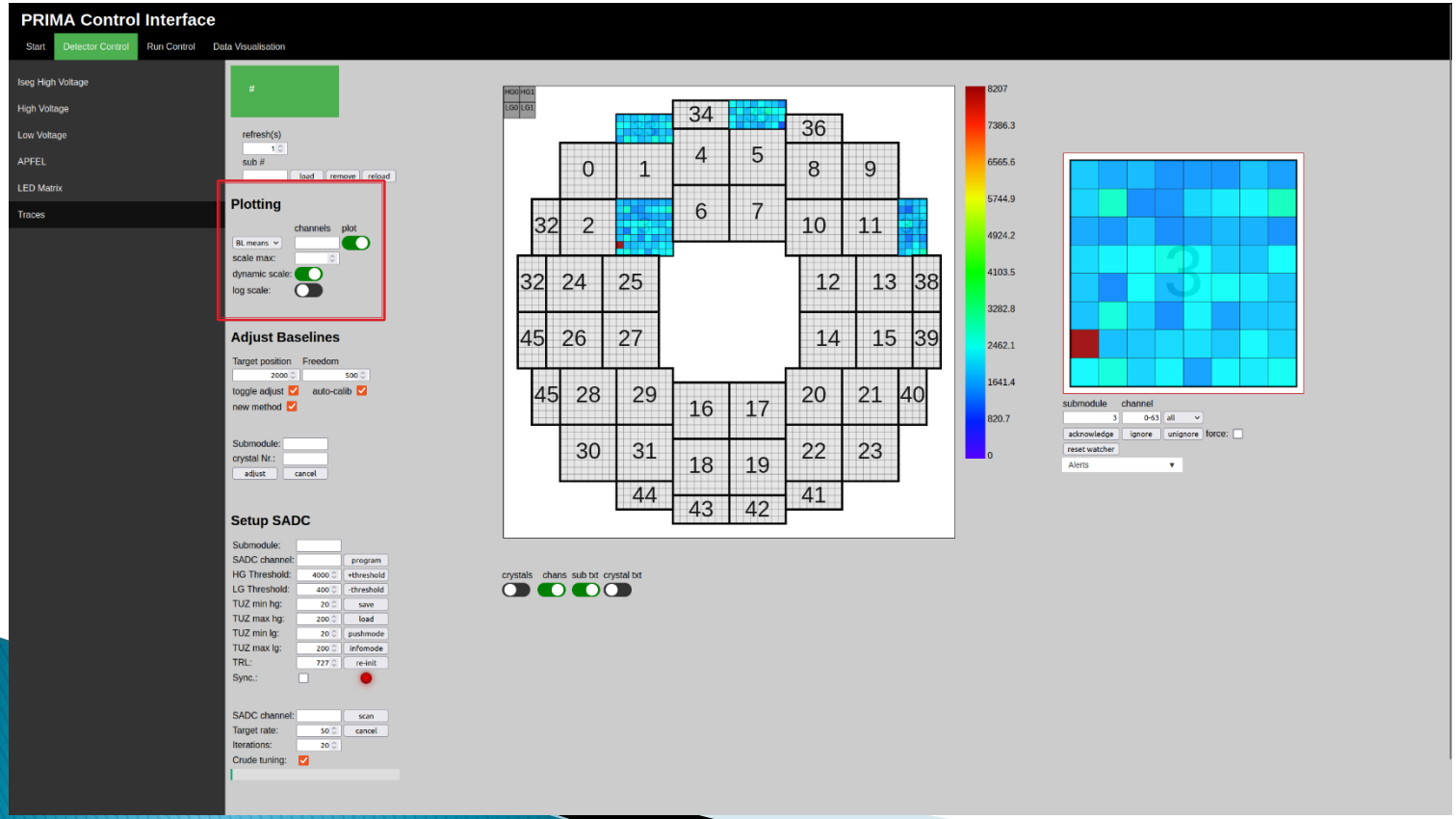
Slow control

- Example: traces app, tested with 1 Full subunit (external setup) and 3 half subunits (climate chamber)
- 2D plotting for:
  - Rates



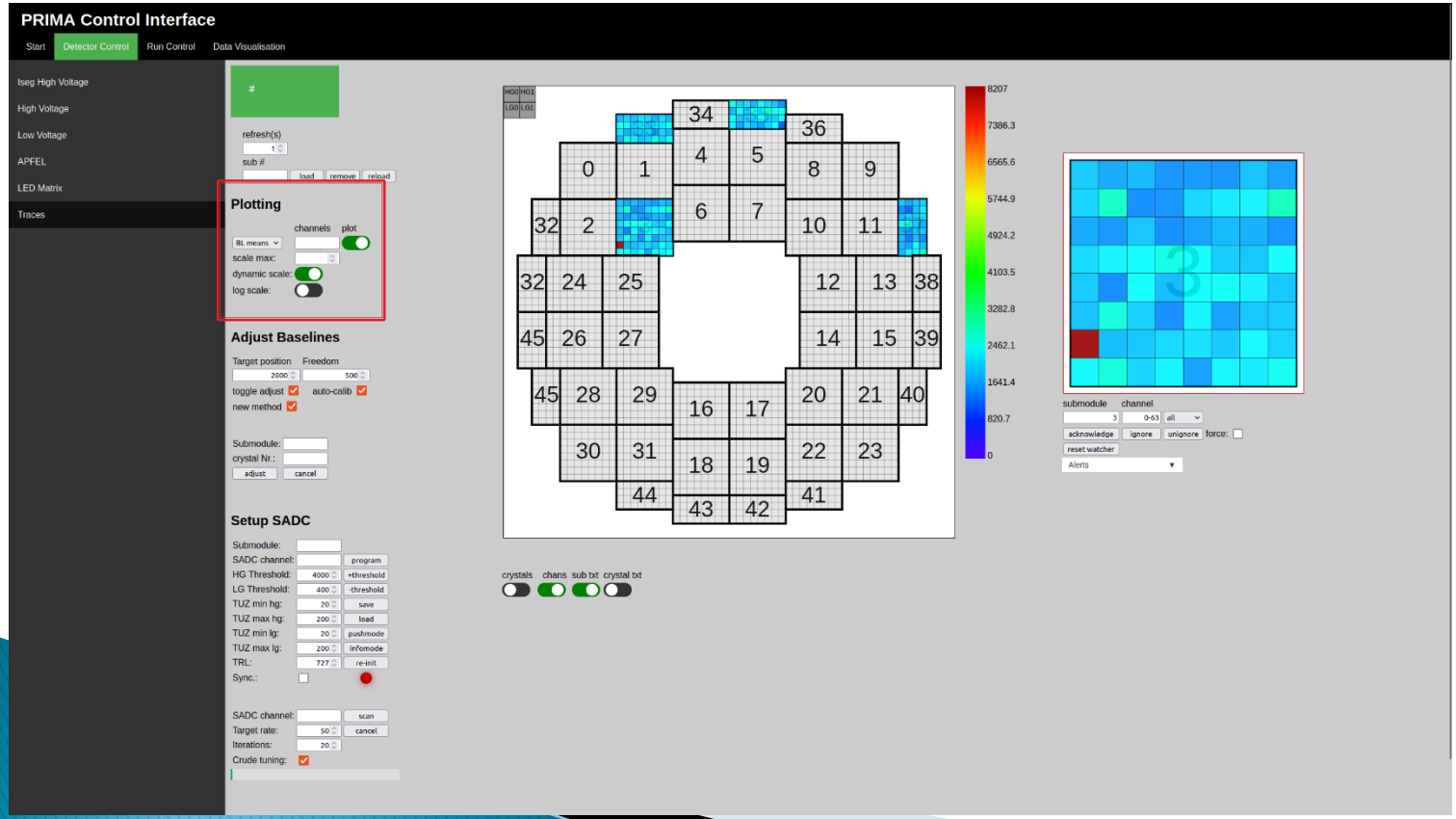
Slow control

- Example: traces app, tested with 1 Full subunit (external setup) and 3 half subunits (climate chamber)
- 2D plotting for:
  - Rates
  - Baseline positions



Slow control

- Example: traces app, tested with 1 Full subunit (external setup) and 3 half subunits (climate chamber)
- 2D plotting for:
  - Rates
  - Baseline positions
  - Baseline standard deviation



Slow control

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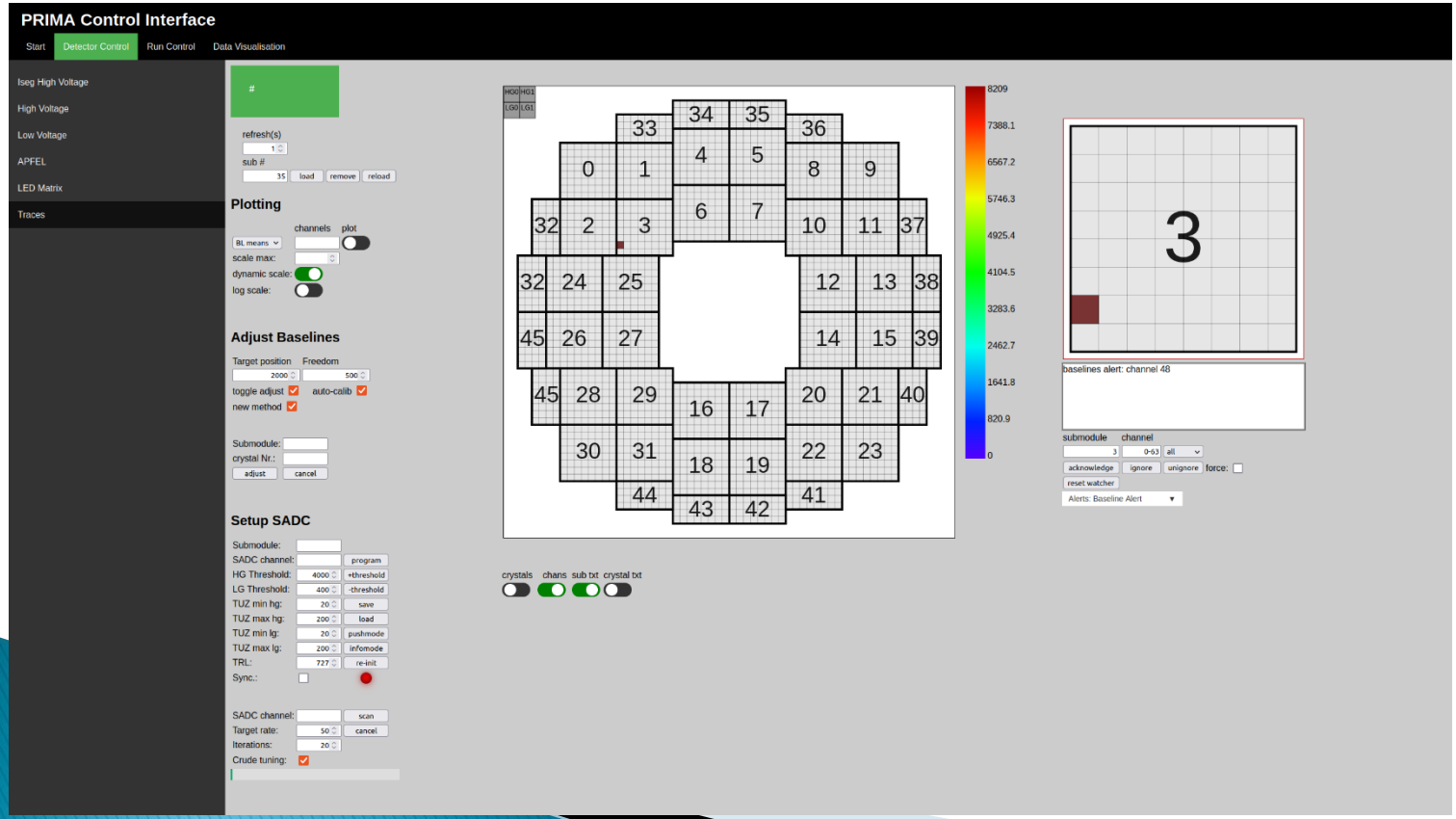
- Alert system:
  - Watcher which checks whether parameters are within limits



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- Alert system:
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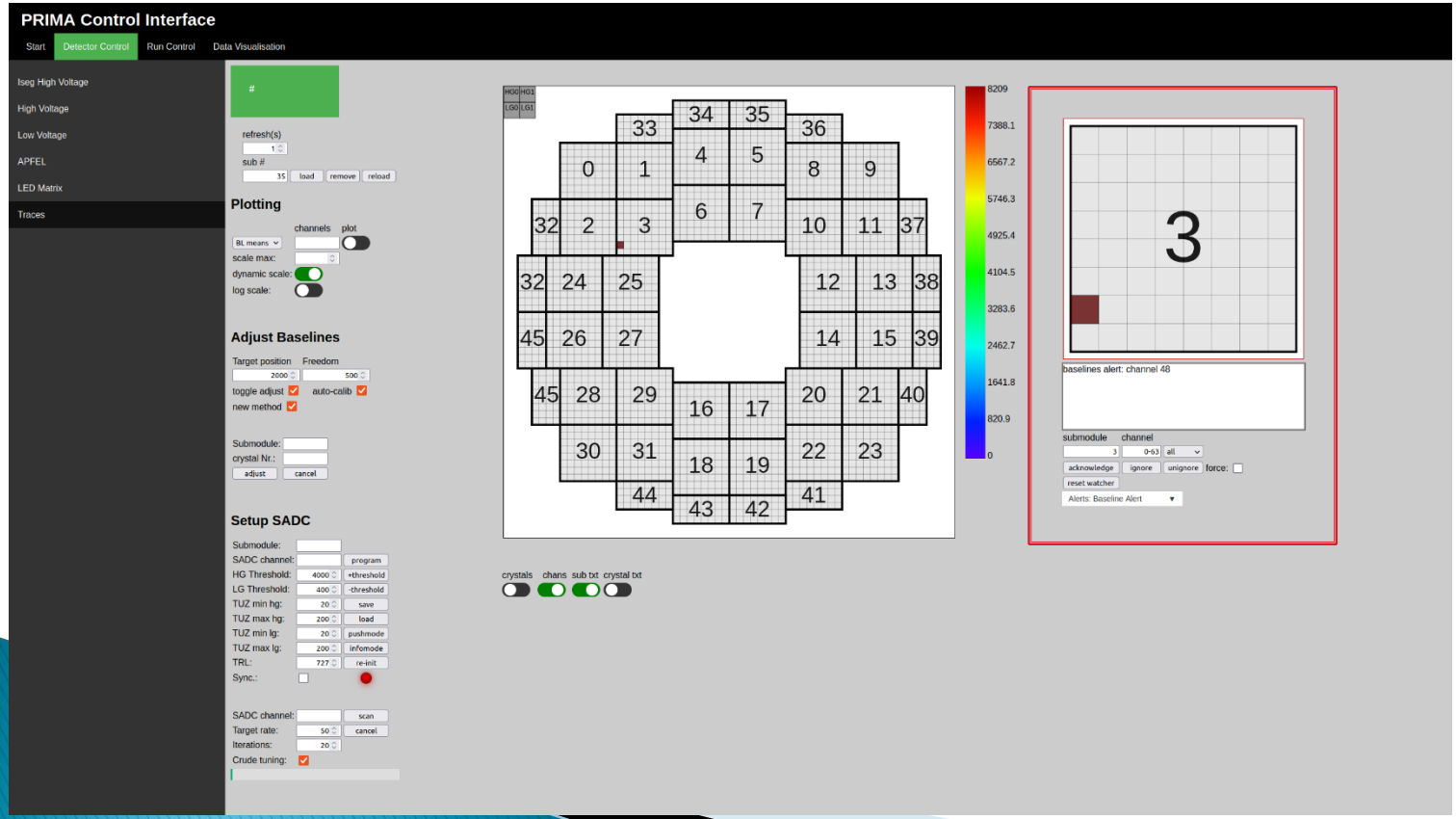
  - If not, acoustic and visual alerts



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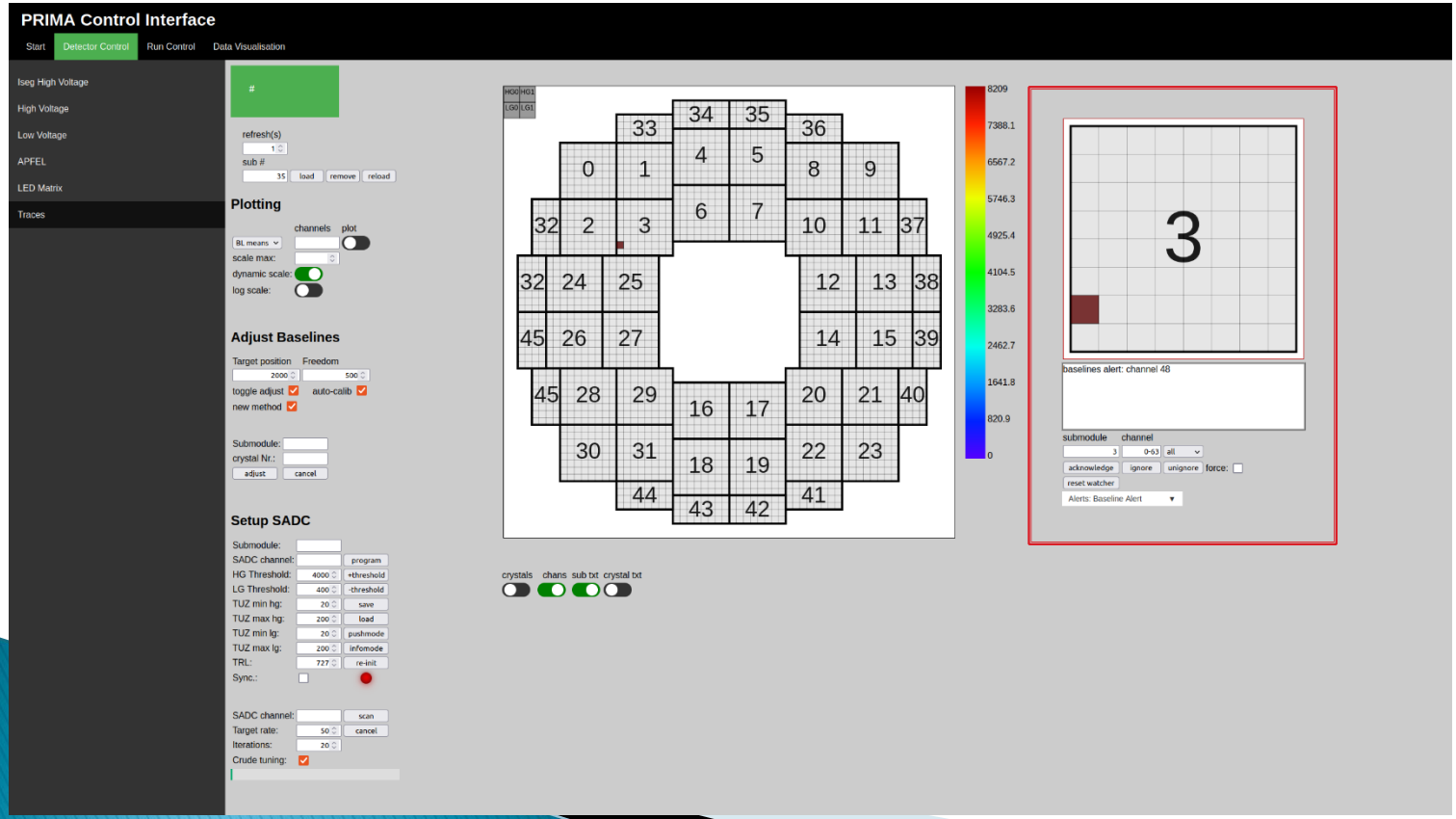
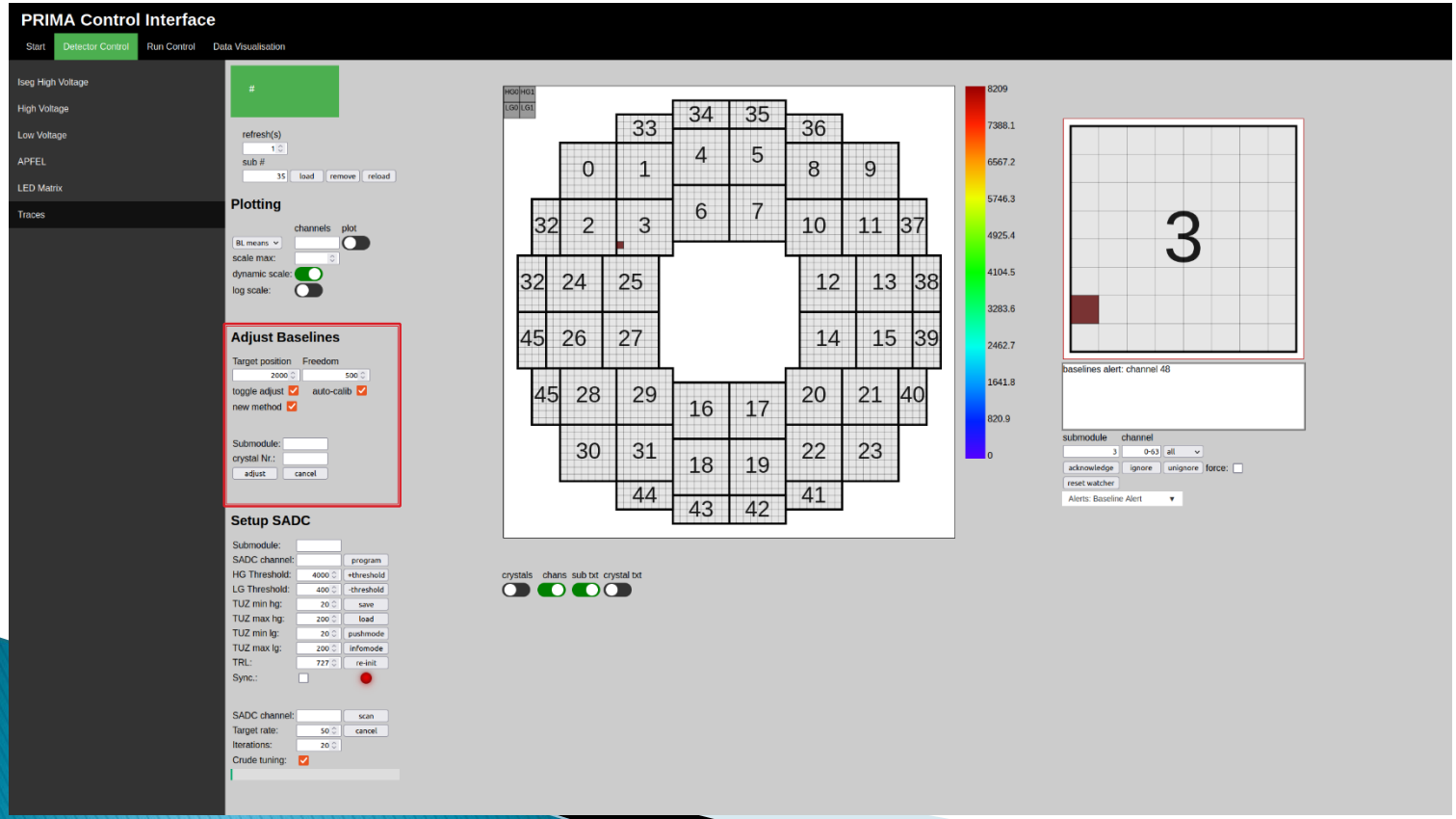
- Alert system:
  - Watcher which checks whether parameters are within limits
  - If not, acoustic and visual alerts
  - Controls which allow to acknowledge/ignore alerts in certain channels



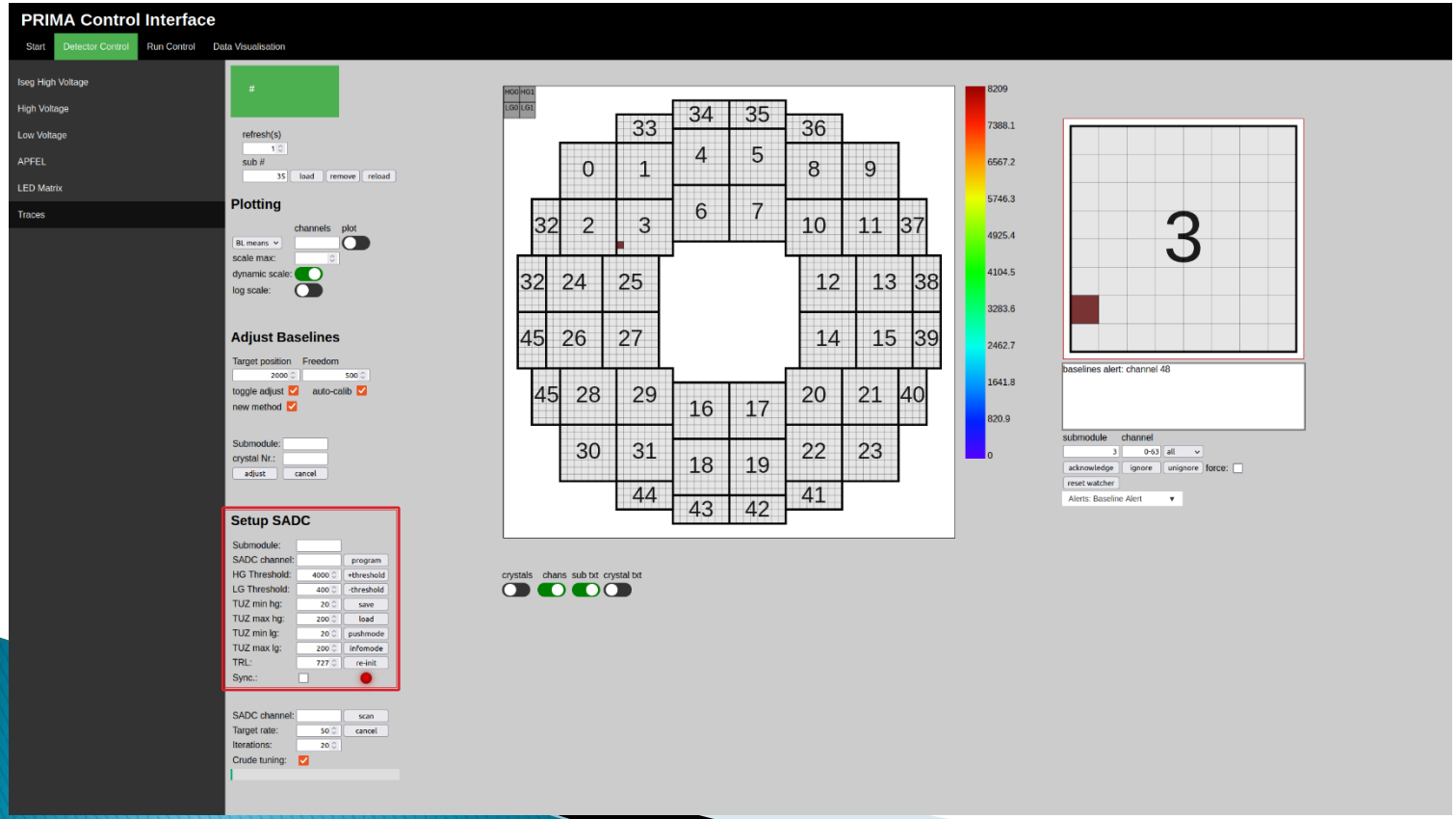
Slow control

- Example: traces app, tested with 1 Full subunit (external setup) and 3 half subunits (climate chamber)
- Control of multiple subunits:
  - Controlling baseline position



Slow control

- Example: traces app, tested with 1 Full subunit (external setup) and 3 half subunits (climate chamber)
- Control of multiple subunits:
  - Controlling baseline position
  - Programming SADCs



Slow control

- Example: traces app, tested with 1 Full subunit (external setup) and 3 half subunits (climate chamber)
- Control of multiple subunits:
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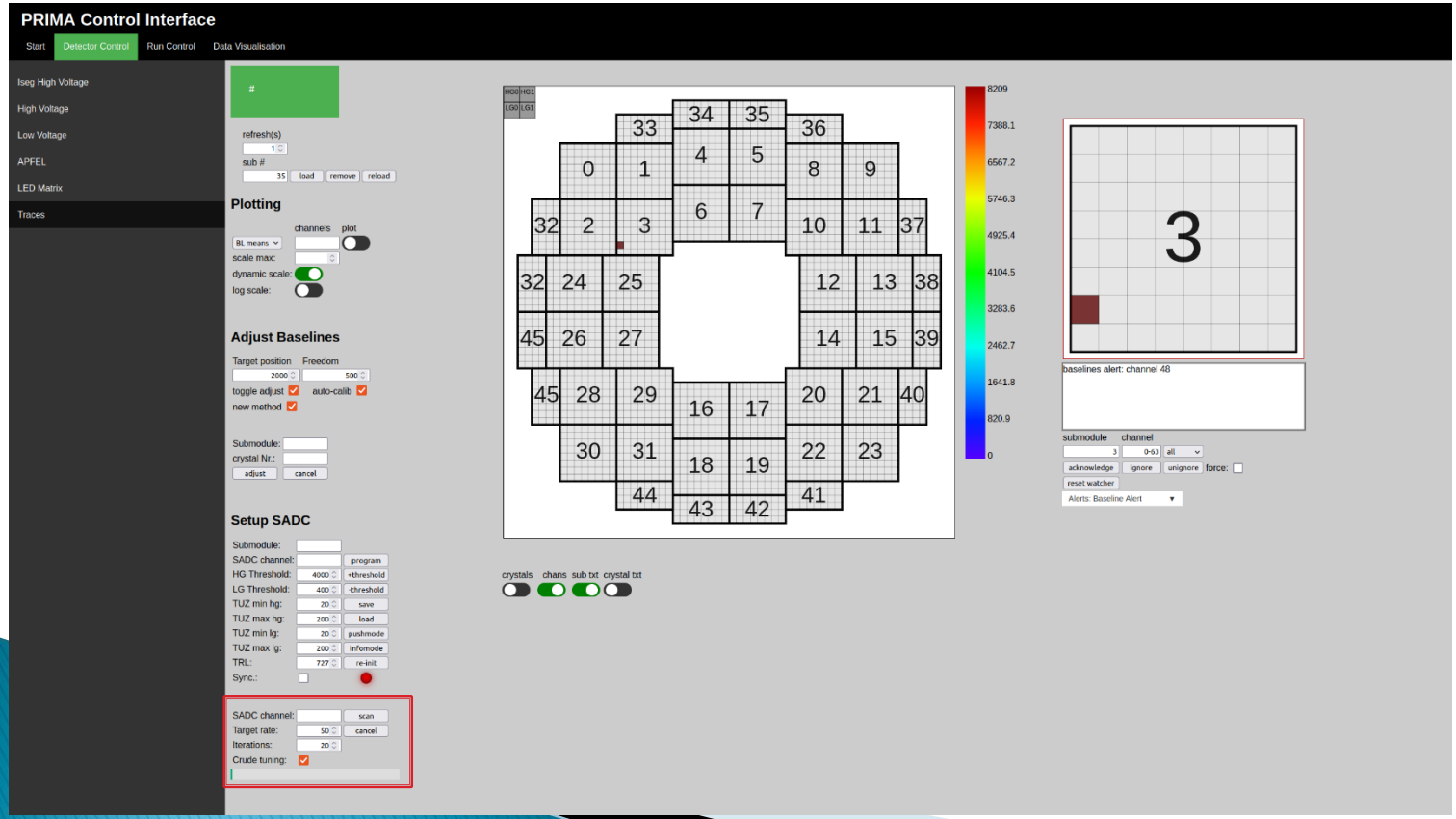
  - Programming SADCs
  - Automatic threshold adjustment to reach defined noise rate

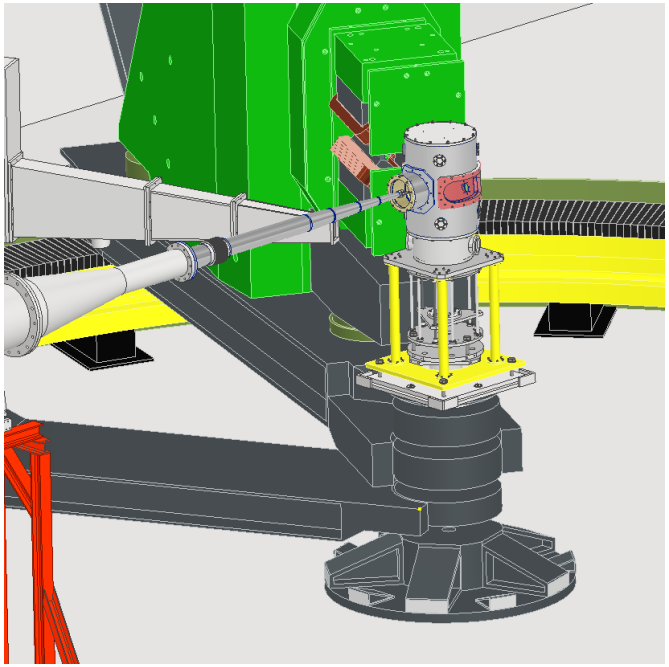


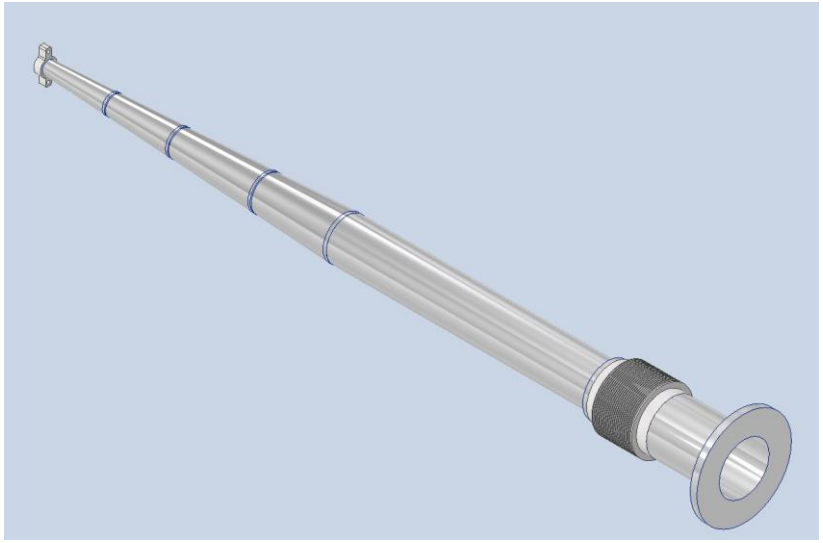
SADC firmware and DAQ status

- Dedicated talk by Olliver Noll (7.2. 9:40)

Mechanical status

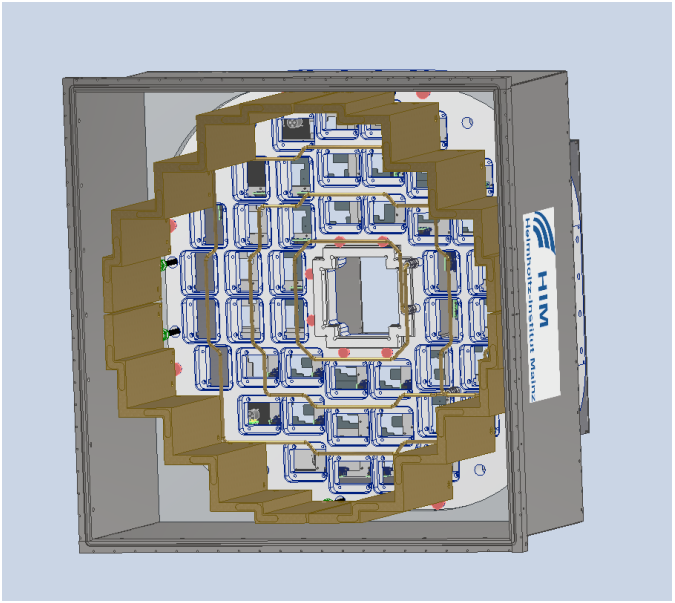
- Exit beampipe for Phase-0 experiment in production in workshop





Mechanical status

- Exit beampipe for Phase-0 experiment in production in workshop
- Cooling system for Phase-0 setup:
  - Test setup with manifolds and chiller built in our hall



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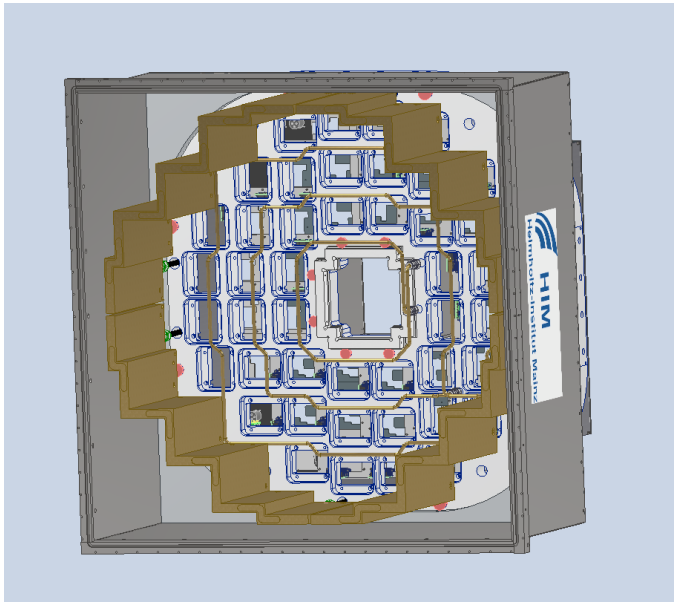

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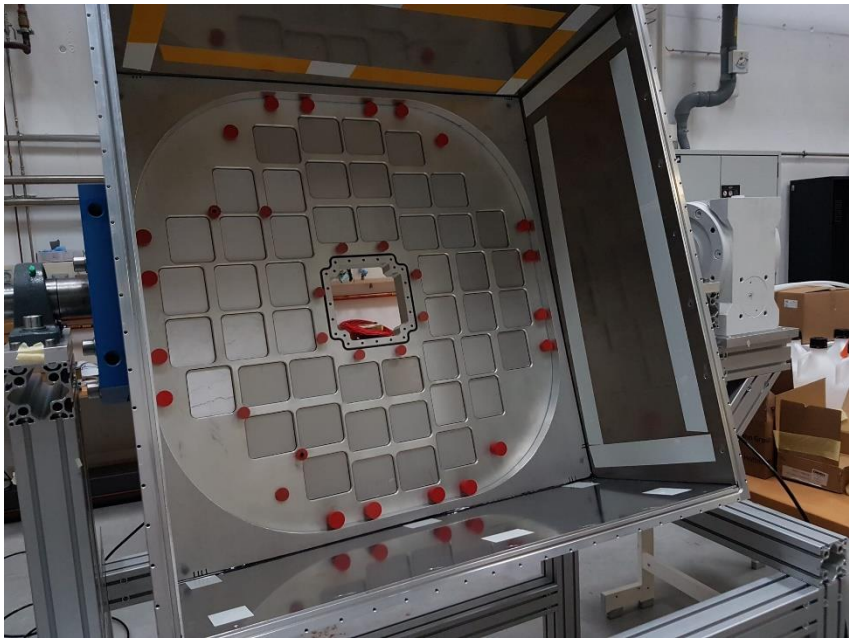
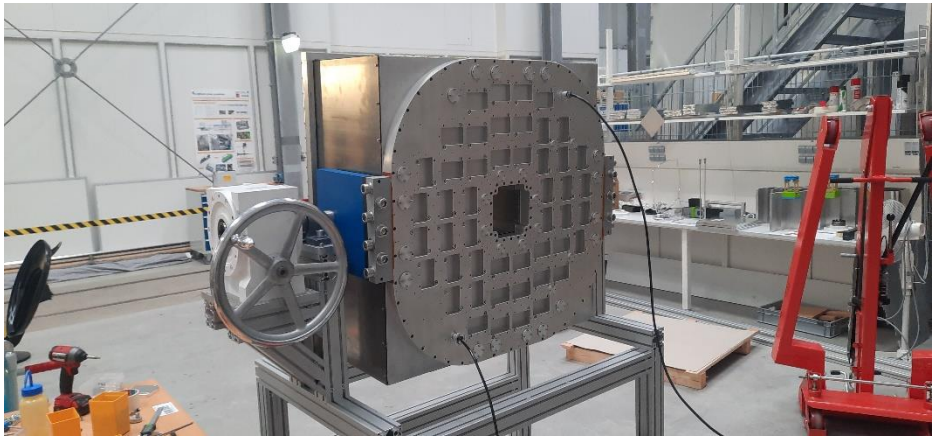
- Tests of airtightness of detector ongoing:
  - Baseplate openings sealed
  - Coverbox glued
  - Detector flooded with nitrogen with defined flowrate
  - Check flow at outflow





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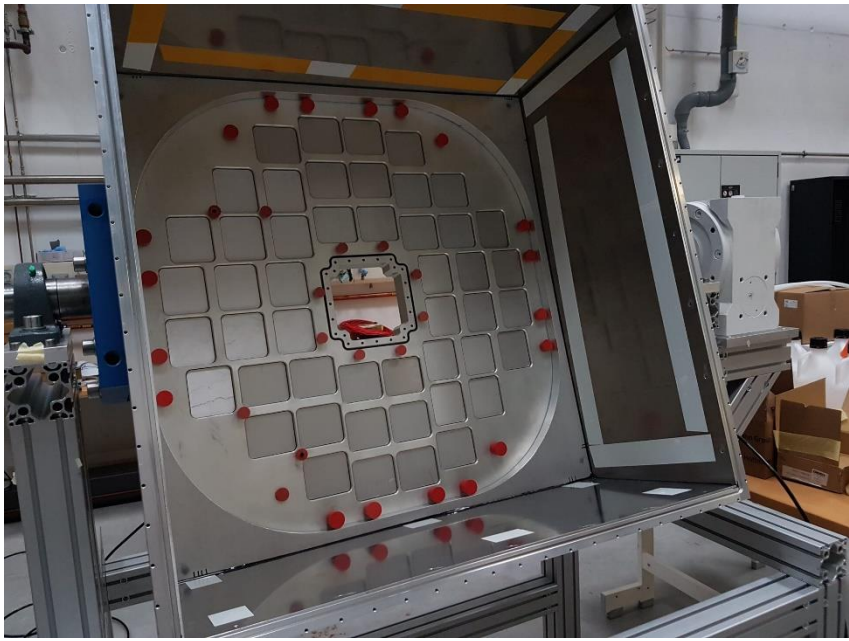
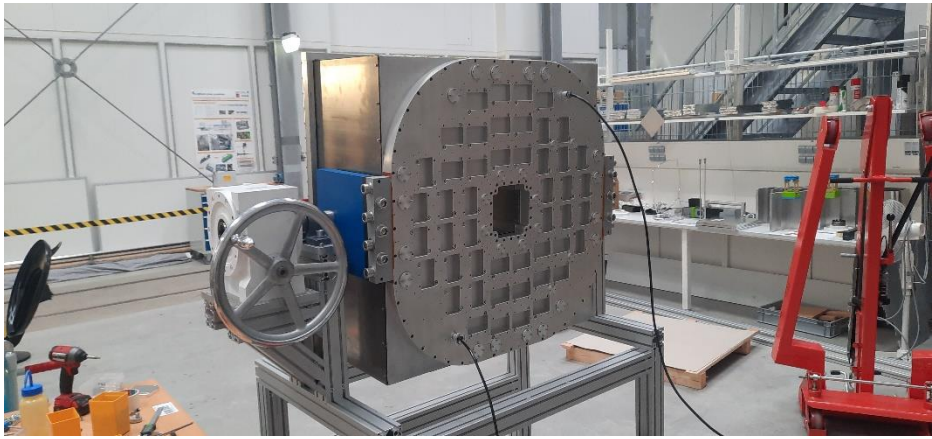
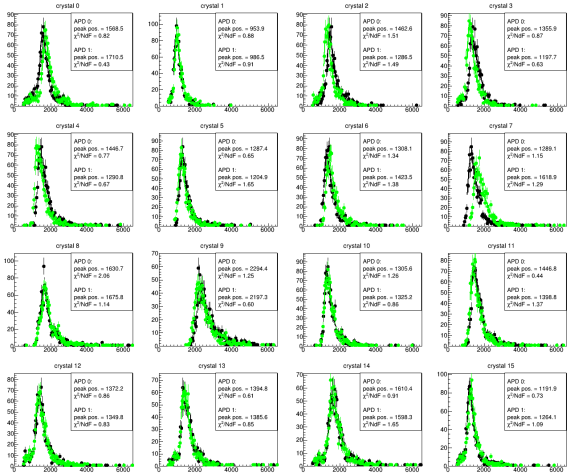
  - Check flow at outflow
- Replacement of nitrogen system with dryed air, procurement in process

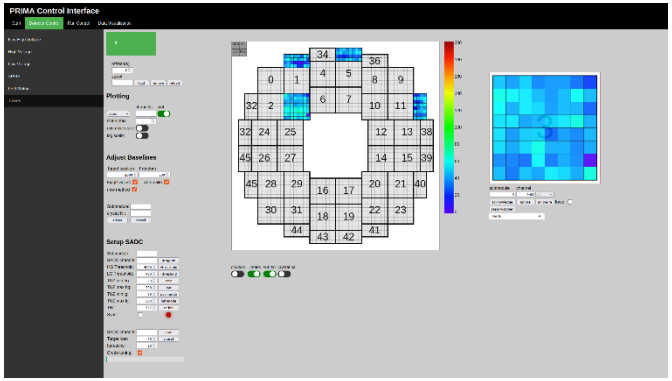


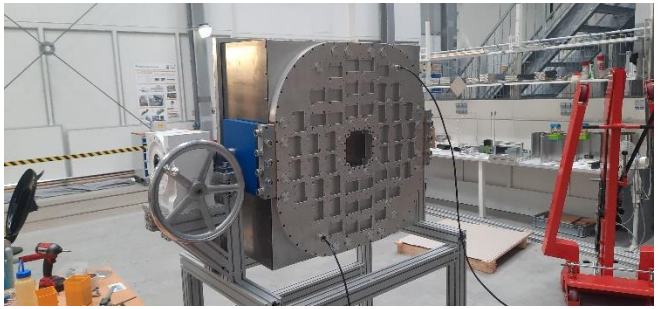


Summary

- Submodule production:
  - Finished ✓
- Calibration of submodules:
  - Measurements finished ✓
  - Analysis in progress
- HV boards:
  - All boards produced, HV calibration done
  - Boards currently in repair due to minor issue
- Slow control:
  - Epics and web interface integration of chiller control finished
  - Detector overview implemented in web interface, including 2D plots, alert system and multi submodule detector controls
- Mechanical status:
  - Exit beampipe in production
  - Cooling and airtightness tests of the Phase-0 setup in progress







Thank You!