# PXD Operation & Status

## PXD/DEPFET Meeting
## 16-18.5.2021

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Overall smooth running and only minor problems.

No new damages to PXD.

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* no new big problems, only the old
  ones which we learned to handle
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# 2022 Challenges (mostly same slide as last time)

- Provide stable operation with increasing beam current
  - B "factory" mode
  - Collect as much as possible luminosity before LS1 (which starts July!)
- Taken over problems from 2020/21
  - Increasing currents on high voltage channel
  - Instable module behavior (noise, pedestals)
  - Damages from **beam losses**
  - Synchrotron Radiation
  - High occupancy events (injection "noise"), → data loss due to exceeding DHP fifo or DHP-DHE bandwidth limits
- OVP-Trip rate (Over-voltage protection) ← reason found!
- Human resources
  - COVID: sparse KEK local presence (→ doubled since April ;))
  - Expert knowledge drain … several experienced people left in 2021
  - Shifters

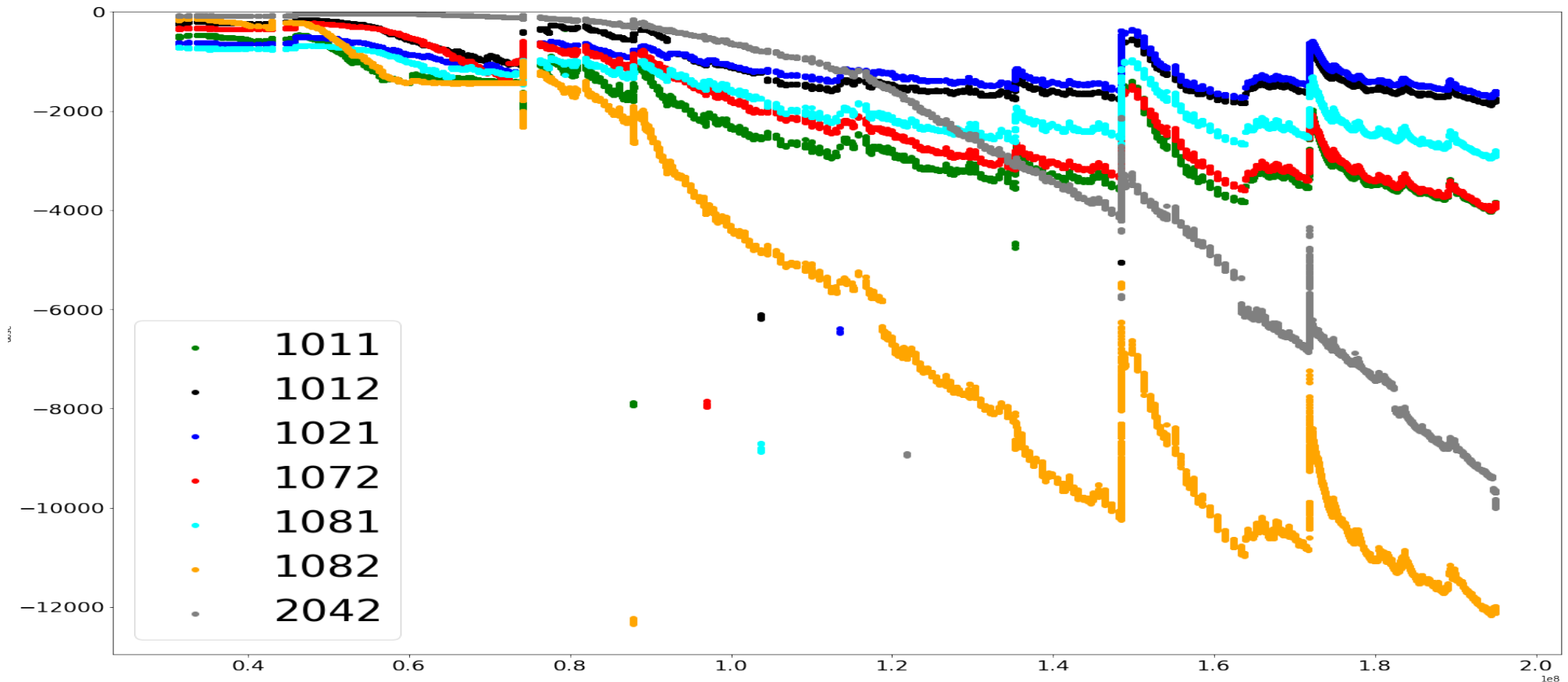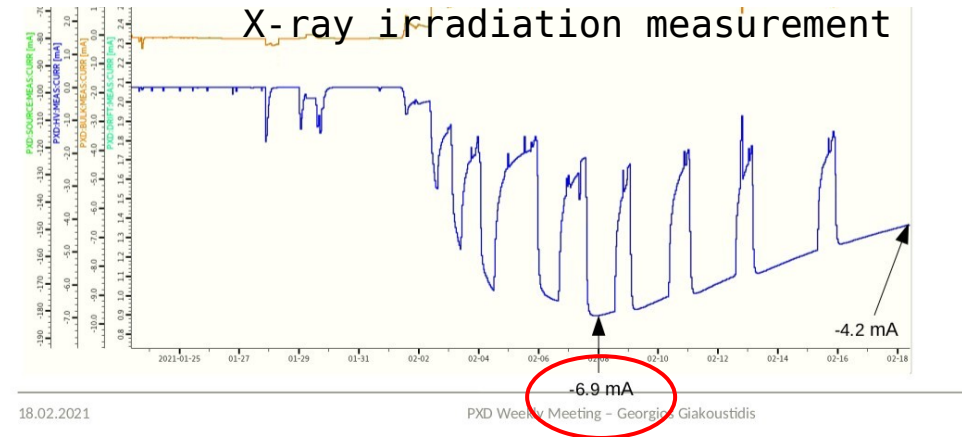Only few news here

Exp: 26; Run: 205; Number of trigger: 39743284
un started at: 2022-05-16 06:56:17.068404; Run stopped at: 2022-05-16 09:03:28.256948; Duration: 2:07:11



Noise

Sync Rad

Offset Calibr.

Most problems in one picture
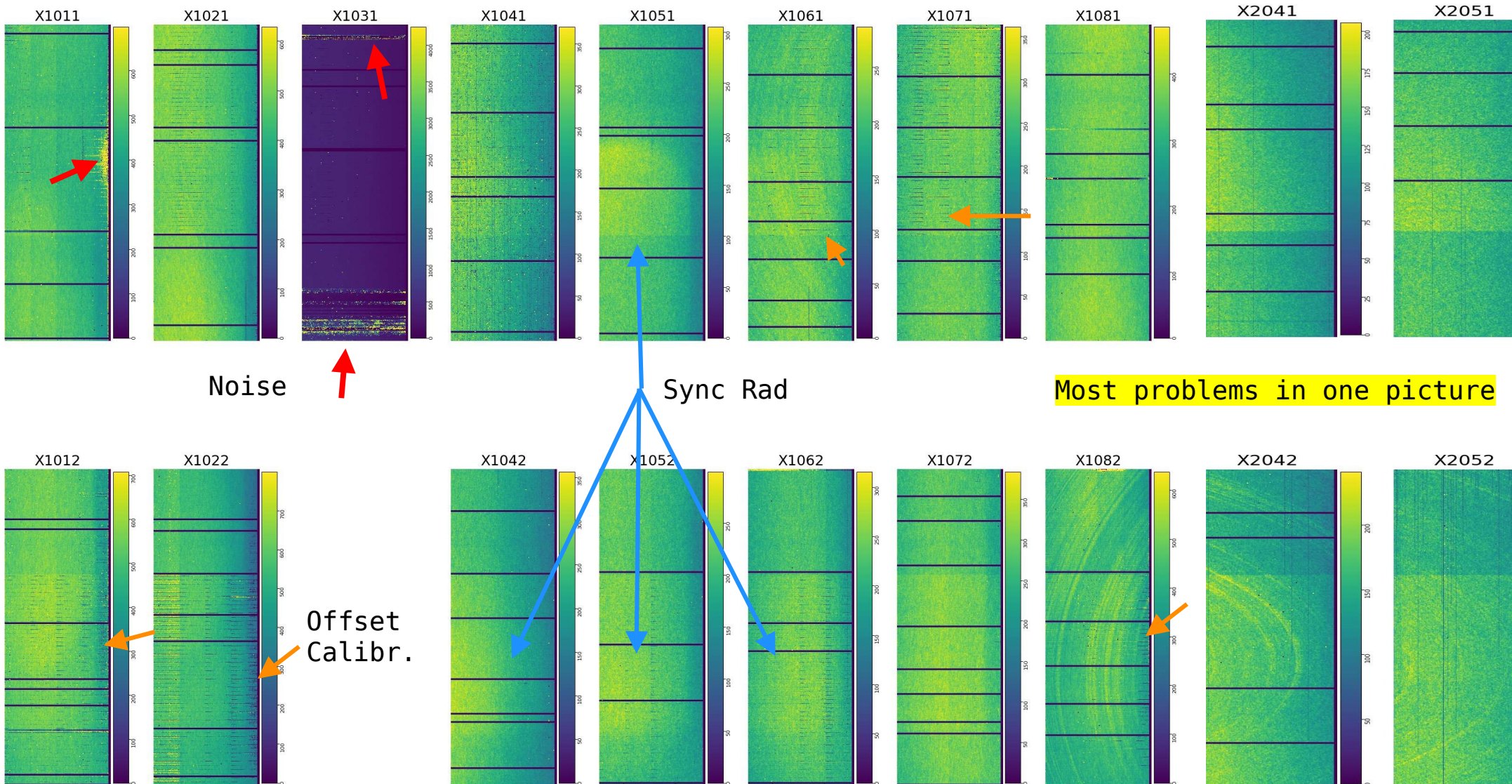
- HV currents further increasing in 2022
  - Workaround: 1.8.2 & 2.4.2 PS Unit modified for max 28mA (others 14mA)
  - Saturation effect for some modules, depending on instant radiation dose?



X-ray irradiation measurement

-4.2 mA

-6.9 mA

18.02.2021    PXD Weekly Meeting – Georgios Giakoustidis

# DAQ Status

- Running with HLT filtering, ROI calculation, but to ROI selection
- No issues!
- No DAQ operation issues with ONSEN nor DHH.
  - DHH – One shelf PS broken and two AMC cards were exchanged
  - No problem with DHP-DHH link stability, but we still have soft errors
- If daq is stopped by "too many errors" it is on purpose to make shifter aware that something is wrong (but actually did not happen recently)

# Slow Control

- Not much changed
- Updated power/ramp up/down sequence (urgently needed for negative gate-off voltage), improvements of save voltage checks
  - More (detailed) messages for CR shifter (→ "Belle II alarm system")
  - Updates on calibration (→ labframework)
    - Change in thread handling for pedestal analysis (which had a small chance of failing)

- Interface to Belle II:
  - Rare glitch on reported HV status (race condition in threads on the nsm gateway ioc) – will not be fixed before LS1
  - Trip recovery should not block injection (request/approval in spring 2021): discussion stalled at TB / DAQ group level. Will not be implemented soon. New DCS (detector control system) group may take care in LS1

# SEU in ASICs

- Issues with configuration flips by SEU in ASICs
  - Until now only detected, fixed by power cycle or manually by expert
  - DHP register changes
    - This will recover automatically now!
    - → several msg in #pxd_log, + msg to the CR shifter
    - **No** power cycle, **no** new run, **no** new pedestals required!
  - DCD register changes can only be detected indirectly
    - "link drops", noisy, occupancy → but no "register change" message
    - call on-call expert! Power cycle and new pedestals would be required
    - Testing now: rewrite register regularly
  - Problem: pedestals taken with changed configuration can lead to corrupted pedestals → need to "invalidate" them
    - Same for pedestals which were taken with a link down

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# Pedestal Update (Calibration)

- Pedestals upload or retaking pedestals main contributor to PXD related down time
  - Pedestals upload is necessary if noise in PXD modules changes → more often than anticipated
    - Noisy areas change (→ pedestals change) esp after power cycle or emergency off (by diamond beam abort)
- Changes only visible after run has been started :-(
  - Pedestal taking can only be done in PEAK
- Pedestal taking automated, <mark>minimal</mark> shifter interaction (single button + restart a run)
- Preventive measures to reduce down times
  - Take & upload new pedestals power cycle to avoid STOP/START after few minutes run time
  - Automatic upload new pedestals if too old >4h
  - Delay taking pedestals by 20s after Ramp Up (settle time)
    - → more stable pedestals, less noise
- Recent improvements
  - Fix for multi-threading analysis (epics-python issue), which did not report back as successfully finished
  - Pedestal taking returns less data frames than we originally wanted → Fix by adjusting trigger rate
  - <mark>Speedup up of upload by 12s</mark>

> Pedestal taking happens automatically at each run STOP (~3s), but uploading takes more time (~50s)

> Automatic or on demand (issued by PXD shifter)

> Delicate: Runs fully transparent and parallel to DAQ and main RunControl

Many headaches,
But works reliable

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# DQM and Monitoring Updates

- Continuous small improvements
  - CM Plot is now filtered for gates
- Warning if histograms from different runs are mixed (avoid the trouble from Dec 2021)
- DAQ flags ("errors") now computed for last 10000 events on ERECO
  - → faster reaction time, avoid run-integral shadowing issues
  - Message to CR is any fraction exceeds 1% of events (→ "call PXD shifter")
  - This should happen in case of SEU, but eventually it may also come with huge background spikes
- Removed mean charge plot for CR shifter
- Color glitches in DQM seems to be fixed, but another appeared for CM plot?
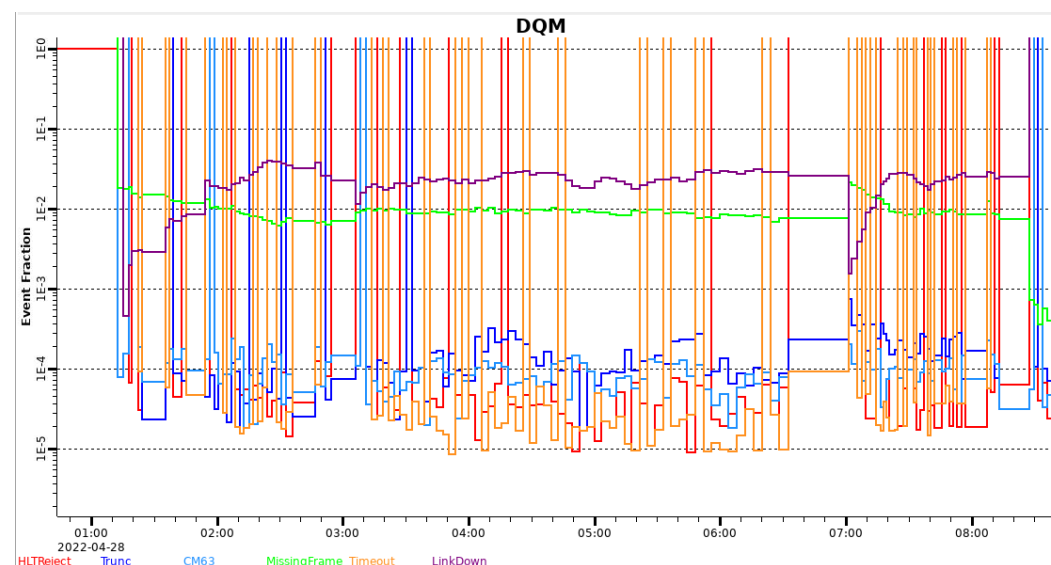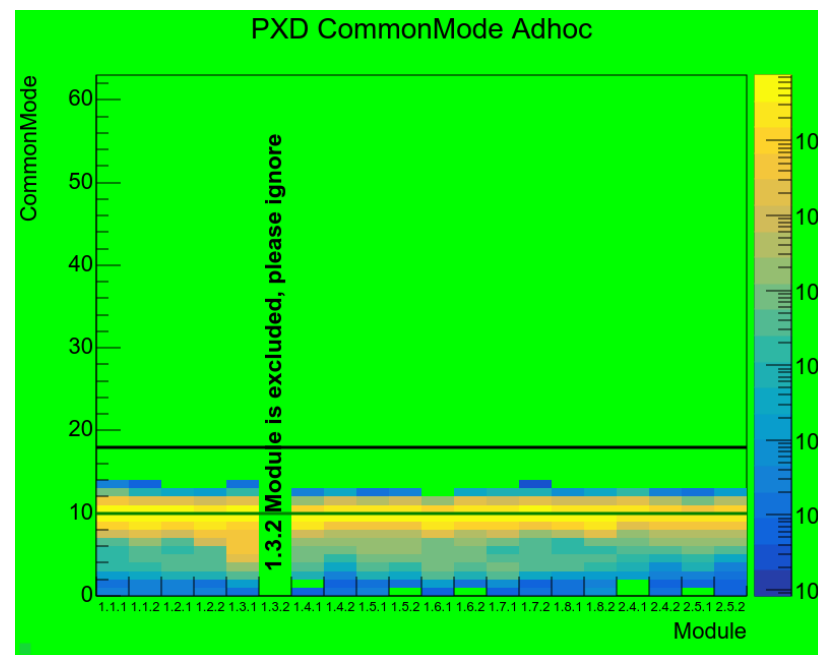
# 2.4.2 Slowly Decreasing Efficiency



**Plot from MiraBelle**
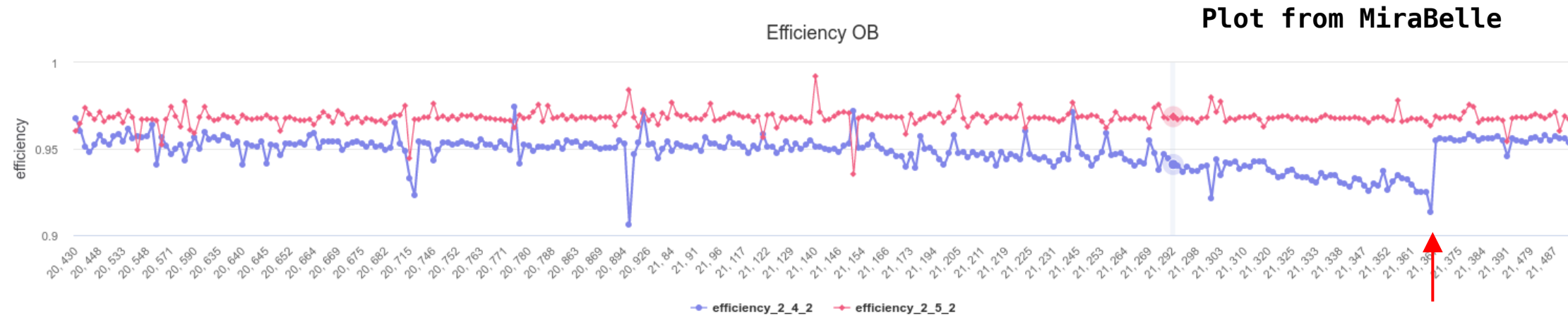
- Noticed by increased rate of "efficiency warnings" and limit adjustments
  - Could have been detected earlier from MiraBelle plot?
  - Real HV on module lower due to increasing currents? Not measured at load!
- → increased HV (-62V→ -65V→ now -69V)
  - Happened again in 2022 (was detected earlier, thus no warning) and HV was increased twice
  - Side effect → even faster HV current increase
- → checking the trend plots is now a mandatory task for shifters

# PXD HV "Trips"

- PXD Trips are issued by OVP board, but (mostly) not module related
  - Rate increased in spring 2021 to ~0.5/day, still on this level
  - No problem from operation as downtime is small due to auto-recovery (from PEAK and STANDBY)
- Irradiation of PS Unit at MAMI (without module)
  - OVPs happen in PEAK, STANDBY, OFF (!!!)
  - → some component on OVP board sensitive to radiation
    - Most likely neutrons
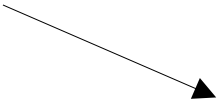- Issue mostly understood!



OVP/Trip by Module in 2021abc
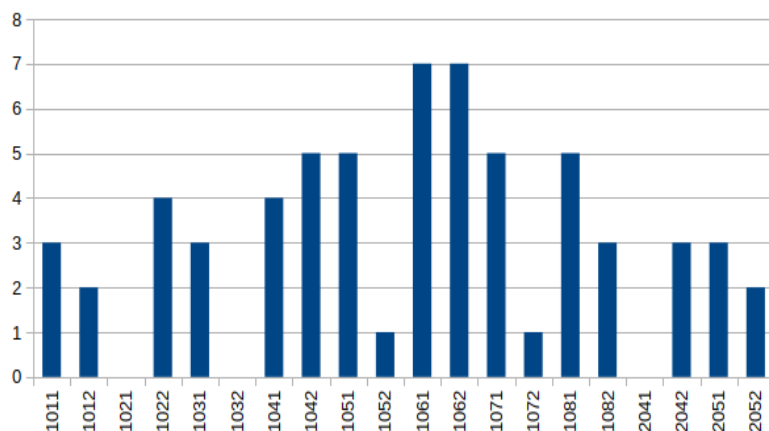


OVP/Trip by Channel in 2021abc
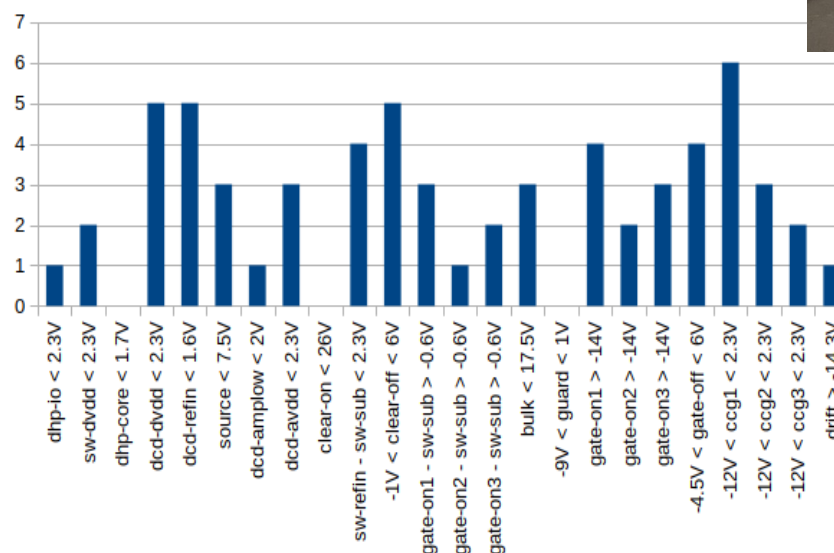
# PXD Shifting (mostly same as 2021ab)

- Since 2020 we made the on-call expert an official task
  - Normal shifter (8h, 4h+4h, 8h, in presence)
  - On-call expert (24h)for emergency cases → works nicely!
  - Shifts are rather uneventful, issuing new pedestals now and due to high occupancy
- COVID effects
  - Coverage problem for DAY shifts as all but one PXD member located in European time zone → unpleasant local times for shifters
- PXD shifter contacted by Control Room mainly for
  - excess of noise in PXD DQM plots
    - Color glitch DQM plot
  - efficiency warning (at run start)
  - run start problems due to pedestals upload issues
- Few calls to on-call expert
  - Issues around DHP SEUs

<mark>Pedestal Taking!
The main reason we cannot switch to a relaxed on-call scheme for pxd shifts</mark>

# Planned Changes in Shifting

- Goal for us:
  - PXD shifter → on call only + DQM / quality flagging at end of shift
  - Any relevant error on PXD side must be visible for CR shifter
    - it is in Kibana, but that is not helpful for CR shifter
    - → messages to rocket chat ("call pxd shifter")
  - Have given CR shifter more influence on PXD, clearer instruction, flowchart, etc; e.g. power cycle without first asking PXD shifter
  - Problem: How to properly detect and handle new issues e.g. DHP/DCD SEU
- We are close, but some issues are still not fully solved, e.g. some alarm messages for CR shifter
- New shifters have (and need) less deep-knowledge on PXD → this could be an issue for 2023

# Summary

- PXD working very well in 2022 and delivering good data
- Instantaneous radiation background has large effect on HV current
  - PS Unit modified/HV currents o.k., need to watch 1.8.2 and 2.4.2
- Module 1.3.1 with high occupancy, more noisy areas
- Pedestal spread, Offset correction
- Most of operational issues from previous years have been solved or recovery is automated
  - DHP/DCD SEU issue … WIP
- Hardening calibration online software continued, adapting pedestal update strategy to minimize down time
- DQM and monitoring updated steadily
- Shifts: Simpler than ever, close to "on call only". Coverage not optimal. Few expert on-call.
- No eminent issue until LS1

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(slides from 08.05.2018)

- Discussion:

  - Whom to train? For now: shifter training is time consuming → train only people where its foreseen that they can/will do lot of shifts.

  - System will advance to more automatisation ("on click actions"). Less shifter knowledge required? Is this good or bad?

  - Shifter will not learn much in a "normal" shift if nothing goes wrong.

# Future Plan

- Can we relax shifting to nearly on-call only?
- Showstopper:
  - Alarms/Errors/Warnings which currently are seen only by PXD shifter need to be issued to the CR shifter (and filtered)
  - Some (more) automation for silently issuing pedestal upload
- Wish: Want to have a reliable way to directly inform on-call shifter automatically in parallel, even if he is not watching CSS (Messenger? Phone?)
- Side remark: Still missing a nice way to contact shifter without exposing (often private) phone numbers on confluence and on rocket.chat.
- The first point should be solvable until March (no promise)
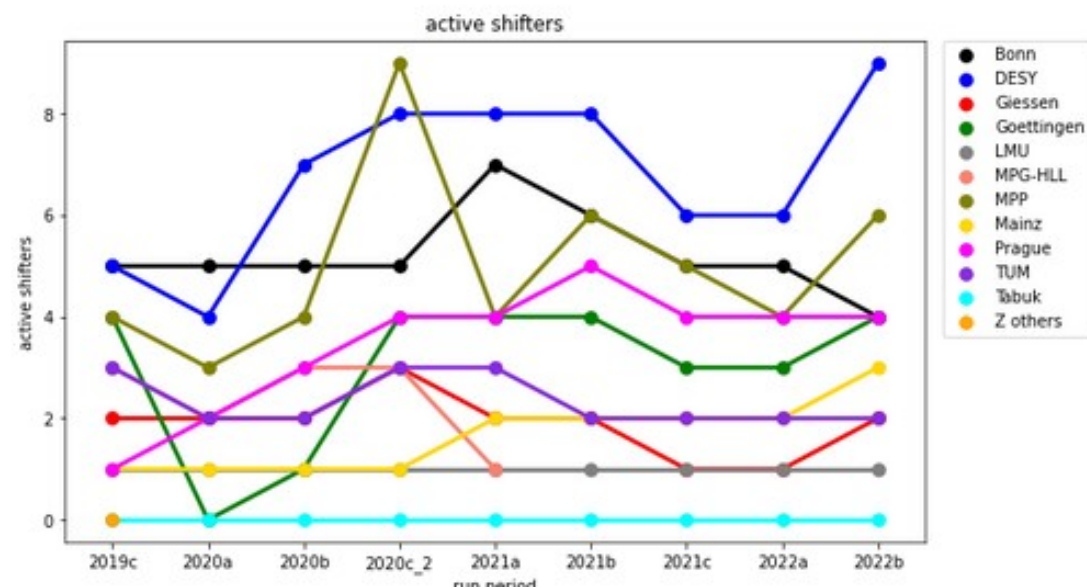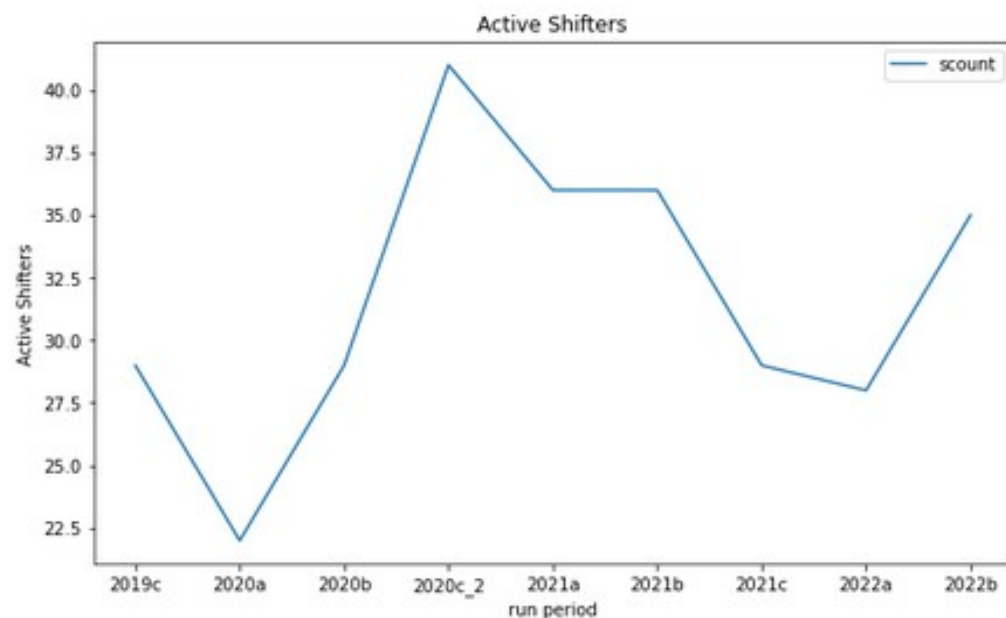
- Increase in shifters between 2022a and 2022b!
- Preliminary trend for 2022, not all shifts are filled yet, still many open day shifts in June

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