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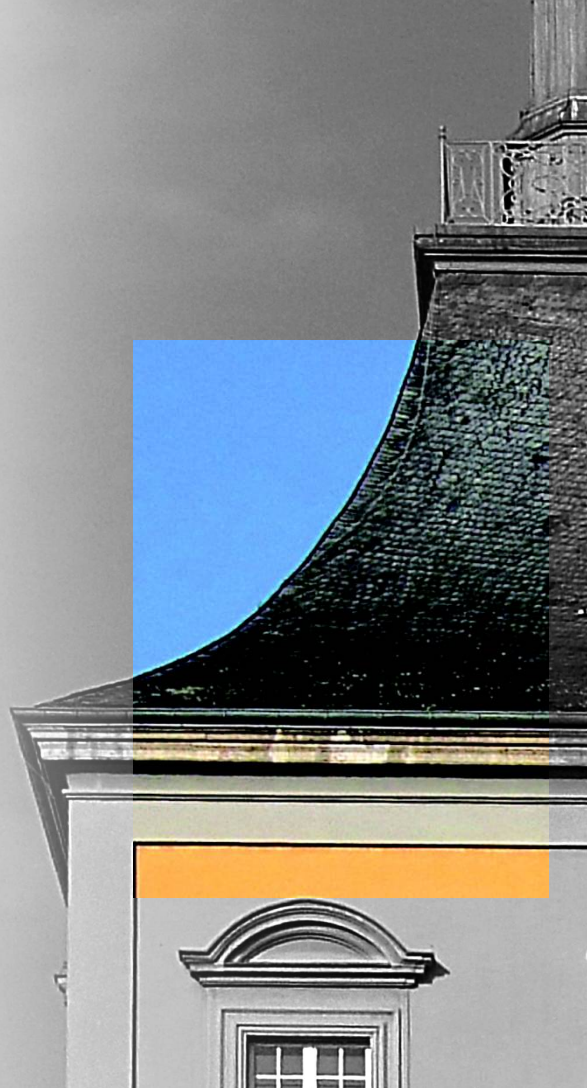
Botho Paschen for the DEPFET collaboration

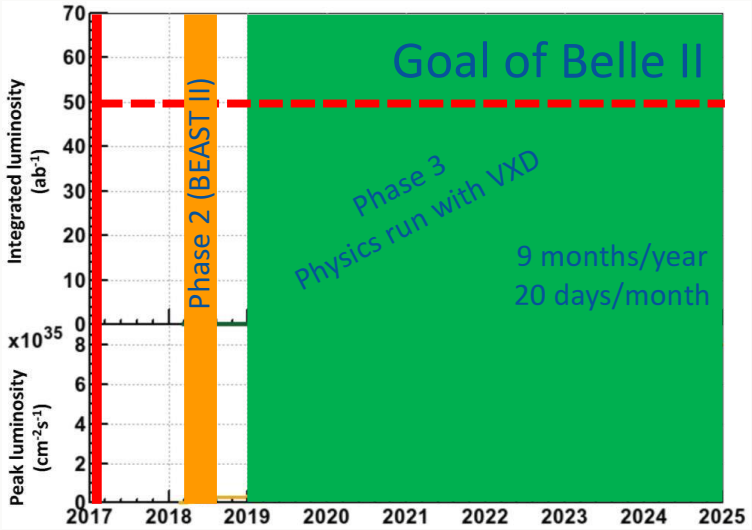
# PHASE 2 PXD

# A MODULE CENTERED INTRODUCTION

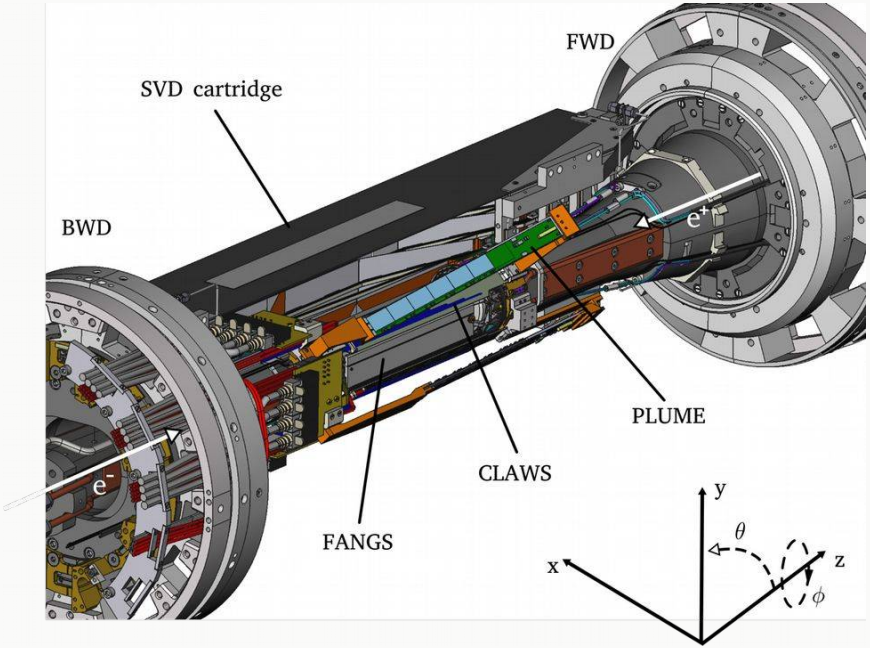


# PHASE 2 AND BEAST

- Phase 1: Accelerator commissioning
- Phase 2: BEAST and partial Belle II commissioning
- Phase 3: Full Belle II detector




- The BEAST II detector (in place of VXD)



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# PHASE 2 PXD

- Modules sent to KEK in September 2017
- Attached to the beam pipe and integrated with the rest of the BEAST detectors Sep – Nov. 17
- Insertion into Belle II mid November 17

2 layers of DEPFET pixels
4 modules
r = 1.4 cm, 2.2 cm

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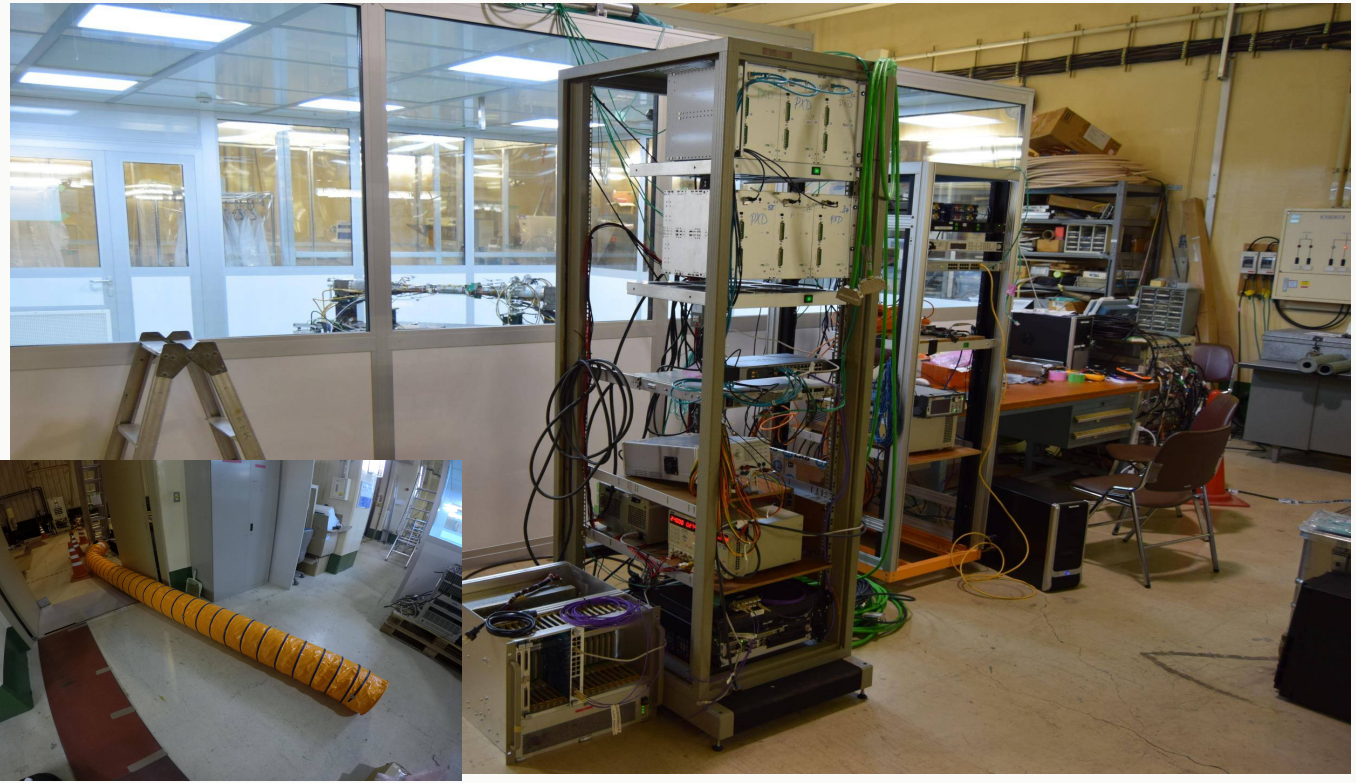
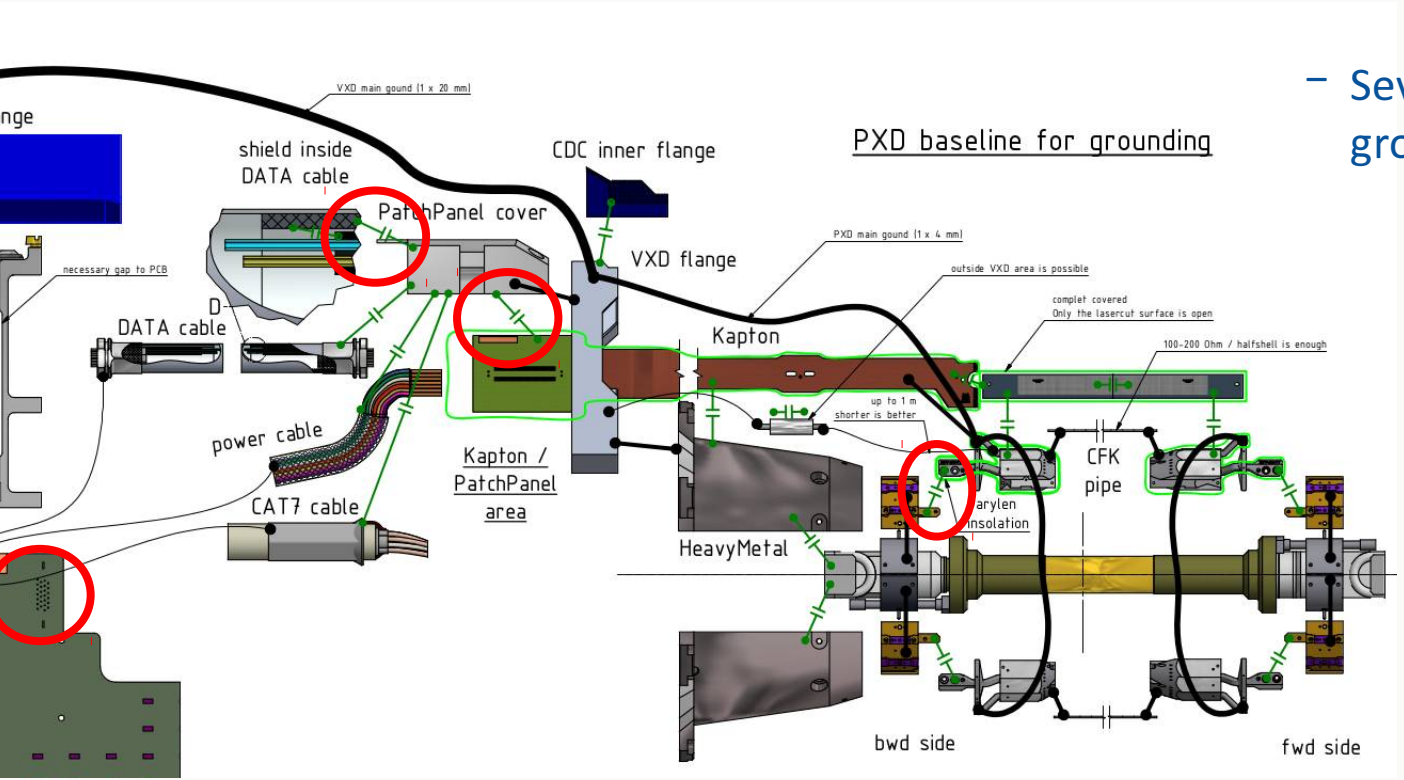
# COMMISSIONING PROBLEMS

- Tools
- Ressources
- Space
- Mechanics
- Cooling
- Grounding
- Power infrastructure
- Networks



# GROUNDING ISSUES




- Several accidental/ill-defined ground connections
  - SCB to beam pipe
  - Patch panel to patch panel cover
  - Patch panel to cable shield
  - Shields and sense GNDs on dock box and DHI PCBs

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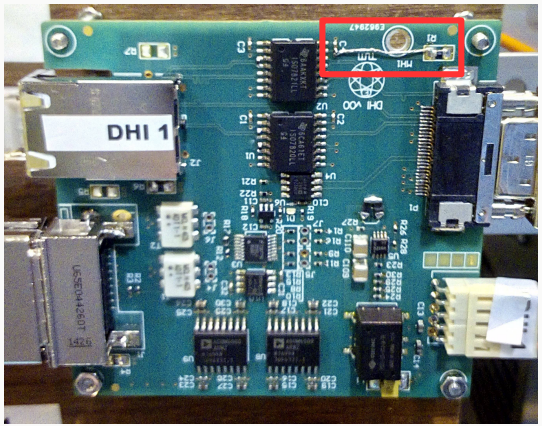
# GROUNDING ISSUES / HIGHSPEED DATA LINK




- Shield (Belle) GND to digital sense GND short introduced on phase 2 DHI for link stability
  -> botched digital voltage sensing on modules, compensated by hand
- Capacitive coupling was tried but did not yield stable links
- Workaround produced quite stable solution (in PEAK state)
- During nominal operation of entire Belle 2 detector only O(1) usually single link failures during phase 2
- More frequent correlated link losses during undefined detector operation (ground upsets?) or in STANDBY (matrix voltages off)

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# SLOW CONTROL AND DAQ PROGRESS

- New firmware for LMU PS without XME
  -> simultaneous powerup without manual intervention!
    - Rare disconnection problem observed (O(1) PXD crashes during phase 2)
- Startup sequencer IOC grew more sophisticated and robust with lots of new features (Harrison)
    - Unexplained configuration errors (timing? TRG PVs?)
- Total GUI overhaul with templates and scaled to final PXD (Simon)

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# PHASE 2 SCHEDULE

- Global Cosmic Run (GCR) started on 14.02.
- First beams started mid of March -> PXD off for several weeks
- First collisions 26.4.
- Regular daily schedule:
  - PXD off 9:00 to ~25:00 on weekdays for beam/collision studies
  - 01:00 to 9:00 luminosity run
  - On weekends often whole weekend luminosity run
  - Accelerator priority, often no luminosity run or heavily delayed

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# PHASE 2 PXD RUNTIME

- Current shifter manual (9th July 18): manual.pdf
  (written by DAQ/module experts and shifters)
- Initial phase 2 runs required full time supervision by PXD experts
- Tried to establish shifter system with experts on call (24h) and presence shifter in CR (8h)
  -> severe manpower issues
- SC automation and HVC integration made shifter intervention rare in the end (< 1 per shift)
- 140 shift reports since 20.05: elog shift reports

| | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday | Monday |
|---|---|---|---|---|---|---|---|
| **Shift time** | **June 5** | **June 6** | **June 7** | **June 8** | **June 9** | **June 10** | **June 11** |
| Module expert (on call) | @Harrison Schreeck | @Harrison Schreeck | @Harrison Schreeck | @Harrison Schreeck | @Harrison Schreeck | @Harrison Schreeck | @Harrison Schreeck |
| DAQ expert (on call) | @Simon Reiter | @Simon Reiter | @Simon Reiter | @Simon Reiter | @Simon Reiter | @Simon Reiter | @Simon Reiter |
| JST 01:00 - 09:00 | @Simon Reiter - shift report **LUMI RUN** | @Simon - shift report **LUMI RUN** | @Simon Reiter - shift report **LUMI RUN** | @Simon Reiter - shift report **LUMI RUN** | @Bjoern Spruck - shift report **LUMI RUN** | @Bjoern Spruck - shift report **LUMI RUN** | @Bjoern Spruck - shift report **LUMI RUN** |
| JST 09:00 - 17:00 | | @Florian Luetticke - shift report | @Bjoern Spruck - shift report | @Florian Luetticke - shift report | @Botho Paschen - shift report **BG STUDY** | @Harrison Schreeck - shift report | @Botho Paschen - shift report |
| JST 17:00 - 25:00 | | @Botho Paschen - shift report | @Harrison Schreeck | @Harrison Schreeck - shift report | @Simon Reiter **LUMI RUN** | @Simon Reiter - shift report **LUMI RUN** | @Harrison Schreeck shift report |

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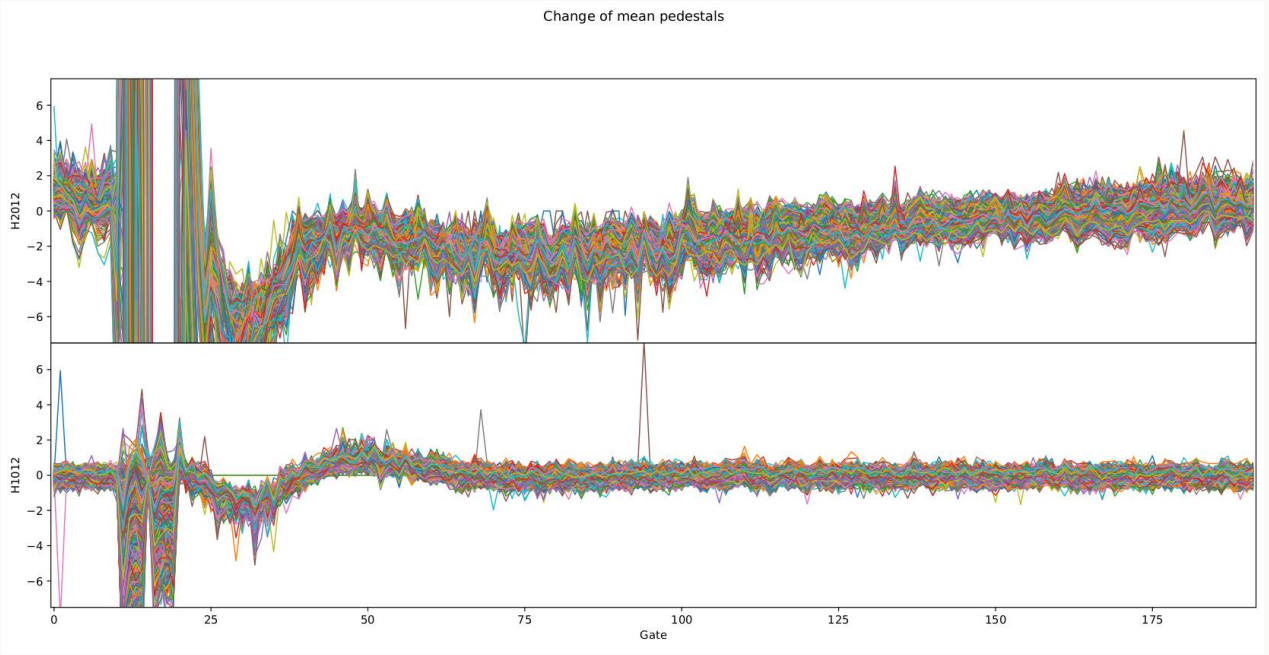
# PHASE 2 PXD MODULE TEST

- Limited time for module tests and optimization
  PXD off during most accelerator studies and taking data during luminosity runs
  - HS link settings never changed (no indication), one link completely lost for unknown reason
  - DCD data delay settings stable (several measurements, no digital errors occuring)
  - Pedestal compression with 2 bit DAC and ACMC
  - Noise study: threshold 7 -> 0 pix/event, threshold 5 -> ~ 20 pix/event

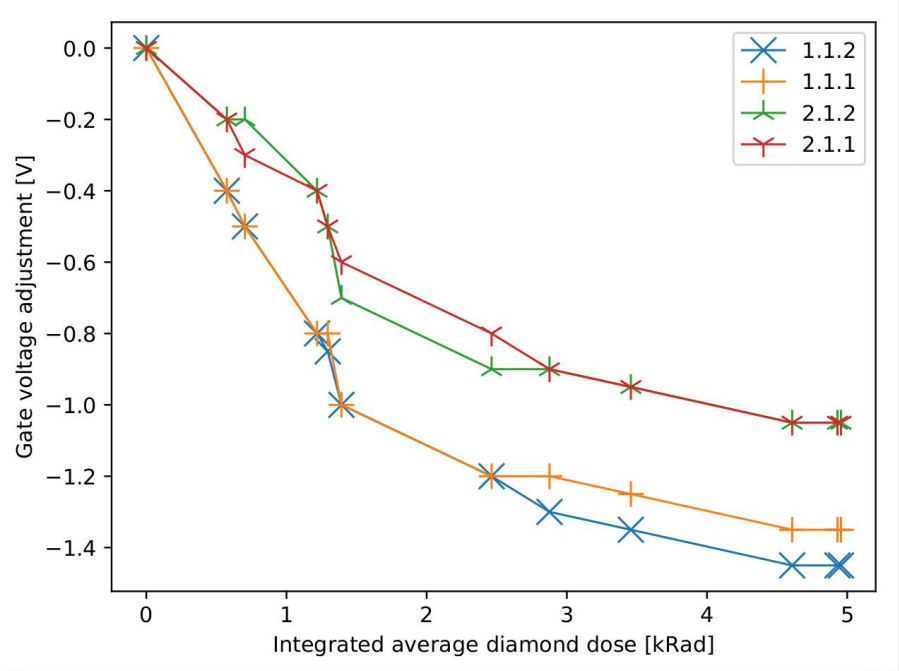
# PHASE 2 PXD GATED MODE TEST

- „continuous GM“ test only (no GM FW)
- Unexpected crosstalk between modules on each side observed
- Currents okay, data for different sequence length and clear seetings taken still to be analyzed...



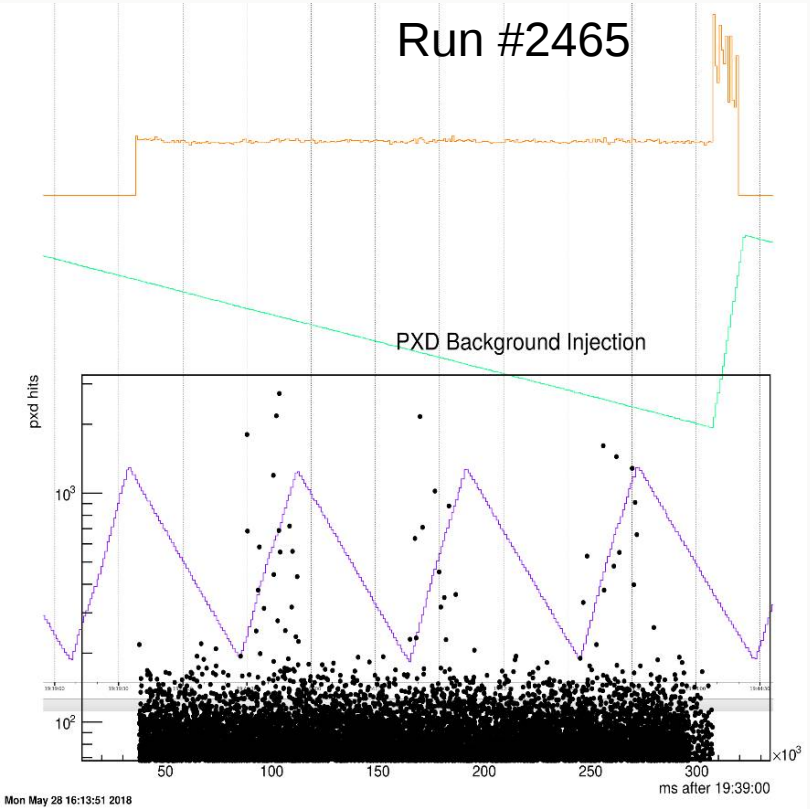
# PHASE 2 PXD GATE-ON SHIFT

- Dose still unclear, radiation foil results expected this week



# PHASE 2 PXD INJECTION OPERATION

- PXD took part in a couple of dedicated injection studies (and some involuntary events)
- High occupancies observed but no damage noticable
- Option to leave part of PXD on during injections for future studies?



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# DHP BUGS

- 2 DHP bugs discovered during phase 2
  - Last gate bug: certain combinations can cause delayed readout
    - Workarounds:
      - Mask last gate (or part of it) (phase 2 solution)
      - Make at least 1 pixel in last gate fire all the time
  - Pedestal offset bug: hits get lost if ADU + pedestal offset >= 255
    - Workaround:
      - Manual pedestal offset (DHP ped. offs. OFF), tested end of phase 2

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# Thank you