

Summary of PXD Operations 2019c

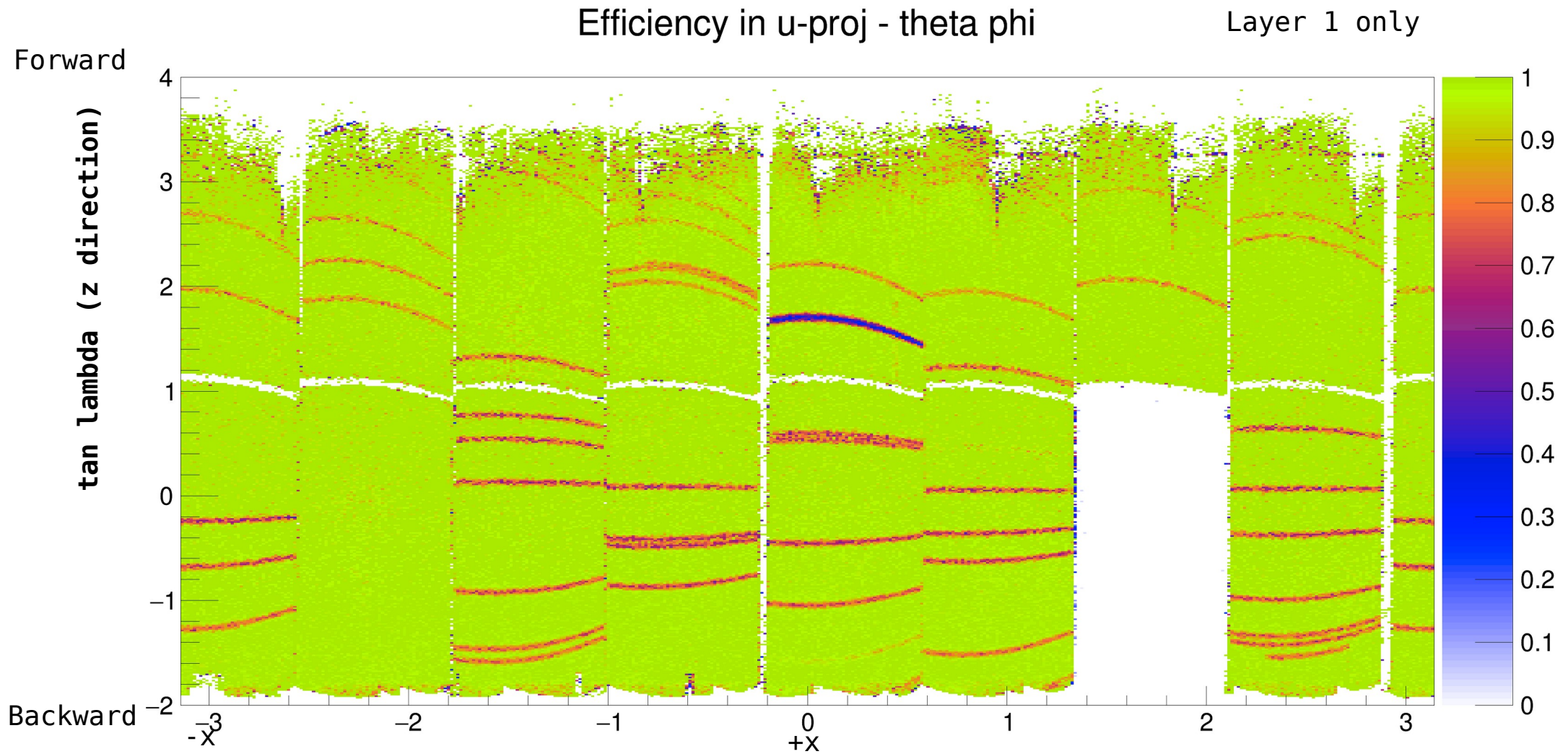
B. Spruck

(For more older details: see talks from last PXD Workshop and last B2GM)

- 20 modules installed end of 2018
 - 1 permanent off ('broken')
 - 2 recovered after beam incidents
 - Inefficient gates
- Overlapping trigger firmware deployed
 - >30kHz trigger rate with data
- Continuous injection in both rings (w/o gated mode)
- Event selection used regularly (HLT ↔ ONSSEN)
- ROI selection proved (for ½ of modules, DHE order)
- No serious problems in Run Control, HV Control Interface

- ~~Module optimization (tuning of HV, bulk, clear off), “voltage sweep”, hard during data taking~~
 - Even if we automate this, we need to find a better way in the future
- Gated Mode
- DATCON (included for few runs for testing)
- HV Control (in case of OVP etc)
 - Move to save state which does not block injection → jira tickets
 - → recovery of single modules
 - Is HV control scheme sufficient to map PXD states for physics ready and injection blocking? → discussion with SC group

(see discussion in slow control session of last B2GM:
<https://indico.belle2.org/event/971/contributions/4865/>)



- Dead Gates (+3 since summer, still not clear why, BIIPXDH-379)

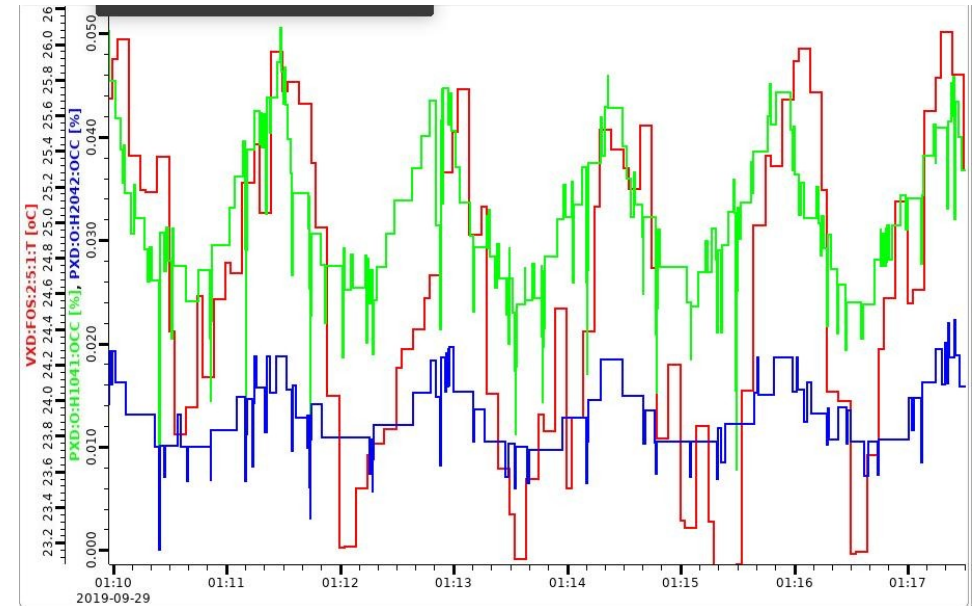
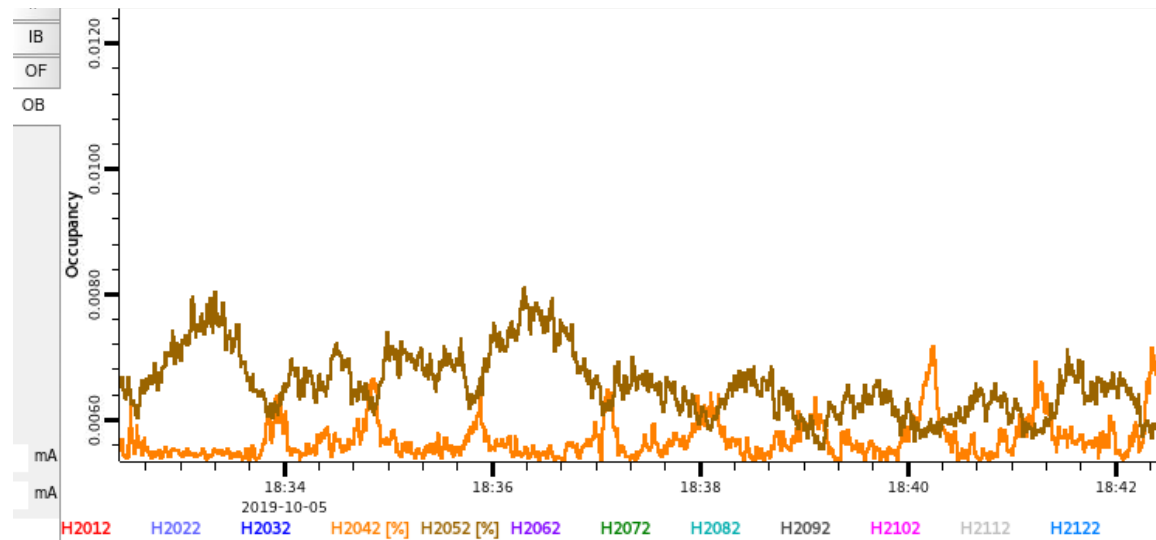
- Optical switch between detector and DHH
 - All sensor ROI processing possible after DHE re-order
 - Monitor light yield
- Load balancing on DHH (→ factor 4 data throughput to EB2, factor 4 in event buffer capability on ONSSEN)
- New firmware (DHH, ONSSEN) – keep a stable set up!
- But new issues
- Large number of link errors between DHH and ONSSEN after changes on RTM
 - Most broken events just rejected on ONSSEN side, but some special case were not covered → “NPIw error”
- ‘Flip’ state in 1.8.2, 1.5.2
- Sync problems (excessive noise)

- New PXD Interlock Box, fast shutdown signal from diamonds
- PXD had to stay OFF during all beam tuning because SKB is exceeding the limits during tuning
 - → No local work in STANDBY, no debugging
- Need new firmware (and hardware) to make this switchable remote
 - But is this save?



- Several additional counters in ONSSEN firmware and slow control
 - Occurrence of CM63 per module
 - Max occupancy per module (in addition to mean)
 - Improvements to send only “valid” numbers to BCG
- Improvements on sequences (OVP handling, voltage limits and more)
- Scripting for 1.8.2 flip and other workarounds
- Constant updates on GUI (Simon!)
- IPMI boards for DHH carrier and DATCON installed
- Calibration IOC and scripts
- Local BonnDAQ, Photon monitor

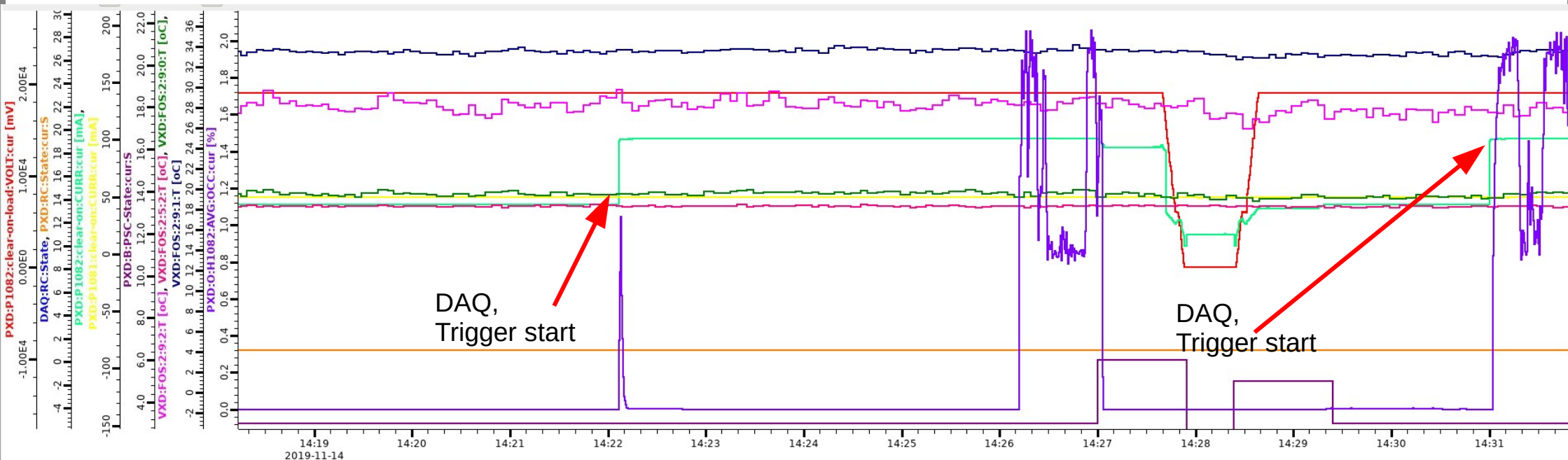
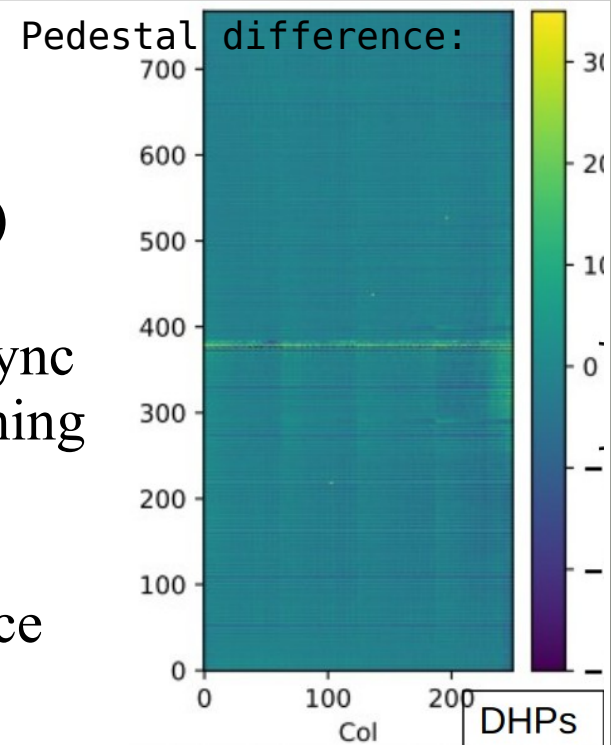
- $T \sim 2.5$ min
- Correlated and anti-correlated with FOS temperature!



- N2 flow is a candidate
- Remark:
 - Impact on data quality? Most likely not. We talk about pixels at threshold level of 7 ADU

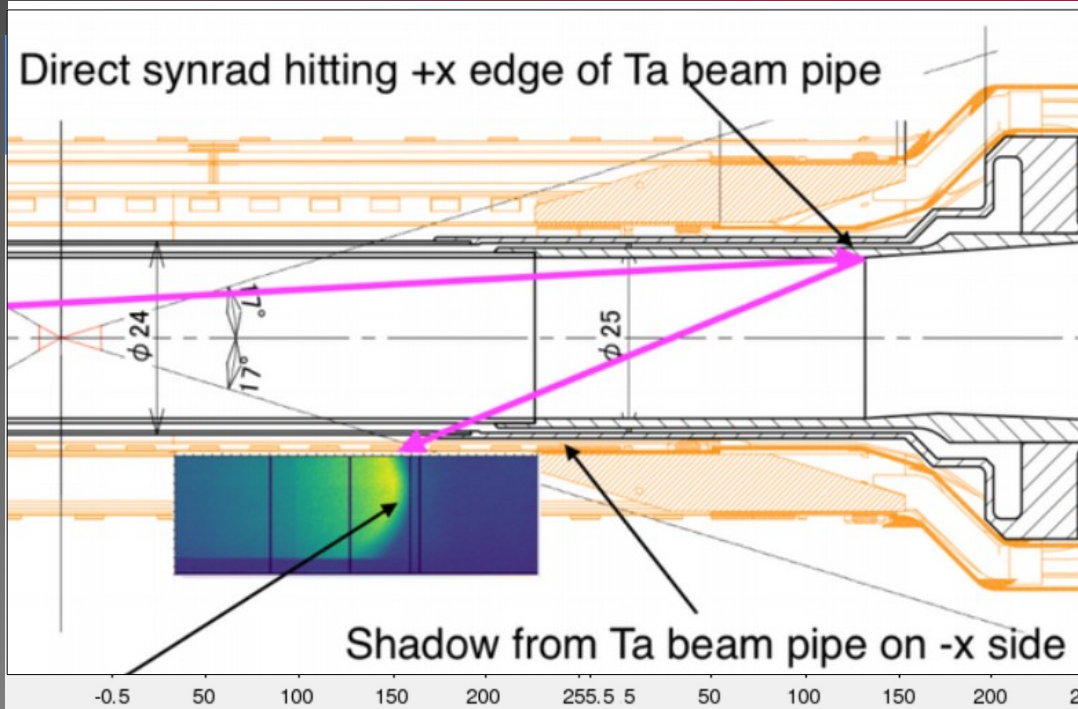
Low/High Current Flip in 1.8.2

- Module started to show high noise after some run starts
- Low and High current state need different pedestals
- Flipping happens often at Run Reset (shifter workaround button)
- Flip to High Current Mode:
 - set DHP last_row register = 180 → Internal DHP framesync will always reset switcher sequence to gate 0 when reaching gate 180
 - delete serin signal from switcher sequence
- Flip to Low Current Mode by reducing clearon-clearoff difference

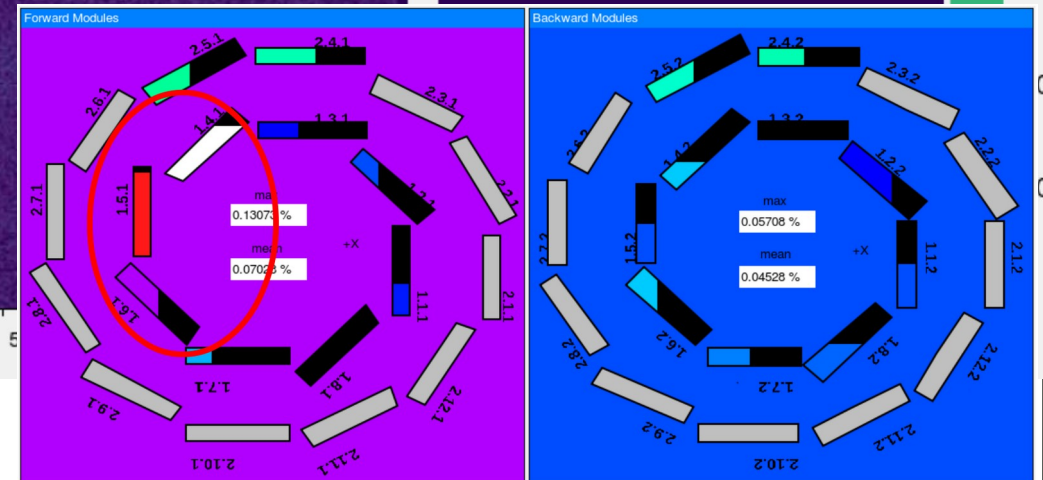
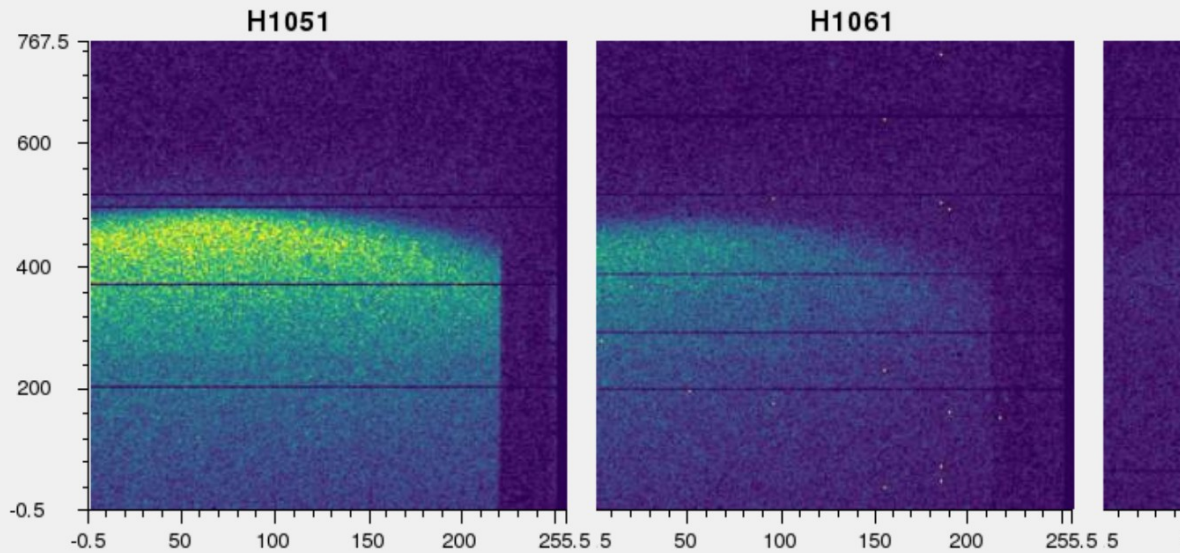
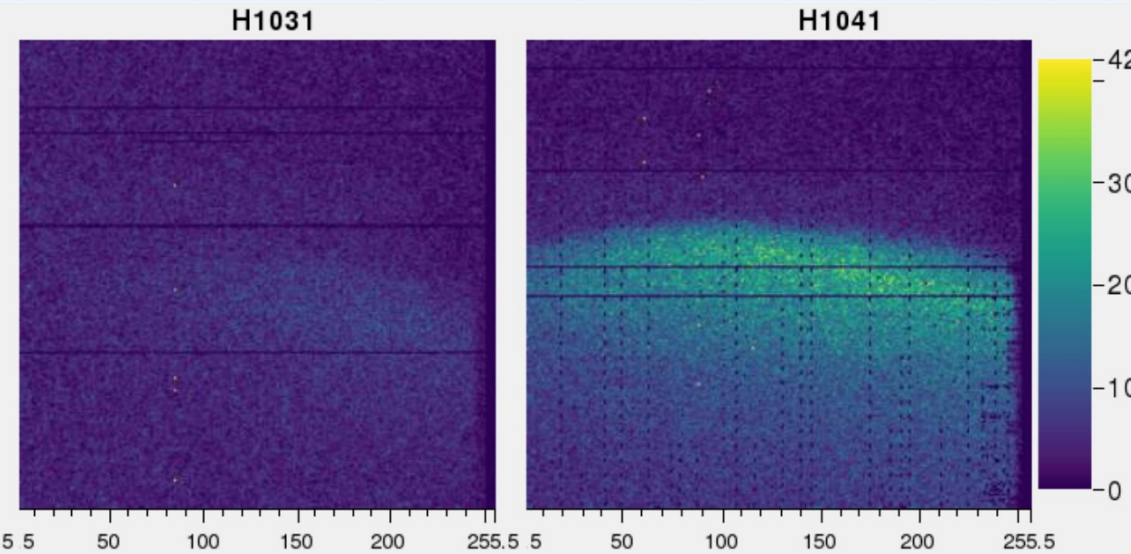


- Clear-On current on H1052 fluctuating between ~ 46 and $61(90?)$ mA
- Reason not completely clear, might be similar to 1.8.2

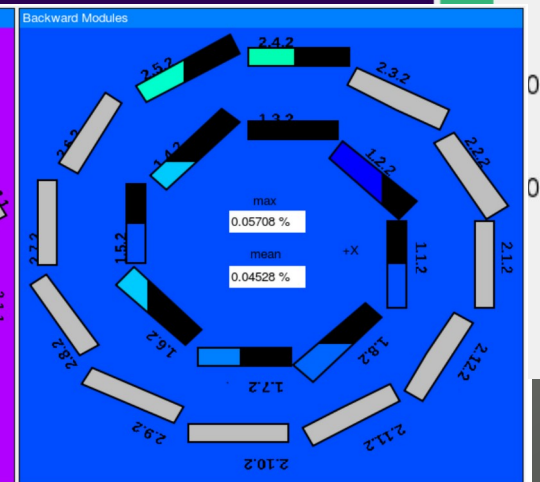
“Synchrotron” Radiation Problem I & II



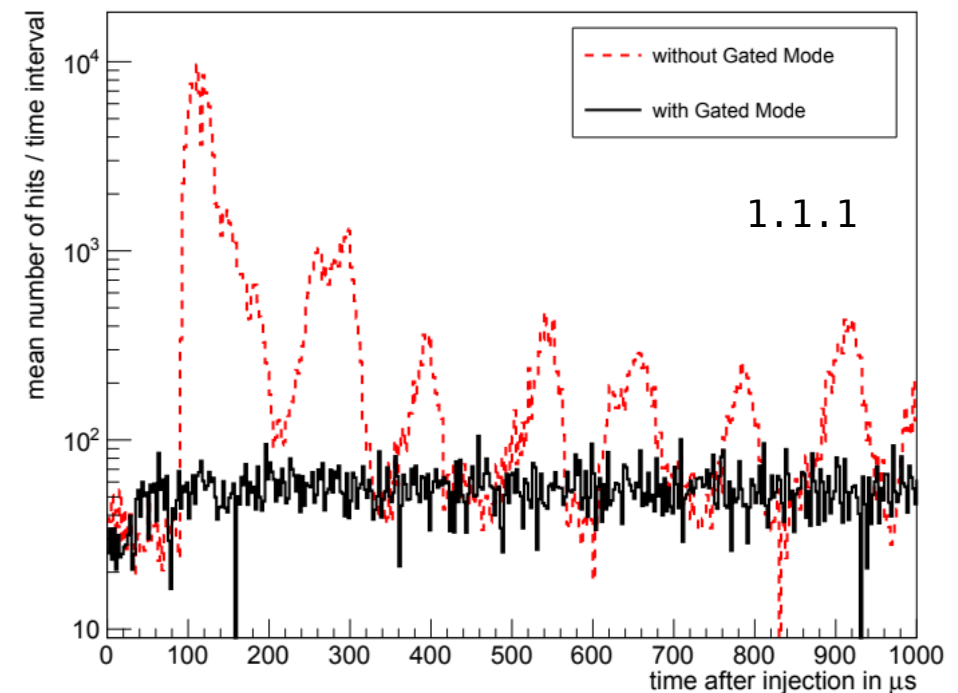
Overview



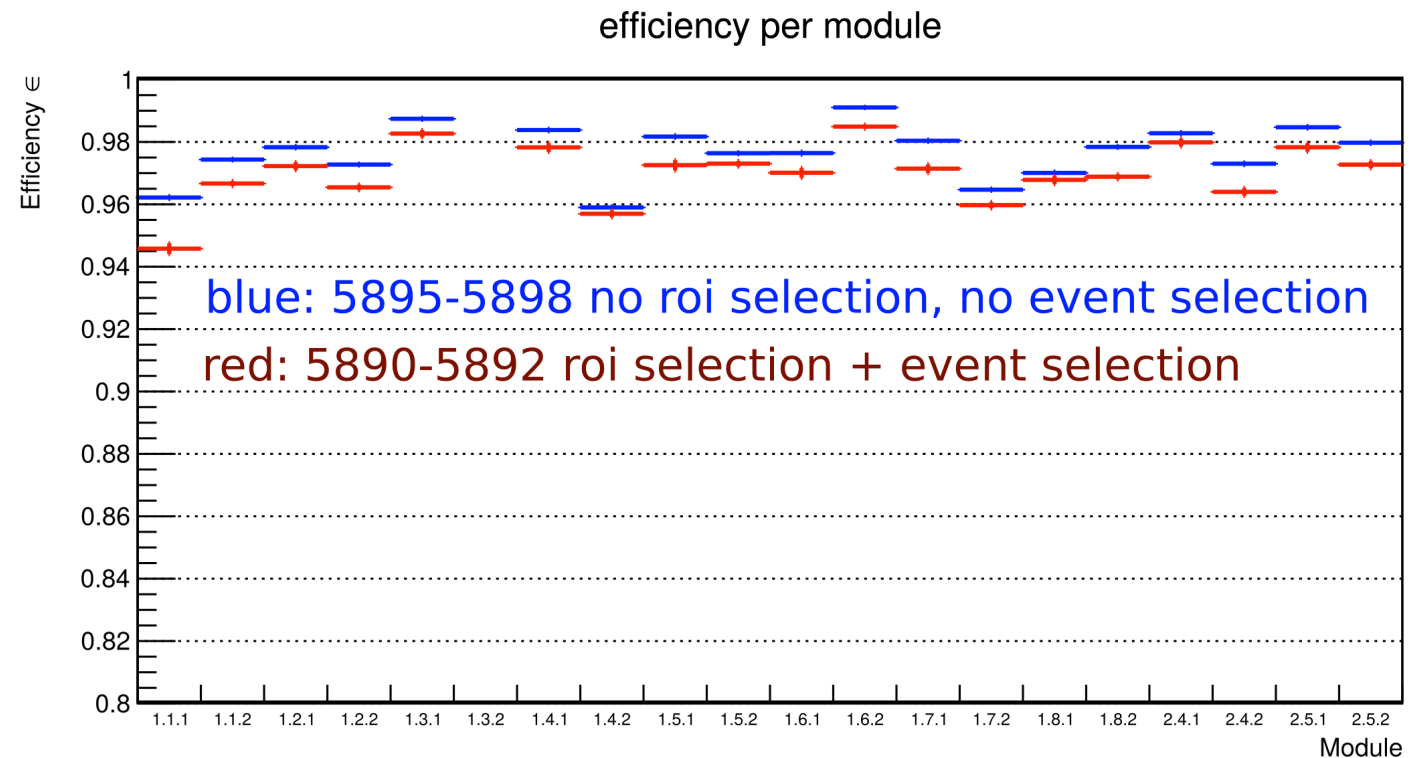
JOHANNES GUTENBERG
UNIVERSITÄT MAINZ



- Later → other slides
- We can suppress the injection noise!
- But:
 - Large threshold (15, 20 instead of 7)
 - Long no-trigger-length (to suppress noise)
 - Different module performing different
 - Some 'structures' not understood
- Technically working
- Not ready for use in physics runs yet



- Working for all modules, tested in 3 runs in December
 - Checked only for events without DATCON ROIs (still investigating)
- 1-2% efficiency loss with ROI selection?
 - Re-check with clusters-per-track after calibration.
 - ROIs too small in forward region? (check angular and v dependence)
 - Effect of Event selection? We change event sample and the position distribution of the tracks \rightarrow efficiency is per track, not per area!



- High occupancy during injection problem (occupancy “drop”; DHE ↔ DHP, desync?)
 - Solved or just not seen anymore because of trigger veto?
- DHH: Sync between modules on reset had small chance to sync on wrong revolution → new signal from FTSW for every second revo should fix this
- OVPs triggered (mostly during tests or ramping) – why?
- DHH: Event building timeouts add up → one source for “HLT before DHH”

- PXD elog ‘server’ – again
- LocalDAQ – Auto start (“follow”)
- CalibrationIOC
 - Hangs, restart needed
- Software branches
 - Make sure that branch is not randomly changed (for tests)
 - Configuration files
- Normal shifter cannot fix/change/restart
 - Double check after each test!

- Efficiency plot not available for weeks. Code was not in the release used. Took weeks to roll-out the fix(es) (lengthy software patch release procedure :-())
- All cosmic/physic runs should be flagged in Run Registry now
 - Taking into account DQM and module/DAQ state

Run Registry Runs Shifter Experts * Bjoern Spruck (spruck) Logout

Run List

Previous 1 2 3 4 5 6 7 8 9 10 11 Next

Experiment First Run Search

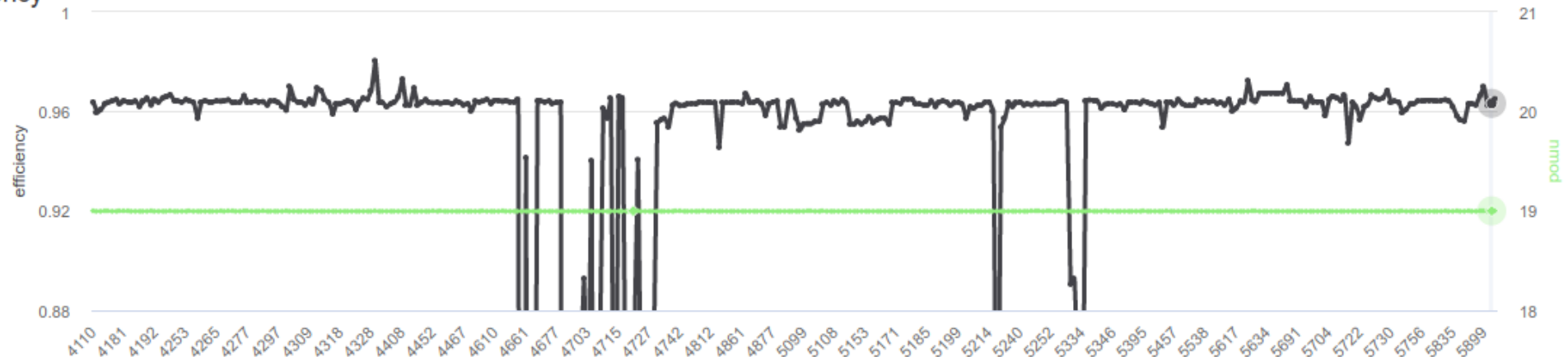
	Exp	Run	Run Type	Start Time	Run Time	Stop Reason	Detectors	Energy in GeV	Magnet in T	Triggers	Events	Luminosity Online	Luminosity Delivered	Luminosity Recorded	Luminosity Offline
Details	10	3477	null	2019/11/04, 09:13		ERROR	PXD SVD CDC TOP ARI ECL KLM TRG	HER: 7.01 LER: 4.00	1522202.00	In: None Out: 13102178	Total: None Hadronic: None Bhabha: None	1.68	0.00	0.00	
Details	10	3476	null	2019/11/04, 08:45		ERROR	PXD SVD CDC TOP ARI ECL KLM TRG	HER: 7.01 LER: 4.00	1522202.00	In: None Out: 27550583	Total: None Hadronic: None Bhabha: None	1.71	0.00	0.00	
Details	10	3475	null	2019/11/04, 08:19		STOPPING	PXD SVD CDC TOP ARI ECL KLM TRG	HER: 7.01 LER: 4.00	1522203.00	In: None Out: 215694	Total: None Hadronic: None Bhabha: None	1.70	0.00	0.00	
Details	10	3474	null	2019/11/04, 05:30		ERROR	PXD CDC TOP ARI ECL KLM TRG	HER: 7.01 LER: 4.00	1522202.00	In: None Out: 252743920	Total: None Hadronic: None Bhabha: None	1.74	0.00	0.00	
Details	10	3473	beam	2019/11/04, 05:08		STOPPING	PXD SVD CDC TOP ARI ECL KLM TRG	HER: 7.01 LER: 4.00	1522200.00	In: None Out: 563311	Total: None Hadronic: None Bhabha: None	0.72	0.00	0.00	

- Mirabelle like, was decided in Oct B2GM
 - (similar to DQMAnalysis, but stores the fit results to xml files)

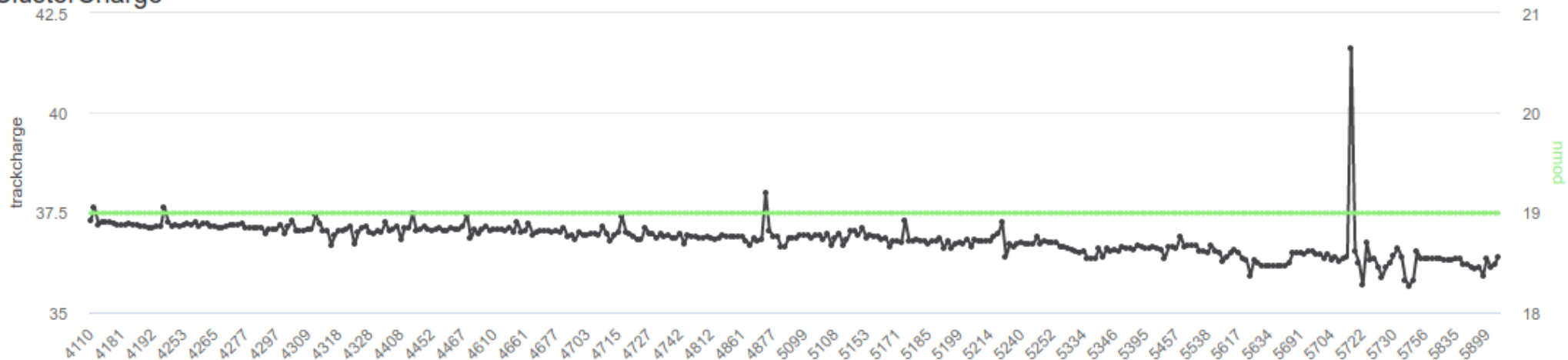
<https://dqm.belle2.org/rundependency/pxd/display.php>

Shown period: 2019-11-15 05:35:06 - 2019-12-12 09:03:41

Efficiency



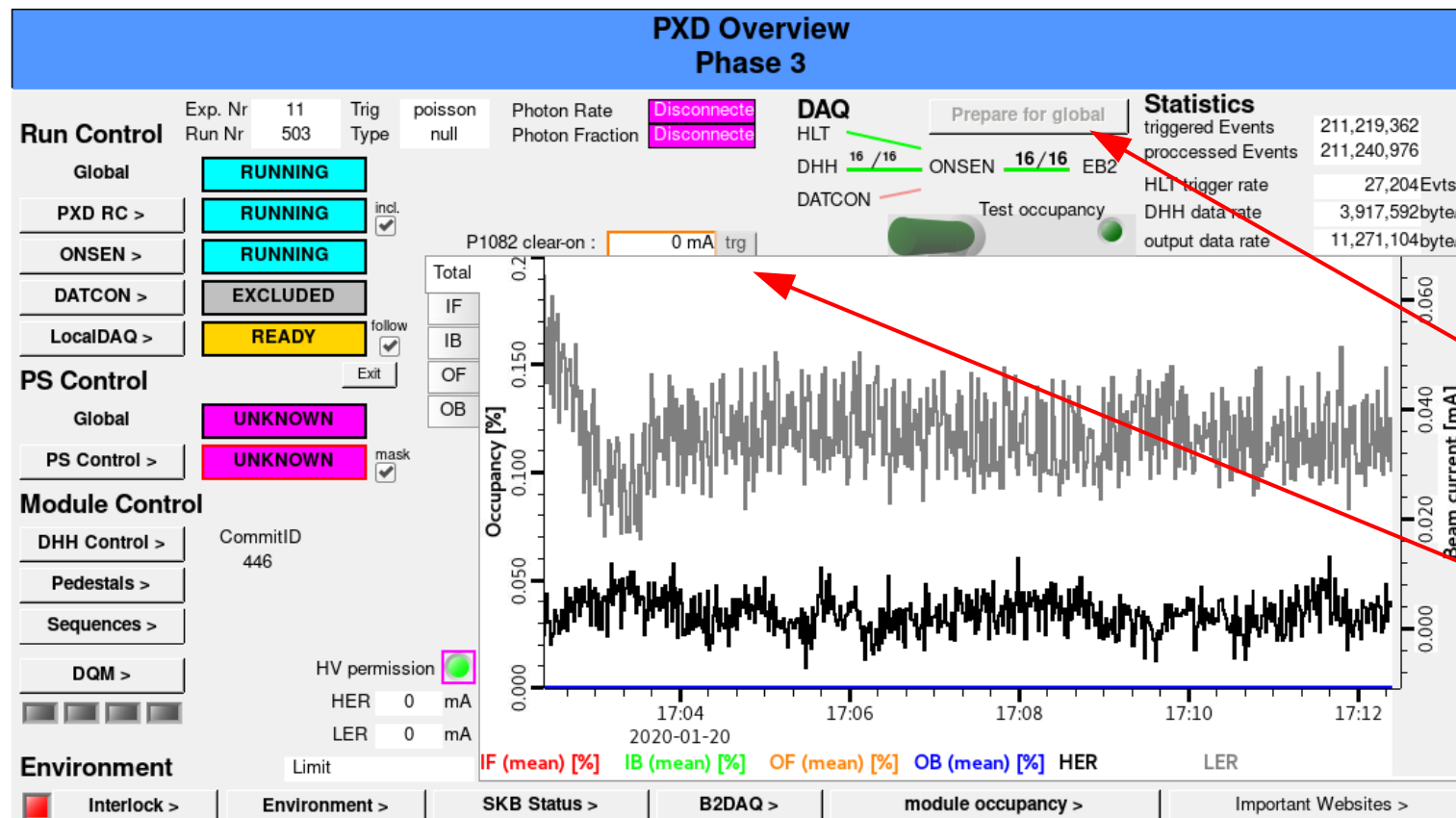
TrackClusterCharge



- Missing events (still)
 - Seems better with new ZeroMQ scheme
- Long processing times for some events (minutes!)
 - Some change on HLT at some point → several second minimum(!) time
- Old events in FIFOs (was not HLT fault → ROPC/copper!)
 - On run pause/stop, few (~10) events stay in FIFO and are not processed → we ever get triggers for them in ONSSEN
- Detected and reported by PXD, but not a real threat
- If one HLT unit dies, we could get memory full at some point or
 - HLT output could die → PXD ERROR → :-/
- Network congestion, triggers came only in “pulses” on high data rate tests
 - → second switch to disentangle HLT trigger and data

- Single Point of failure
 - Emergency access because of faulty fuse
- Second switch will be available soon

- Constant improvements (mainly by Simon)
 - Remove left-overs from (phase 2) expert displays
 - NSM2 mostly removed
 - Add new monitors
- → please update your CSS/OPIs before your shift



- Transition from expert shifter → non-expert shifter (again)
 - → expect plenty of new (untrained) shifters for autumn run
- Requirements:
 - Shifter mailing list pxd-shifters@belle2.org, training and shadow shift
- Big restructuring of the shifter manual
- Weekly shifter meeting (monday morning in Germany)
 - including “operation overview and discussion”

- Coverage much better, but still issues on weekends
- Some shifts are again filled only in the last minute

October 2019						
	01 Tue	02 Wed	03 Thu	04 Fri	05 Sat	06 Sun
	Botho ...	Felix ...	Christ...	Philip...	Varghe...	OWL
	DAY	Boqun ...	Boqun ...	Boqun ...	Boqun ...	Boqun ...
	Thomas...	Thomas...	Thomas...	Thomas...	Qingyu...	Qingyu...
07 Mon	08 Tue	09 Wed	10 Thu	11 Fri	12 Sat	13 Sun
Botho ...	Botho ...	Felix ...	Christ...	Varghe...	Felix ...	Felix ...
Boqun ...	Dmytro...	Dmytro...	Dmytro...	Dmytro...	Boqun ...	Dmytro...
Varghe...	Simon ...	Botho ...	Felix ...	Qingyu...	Philip...	Klemen...
14 Mon	15 Tue	16 Wed	17 Thu	18 Fri	19 Sat	20 Sun
Felix ...	Simon ...	Simon ...	Simon ...	Simon ...	Andrey...	Jakub ...
Boqun ...	Dmytro...	Dmytro...	Dmytro...	Floria...	Floria...	Qingyu...
Philip...	Felix ...	Philip...	Christ...	Hua Ye	Hua Ye	Hua Ye
21 Mon	22 Tue	23 Wed	24 Thu	25 Fri	26 Sat	27 Sun
OWL	Varghe...	Varghe...	Christ...	Philip...	OWL	OWL
Dmytro...	Boqun ...	Boqun ...	Boqun ...	Dmytro...	Bjoern... ✗	Bjoern... ✗
Patric...	Patric...	Patric...	Patric...	Qingyu...	Hua Ye	Hua Ye
28 Mon	29 Tue	30 Wed	31 Thu			
Patric...	Varghe...	Andrey...	Christ...			
Floria...	Floria...	Floria...	Floria...			
Felix ...	Felix ...	Felix ...	SWING			

Weekend shift keep on being a problem in Nov and Dec, too

B2GM → BPAC weekend

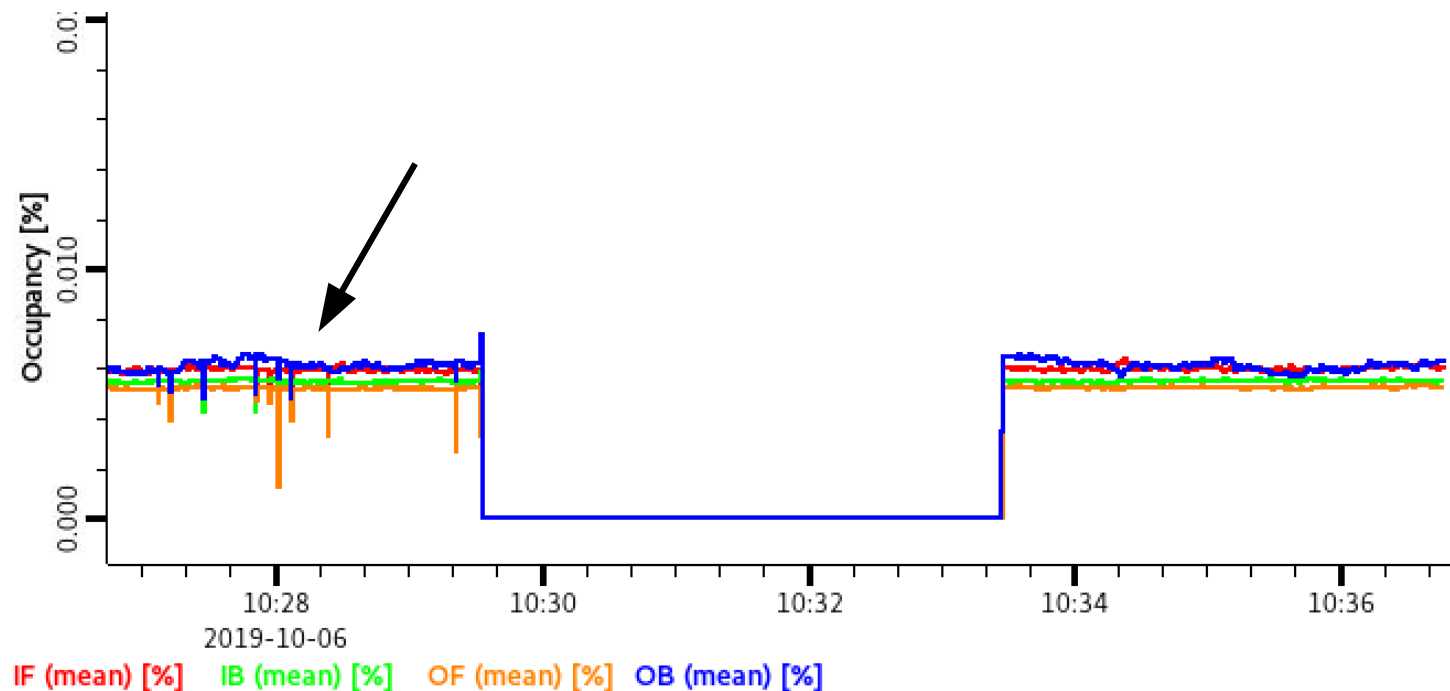
- Complains by Run Coordination about ‘badly trained’ or inexperienced shifters
 - Switch from local to global data taking took to long
 - This got more and more complicated during the autumn run because of issues with ‘current flip’ and sychronization issues
 - Communication issues with global shifter and/or BCG
 - In combination with badly trained CR shifter
 - Unclear communication from all three sides
 - Changing procedures people were not aware of (on both sides)
- Shifter did not follow procedures/the manual
 - No msg/status updates in channels on what he is doing (#pxd)
 - No msg if the status is changing (#pxd_operation, #svd)
 - Did not check for updates in the manual

- System gets more and more stable (from procedures point)
- Simplify procedures for shifter (→ Manual). Expert procedures/knowledge is vanishing or out-dated.
- To few up-to-date documentation of expert knowledge
 - Infrastructures, services, module operation, DAQ, ...
- But:
 - Some services are running now on machines which were used as workarounds or for testing, which means, no backups, no redundancy :-(
 - Operation critical add-ons (synchrotron rad monitor) need to be taken care of
- Few people know how to turn on machines remotely, no complete view
 - Cold start not possible by a single person

- Much smoother running than in 2019a,b
 - DHH Firmware more mature
 - Better optimized sensors
 - Several issues fixed
- New problems (or not visible/detected before?)
 - Sensor current-flip
 - Synchronization
- Too much intervention by PXD shifter needed
 - Still to much dependence on experts if something does not work right-away

- Misleading! **This is not an issue!**
- They have nothing to do with our occupancy!
- Effect of dividing two numbers which are sampled at slightly different time
- Trigger stopped by busy (f.e. SVD) lead to small number
- This has nothing to do with what we saw as rate drops due to link/desync problems in spring → they might be an issue with beam again

$$\text{occupancy} = \frac{\text{nr of pixels}}{\text{nr triggers}} \text{ (within time intervall of 0.5 s)}$$



- Important: CR Shifter should only change between STANDBY and PEAK
 - Recovery need PXD experts
- Working as designed, but maybe not what is wanted
 - Injection inhibited while HV is in error (after over voltage protection shutdown) turning on/off or interlocked (cooling)
 - Removed TURN ON/OFF from state machine response (this is not what is intended...)
 - Automatic transition from ERROR to OFF
- Ongoing discussion ...
- Observed several OVP in phase 3. → PXD shifter need to intervene as error state is blocking injections. Not clear yet how we can fit some (partly) automatic recovery in the current HVC scheme.

- PXD SC: no major issues, hardware was upgraded
 - IOCs, GW, archiver, monitoring...
- Alarms system & alarm tree
 - DHP temp measurement, occ. Drops, links ...
 - Interface to RocketChat
 - (independent development from the one which is now used for DAQ/Zabbix)



#pxd_log

PXD Log and Alarm Messages

Log message — **DHE62** : chip 3 does not support IDCODE.

PXD logging @michael.ritzert 16:21

Log message — **/psApp/** : Unit 79: emergency shutdown: OVP

PXD alarm system @michael.ritzert 16:21

Alarm triggered – PV: **PXD:P1081:status-ovp:S:cur**, State: **MAJOR** (STATE_ALARM) [here](#)

PXD logging @michael.ritzert 16:21

Log message — **/psApp/** : Unit 79: emergency_shutdown

PXD logging @michael.ritzert 16:27

Log message — **DHE62** : No chain with this name in driver

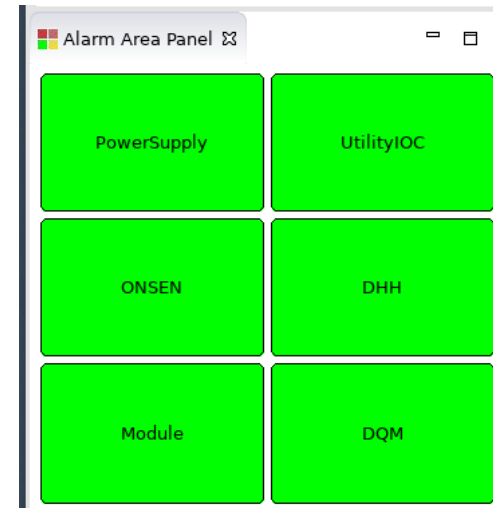
PXD logging @michael.ritzert 16:27

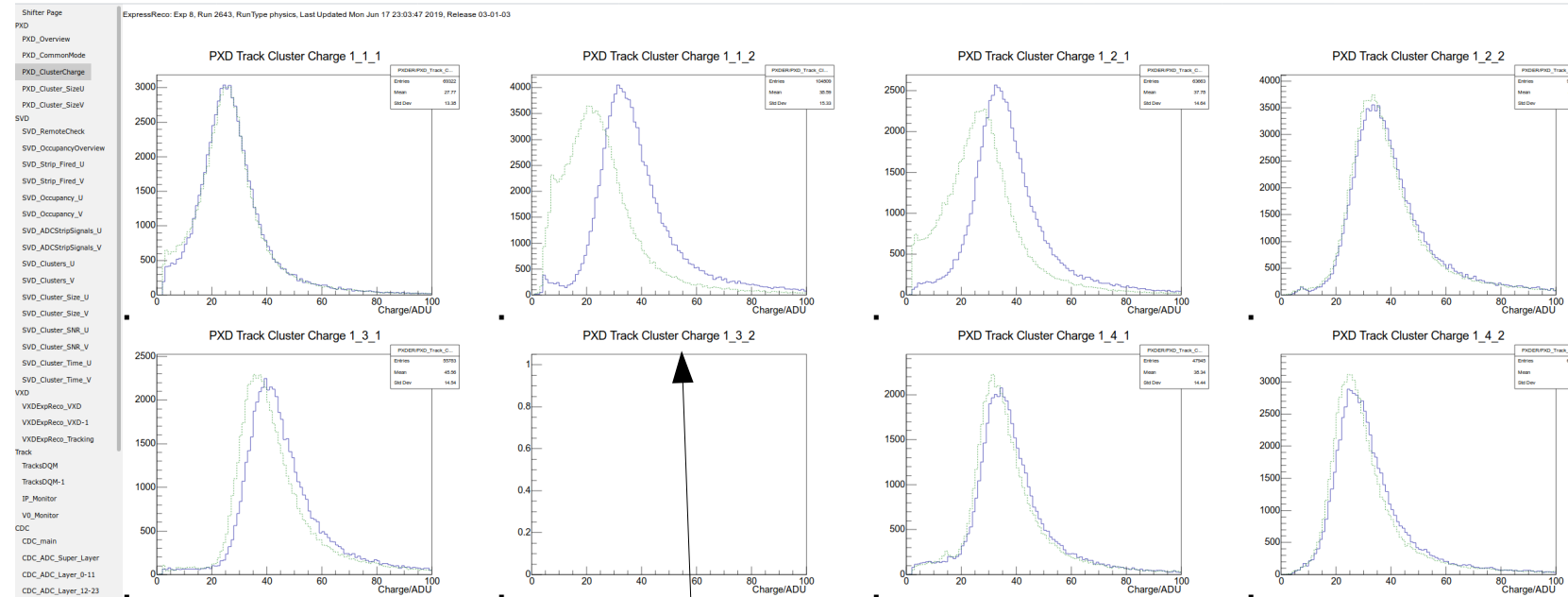
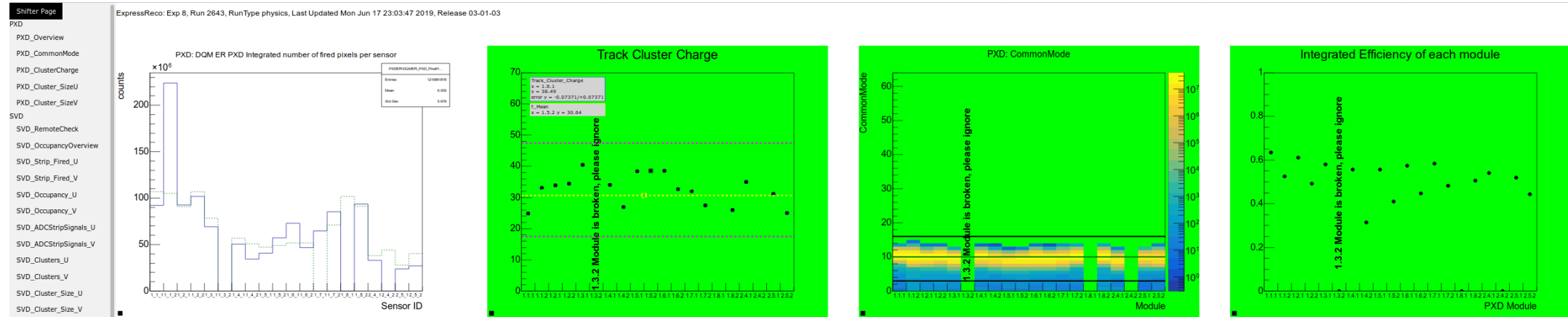
Log message — **DHE62** : Calibration unsuccessful. You may check if ASICs are on.

PXD logging @michael.ritzert 16:27

Log message — **DHE62** : Calibration unsuccessful. Status = -1

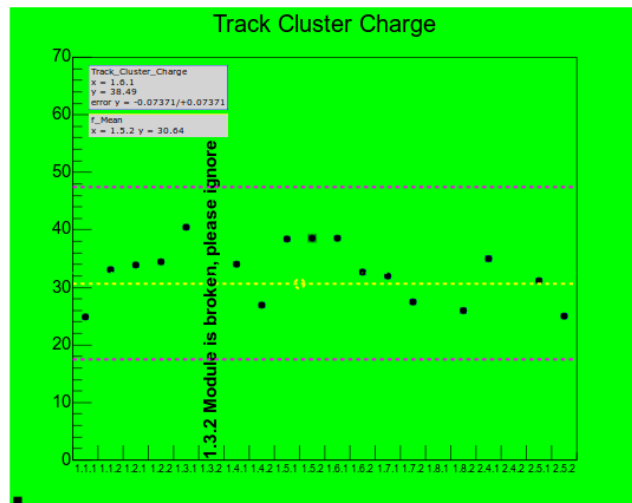
- ▶ ● Area: PowerSupply
- ▶ ● Area: UtilityIOC
- ▶ ● Area: ONSEN
- ▶ ● Area: DHH
- ▼ ● Area: Module
 - ▼ ● System: 1011
 - PV: PXD:1011:occ-dropped:ALRM:cur
 - ▶ ● System: 1012
 - ▶ ● System: 1021
 - ▶ ● System: 1022
 - ▶ ● System: 1031
 - ▶ ● System: 1041
 - ▶ ● System: 1042
 - ▶ ● System: 1051
 - ▶ ● System: 1052
 - ▶ ● System: 1061
 - ▶ ● System: 1062
 - ▶ ● System: 1071
 - ▶ ● System: 1072
 - ▶ ● System: 1081
 - ▶ ● System: 1082
 - ▶ ● System: 2041
 - ▶ ● System: 2042
 - ▶ ● System: 2051
 - ▶ ● System: 2052
- ▼ ● Area: DQM
 - PV: DQM:PXD:TrackCharge:Status
 - PV: DQM:PXD:CommonMode:Status
 - PV: DQM:PXD:Eff:Status



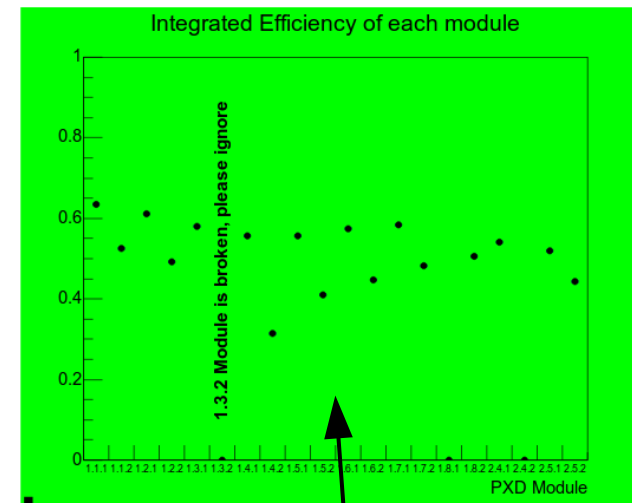
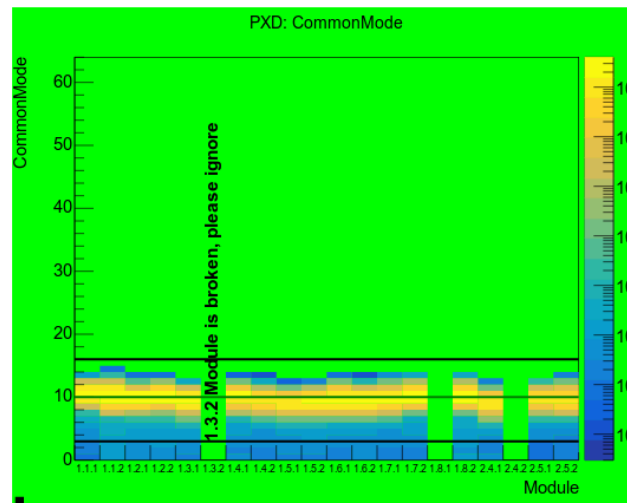


Optimized since ref was taken

- Limits for turning Green, Yellow, Red to be discussed and adjusted.
- Not so clear if we really can conclude sensor and data quality

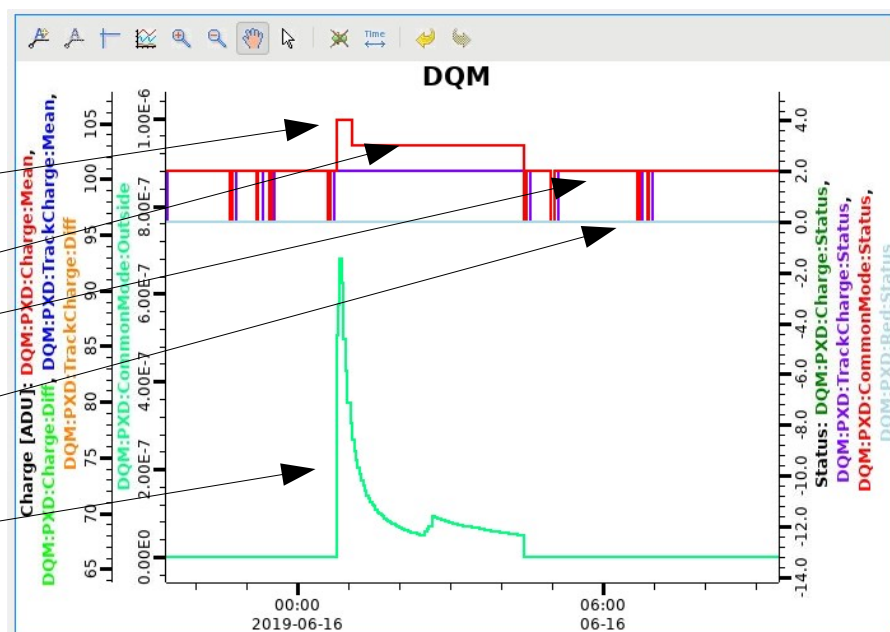


“MPV position”



Efficiency

Histogram Status exported to EPICS & archived



RED = CHECK!!!

YELLOW = check

GREEN = OK

GREY = empty

Value the decision
is taken from

50% puzzle solved:
**Check on in- and outgoing leg
of track (works for cosmics
and phase 2 but not phase 3)**
→ algorithm changed

**More/other/better DQM tools
will be added/available soon!**
→ Monitoring Task Force

- High occupancies together with triggers following shortly after each other → “link dropped” (actually the link is still there, but no data is coming for the current event)
 - DHP fifo full (CM=63)
 - Mainly during HER injection, ‘dirty bunch’
- This won’t stop the DAQ → manual SALS (go into ERROR?)
- DHP ASIC limit
- Workarounds
 - 1: Increase the trigger veto length thus we should not get triggers when we have highest occupancy (done)
 - 2: Gated Mode (to be proven now)
 - 3: Reset DHP during injection veto time thus the dropped links would be limited to a time span between two injections. (future)