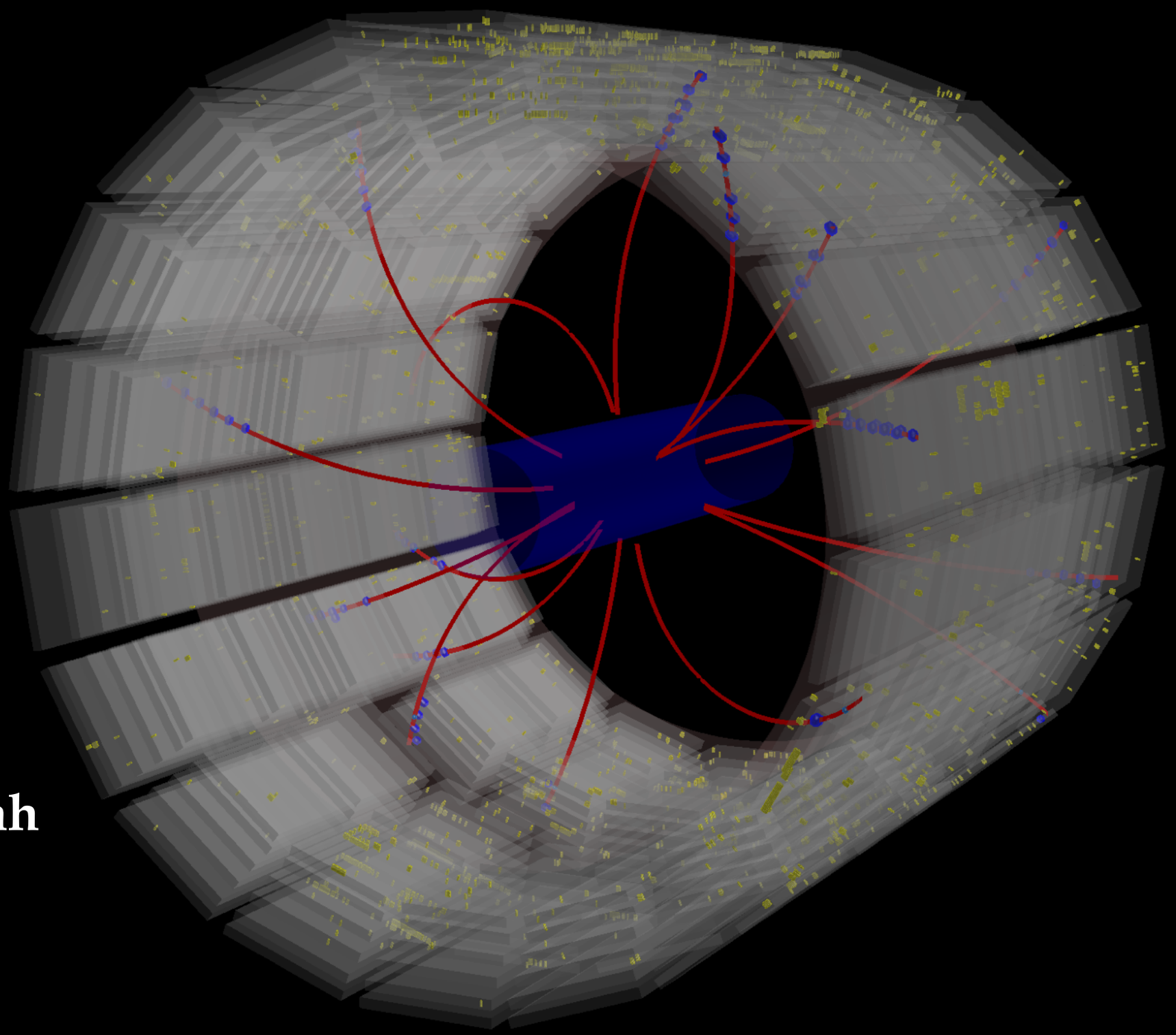
Link Monitor Error Analysis Update



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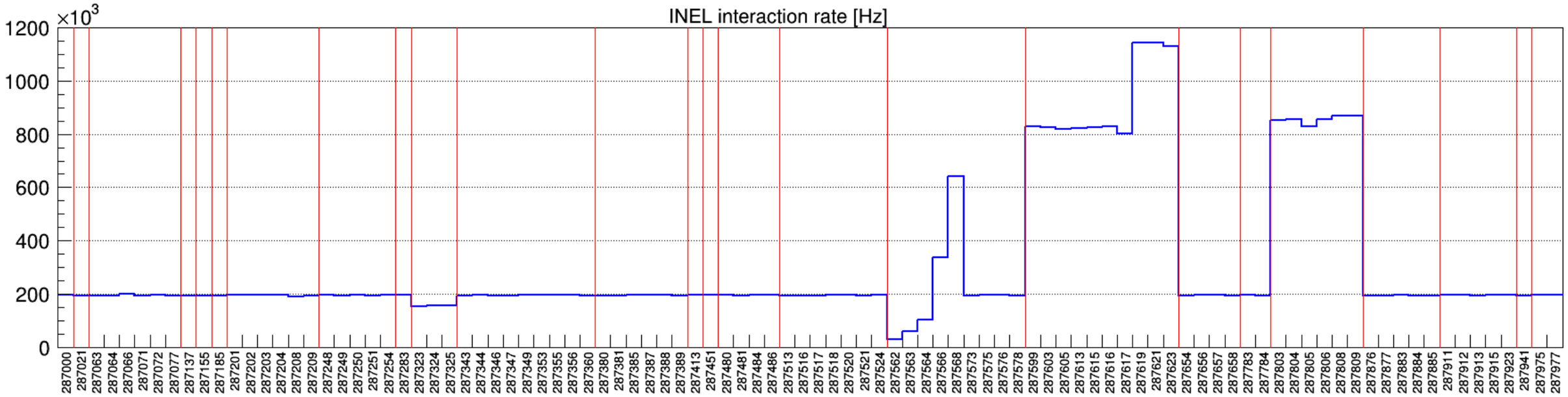
University of Heidelberg
16.07.2018

Data Extraction and Analysis

- 208 xml proxy files downloaded from DCS with help of Tom and Sebastian, total size about 2 GB.
  → a detailed wiki will be written how to access those files
- I wrote a root/C++ parser which scans all xml files in one directory and writes the information (**run id, time, number of chambers, start or run - SOR, end of run - EOR**) in an event header class: **Class_TRD_R_state** and the (**sector, stack, layer, ROB, MCM, gsm, ni, N_ev, N_trg**) information in a sub class: **Class_TRD_R_state_chamber**. The tree for the 208 xml files has a size of 11 MB.
- A second program is analyzing the trees and makes correlations.

Interaction Rate vs Run Id



Global State Machine (gsm) States

Table 1

//	MCM Global State Machine State Definitions
	enum mcm_gsm _state {
	low_power = 0,
	test = 1,
	wait_pre = 3,
	preproc = 7,
	zero_sp = 8,
	full_rd = 9,
	clear_st = 11,
	wait_L1 = 12,
	tr_send = 14,
	tr_proc 15
	};

Network Interface (NI) States

Table 1-0

clear	= 0
idle	= 1
idle_tr	= 2
idle_rr	= 3
idle_net	= 4
send_tri0l	= 5
send_tri0h	= 6
send_tri1l	= 7
send_tri1h	= 8
send_tri2l	= 9
send_tri2h	= 10

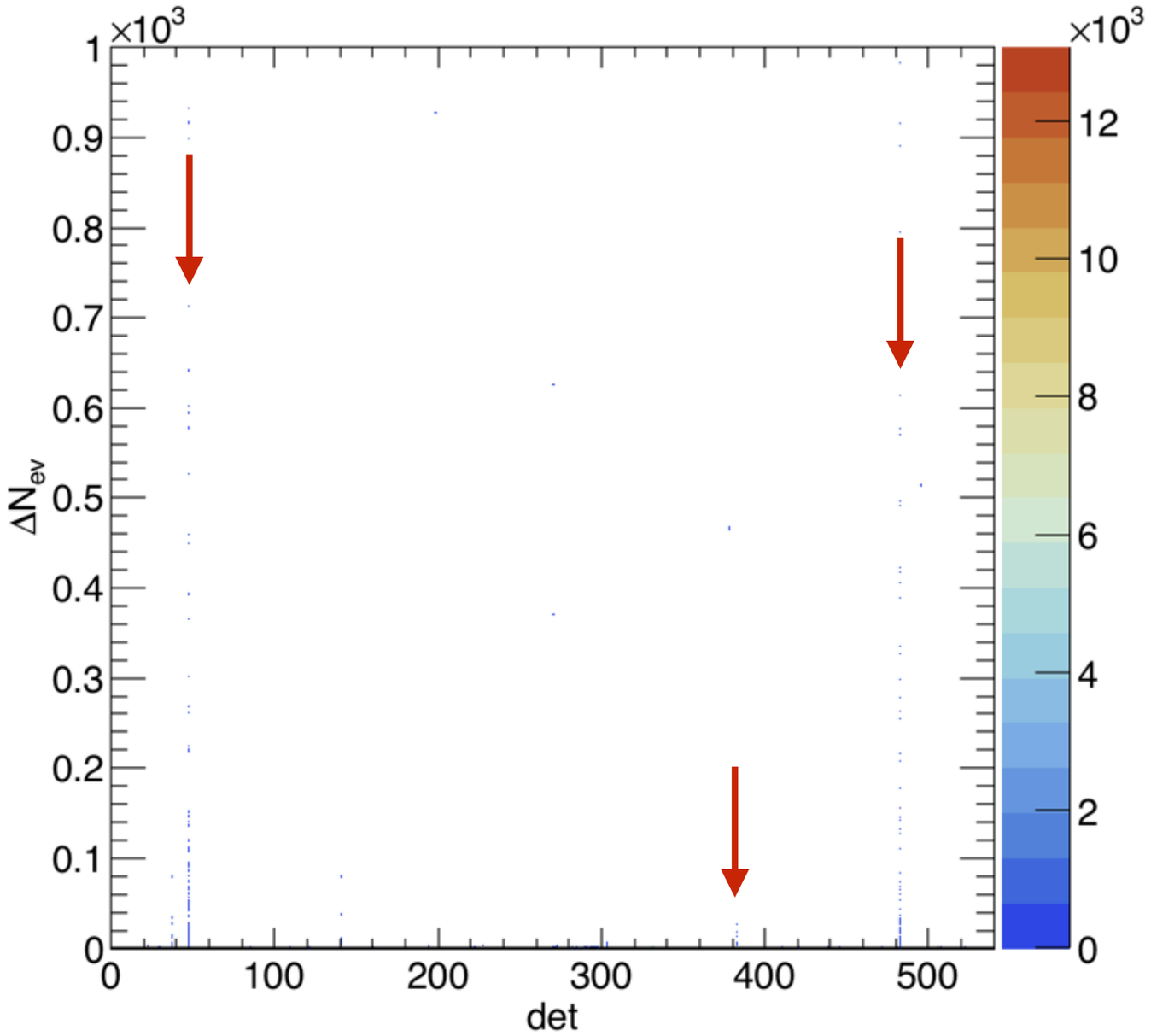
Table 1-1

send_tri3l	= 11
send_tri3h	= 12
send_trp0	= 13
send_trp1	= 14
send_trp2	= 15
send_trp3	= 16
send_rrf0	= 17
send_rrf1	= 18
send_rrf2	= 19
send_rrf3	= 20

Table 1-2

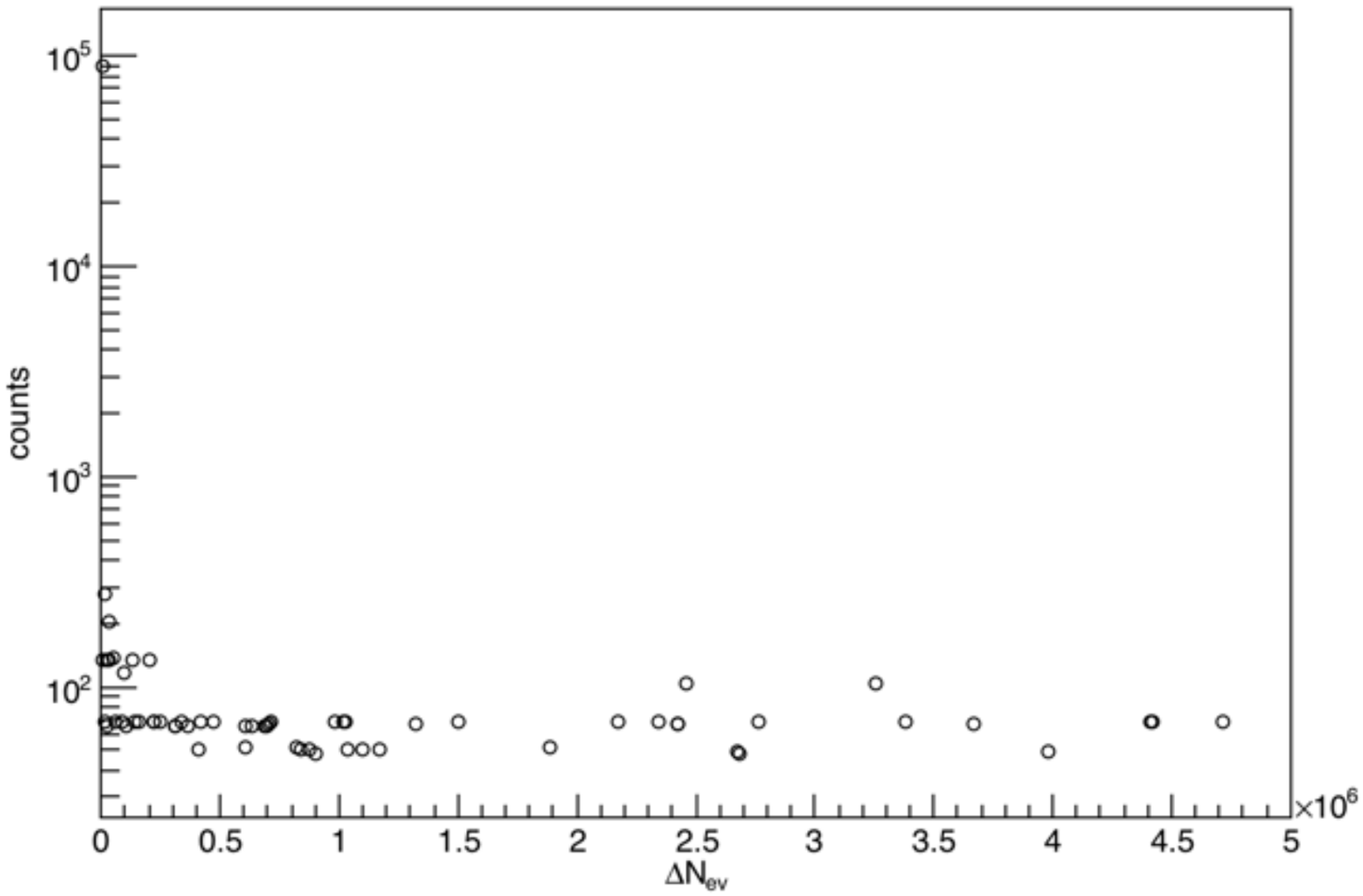
send_rrp0	= 21
send_rrp1	= 22
send_rrp2	= 23
send_rrp3	= 24
finished	= 25
send_tpl	= 26
send_tph	= 27

Event when Error Occurred



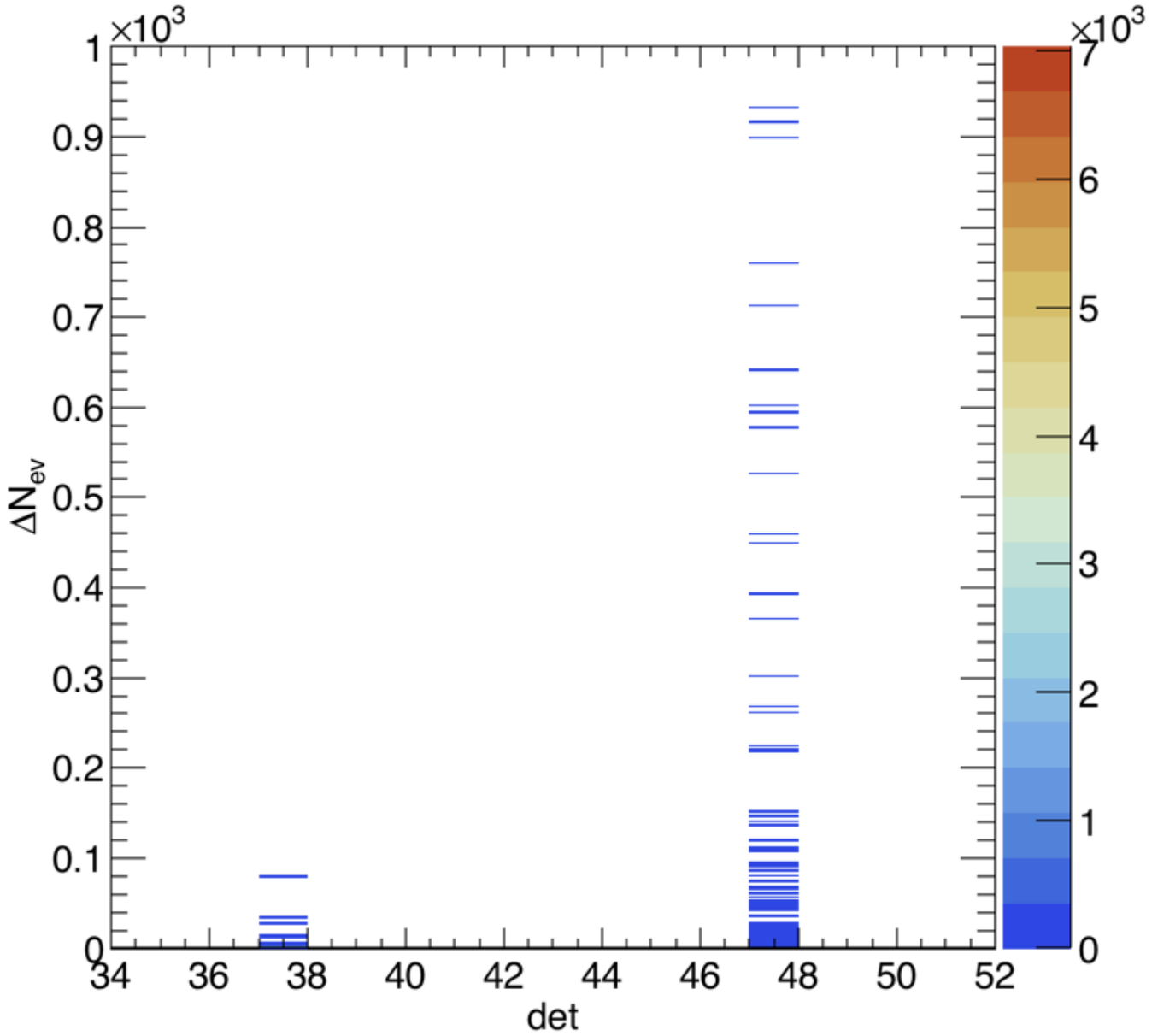
- Whenever the standard gsm state: 3 has changed between SOR and EOR the difference in event counter is calculated.
- Some detectors show a clear pattern: most errors occur within the first 1000 events.
- Other detectors don't show any patter (so far).
- See zoom in on the next slides.

Event when Error Occurred



- Projection for all detectors and larger range (5M).
- Many errors occur during early times, but a few also much later in the run.
  → A MCM has a problem, it will usually show up early.

Event when Error Occurred: det. 47



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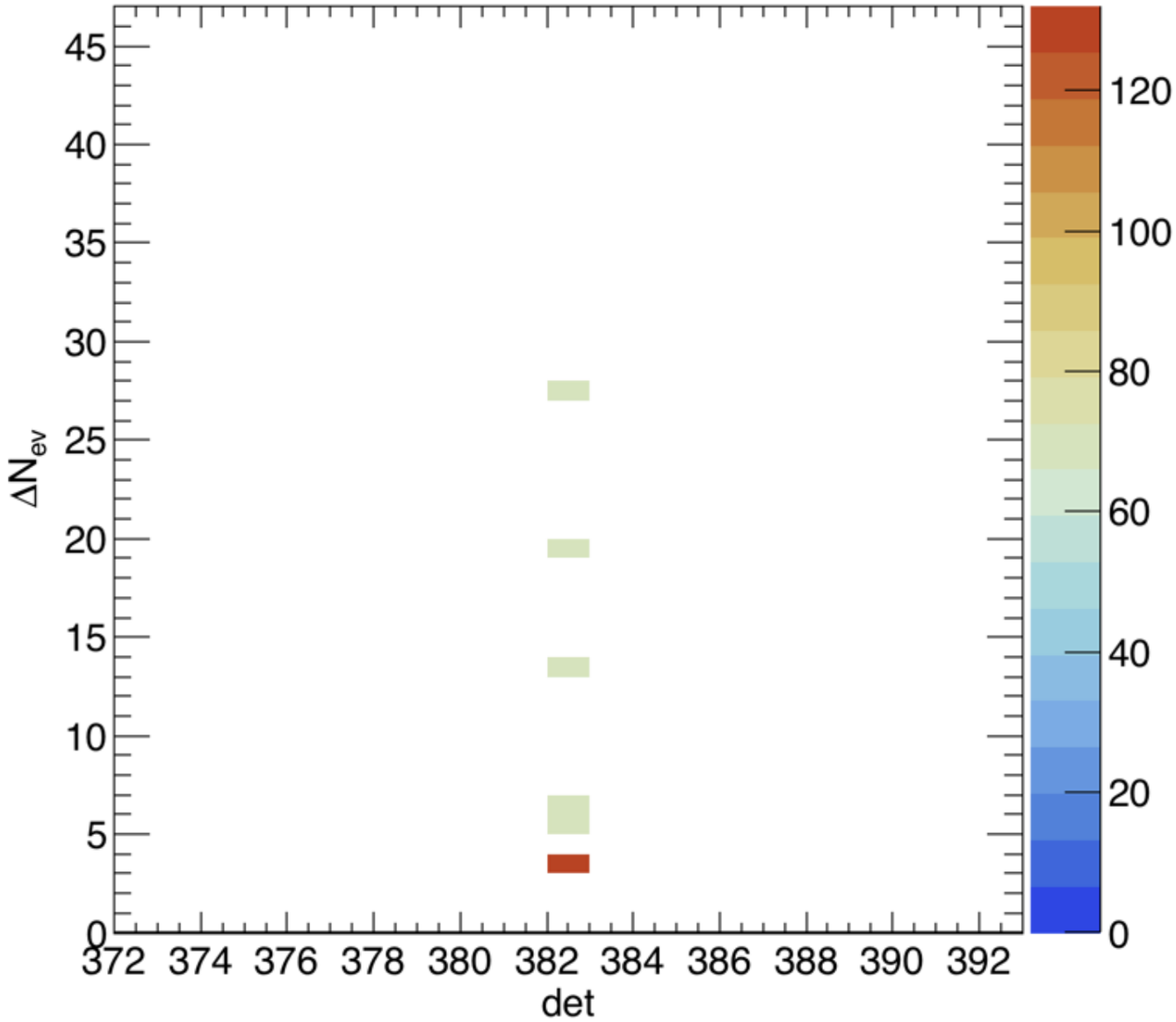
Event when Error Occurred: det. 382



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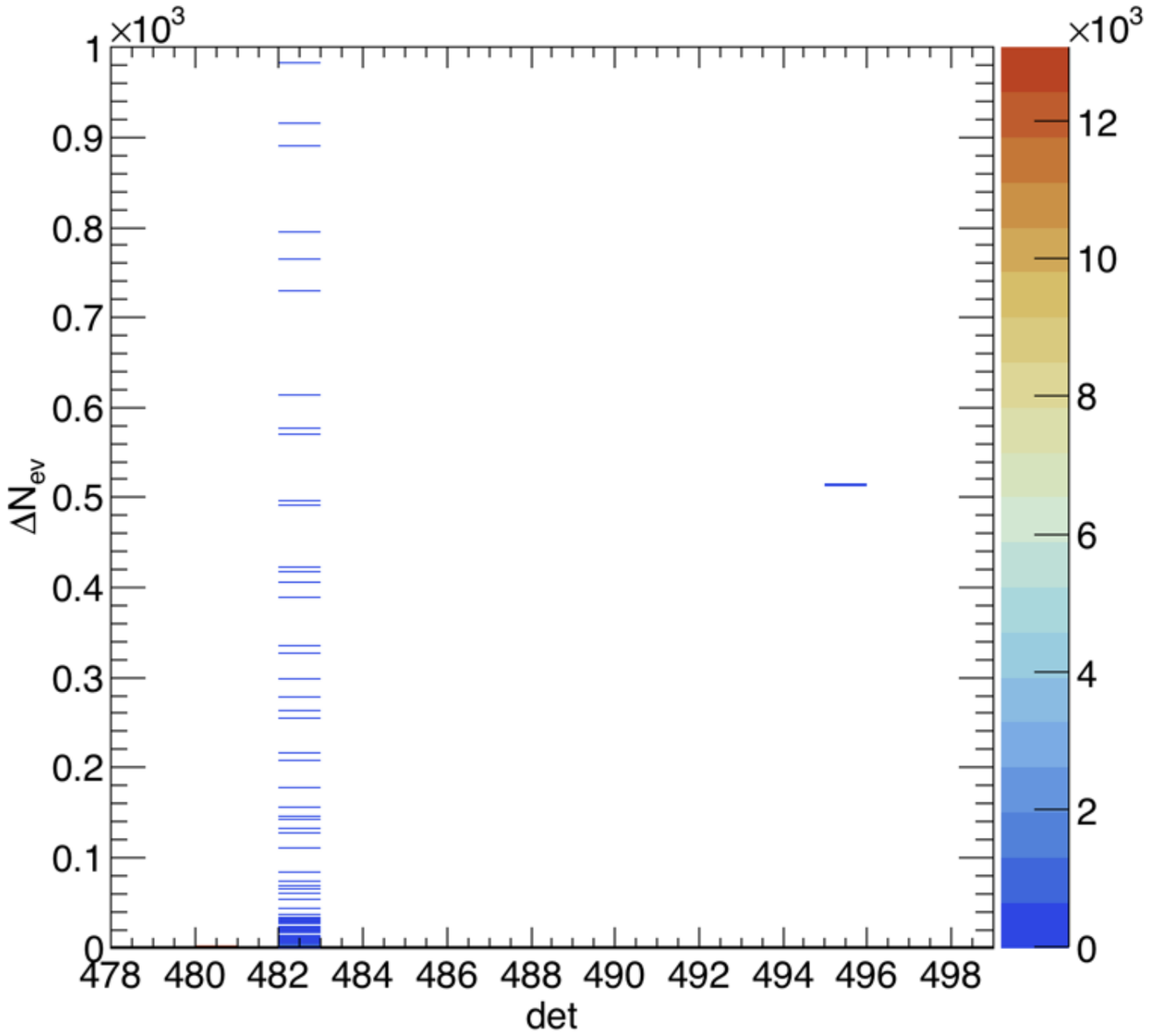
Event when Error Occurred: det. 482



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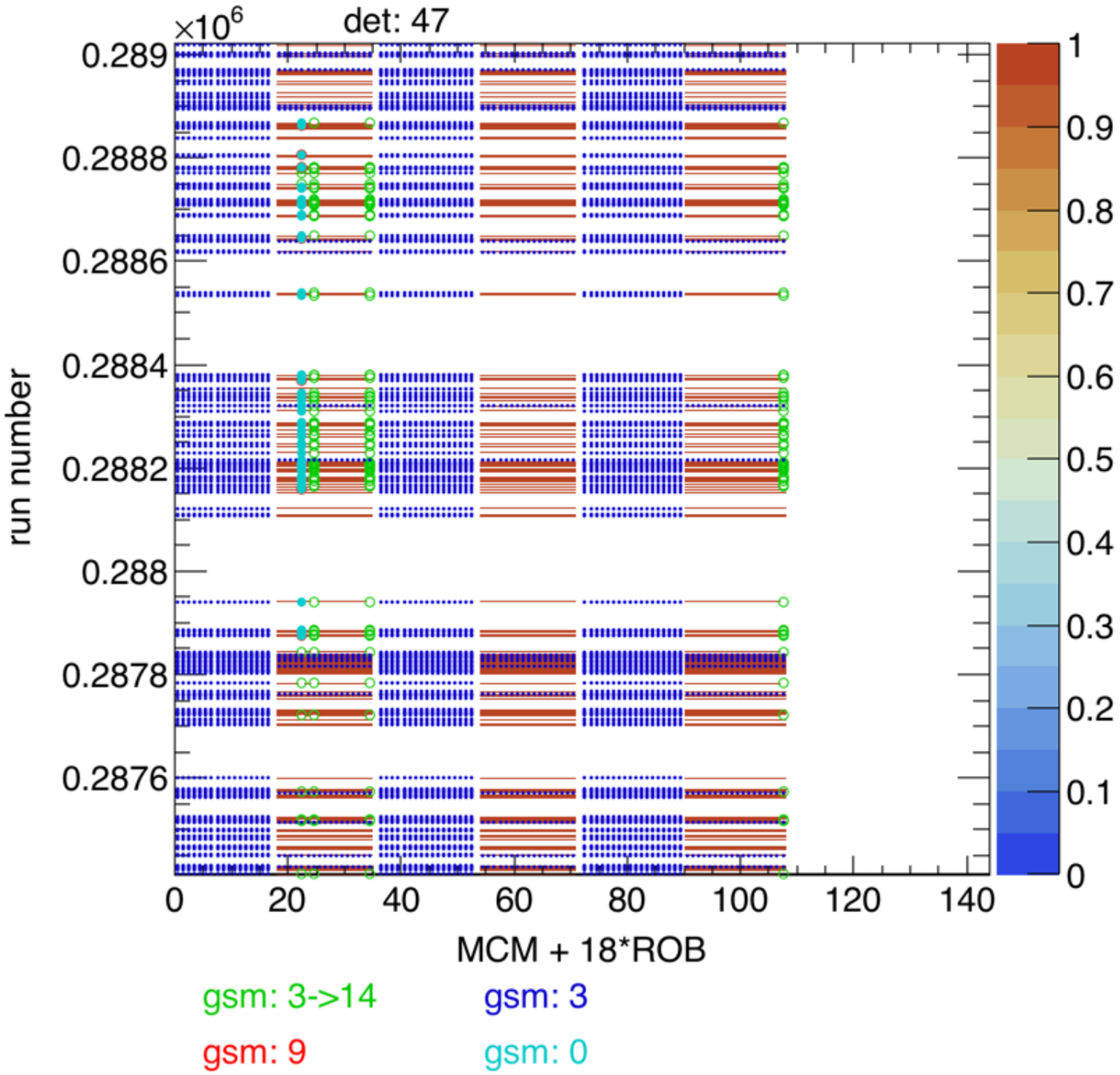
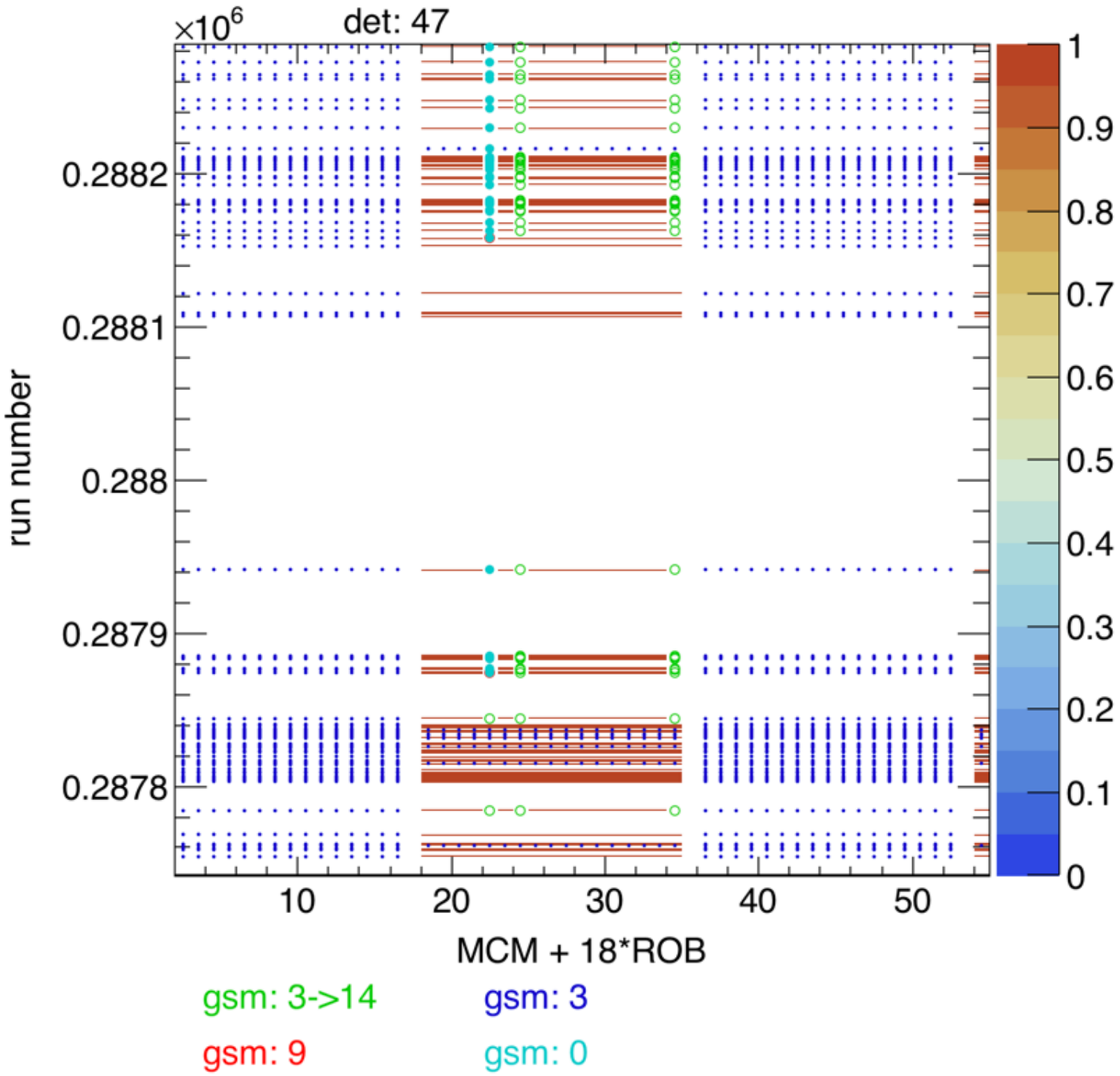
GSM States: TRD det. 47



- Most of the time this (half) chamber has a problem. It is a single MCM, gsm state switch from 3 to 14 (**tracklet send**).
- The whole half chamber switches to mode 9 (**full readout**).
- Board merger and half chamber merger also switch to gsm state 14.

GSM States: TRD det. 47



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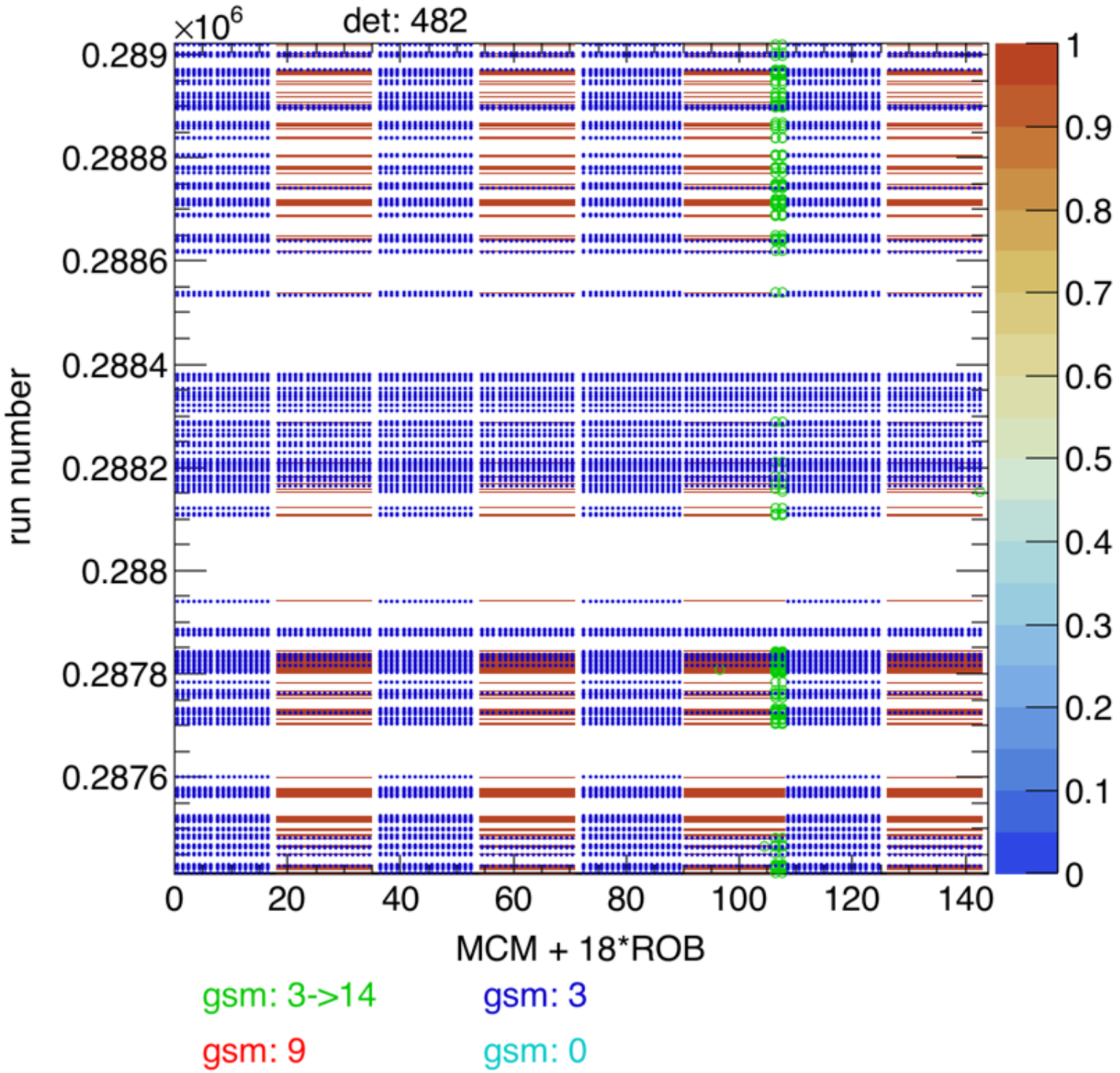
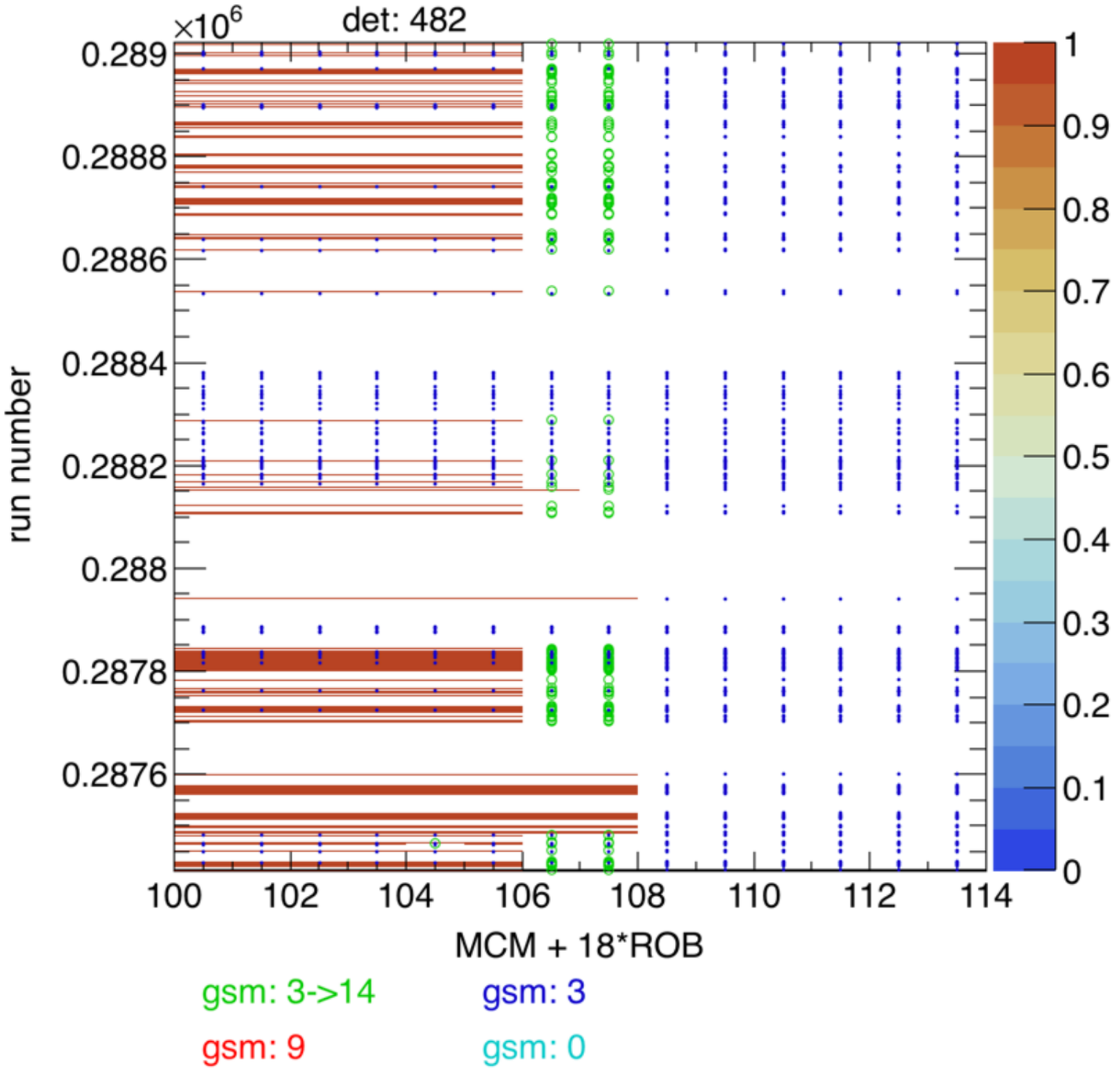
- The whole half chamber switches to mode 9 (**full readout**).
- Board merger and half chamber merger also switch to gsm state 14.
- At some run id the MCM which is causing the problem switches to gsm state 0 (**low power**).
- This does NOT cure the problem.

GSM States: TRD det. 482



- For this detector the states are at least sometime good (3).
- Again one MCM is causing the problem, mode 14 but it does not change to gsm state 0.

GSM States: TRD det. 482



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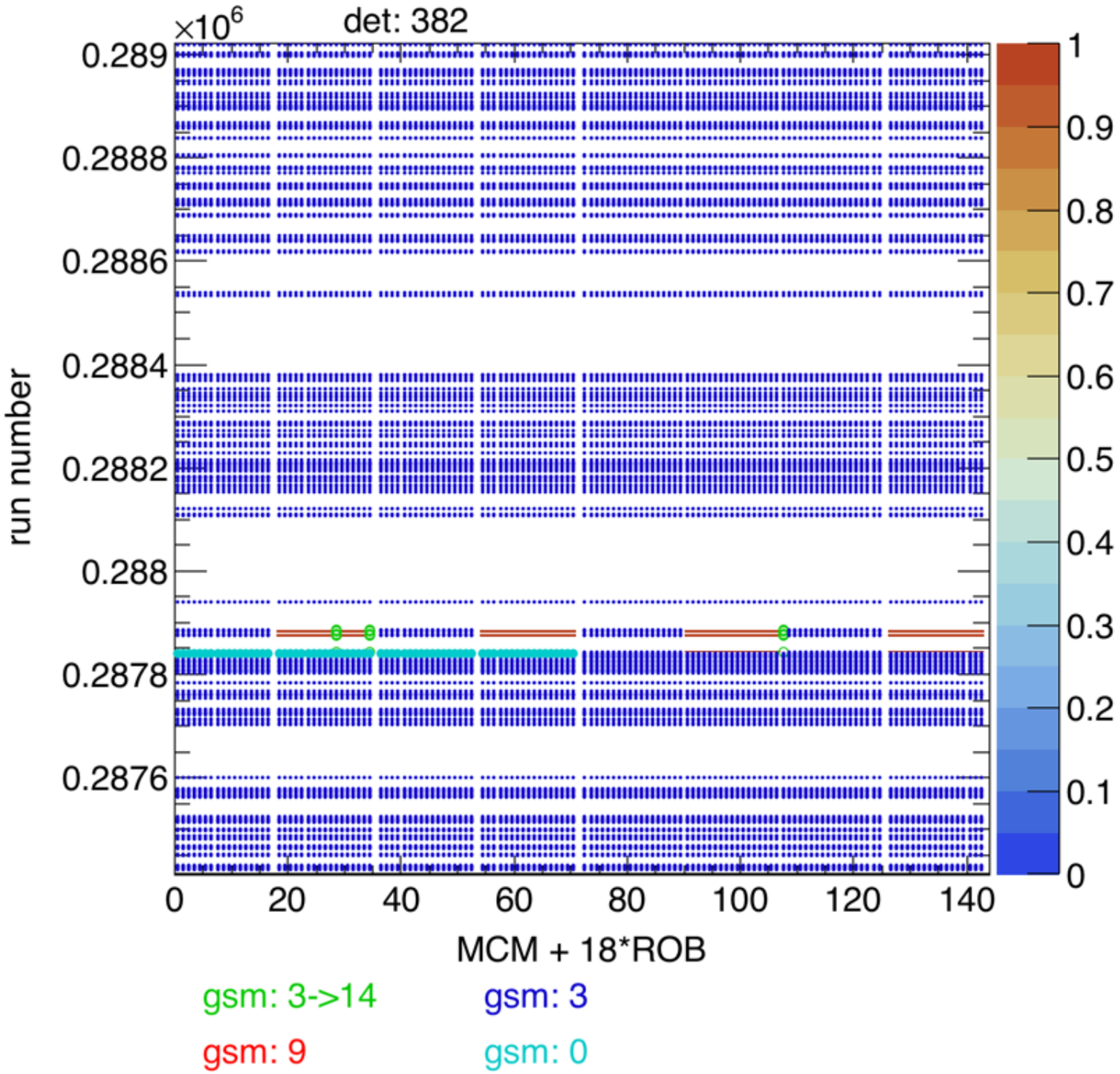
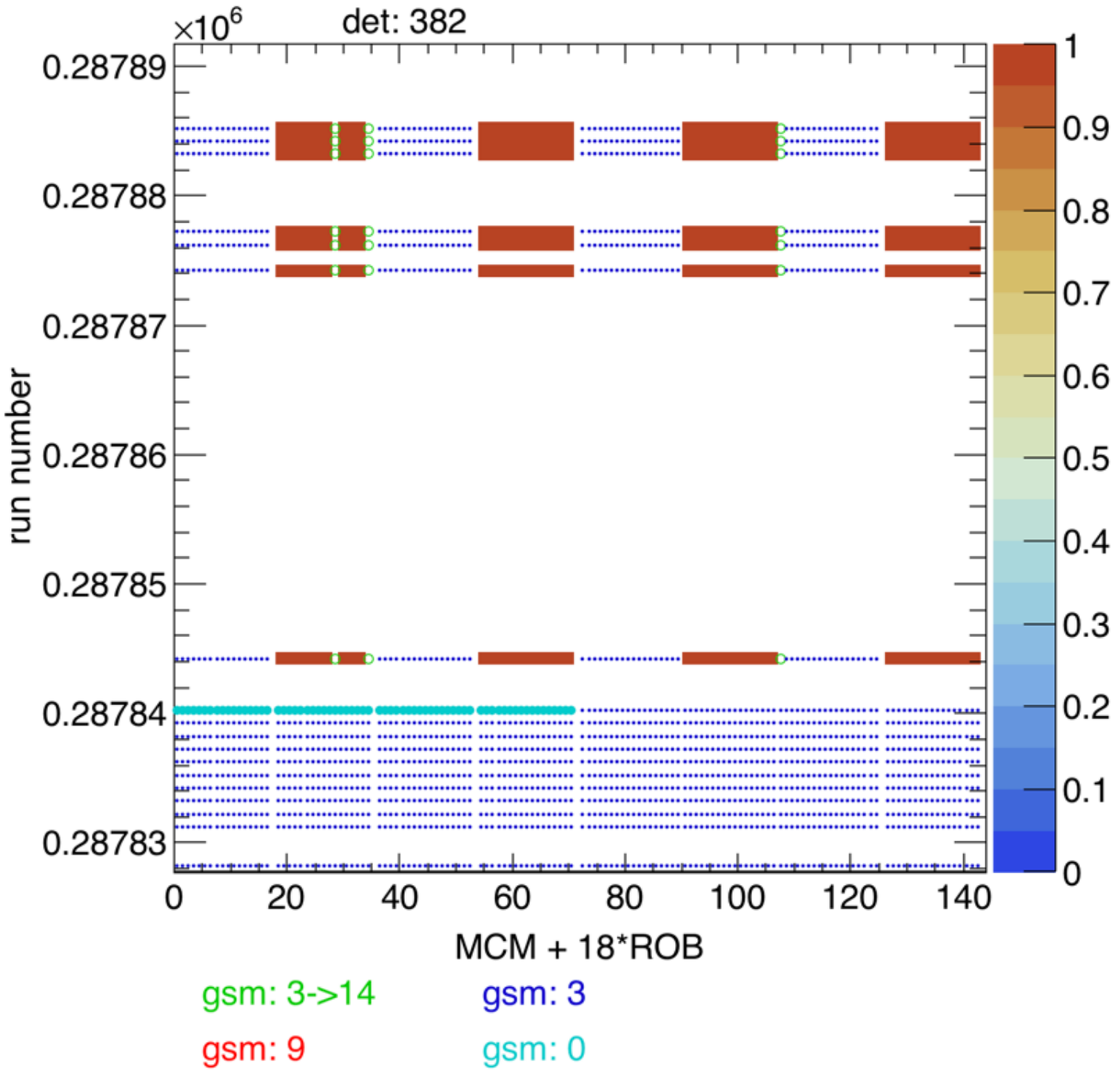


- This detector shows a really weird error. The event and trigger counters are all fine, then they are both off by exactly one bit (bit 17, not shown here). At this time they are still in mode 3 (wait pre trigger).
- At some point the first 4 ROB switch to gsm state 0 (**low power**), then one MCM within those 4 ROB is causing a problem, gsm state 14 (**tracklet send**), the half chamber then switches to gsm state 9 (**full readou**t).
- Later the two counter are again in perfect agreement with ALL other MCMs.
- The 4 ROB are from different half chambers. It is not at all easy to understand how this could happen. Sebastian and I discussed it with Venelin. There might be some possibilities but its not conclusive yet.

GSM States: TRD det. 382



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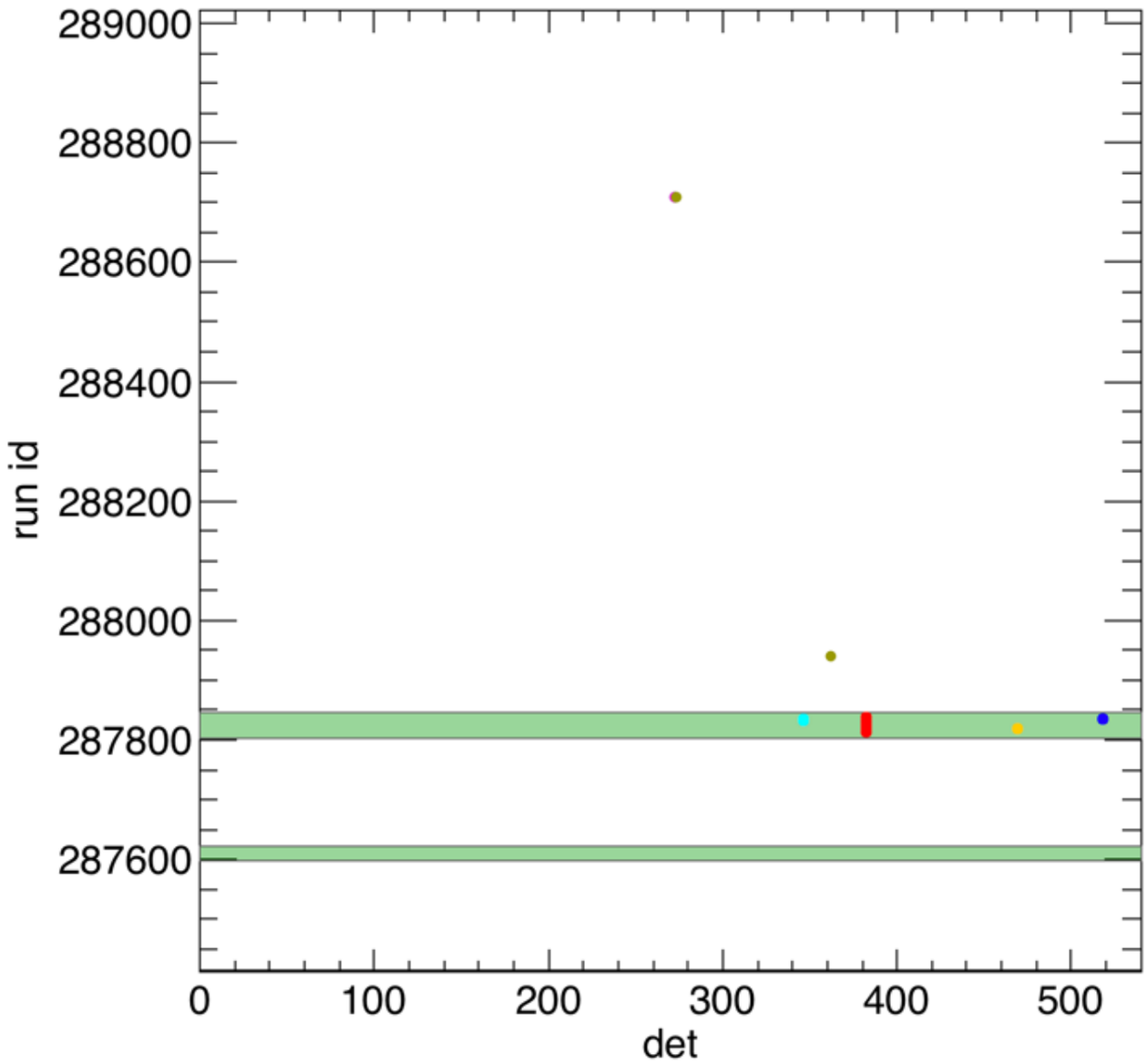
Bit Flips: Run Id vs Detector



- Different color means different bit flipped, bits 0, 1, and 32 are excluded.

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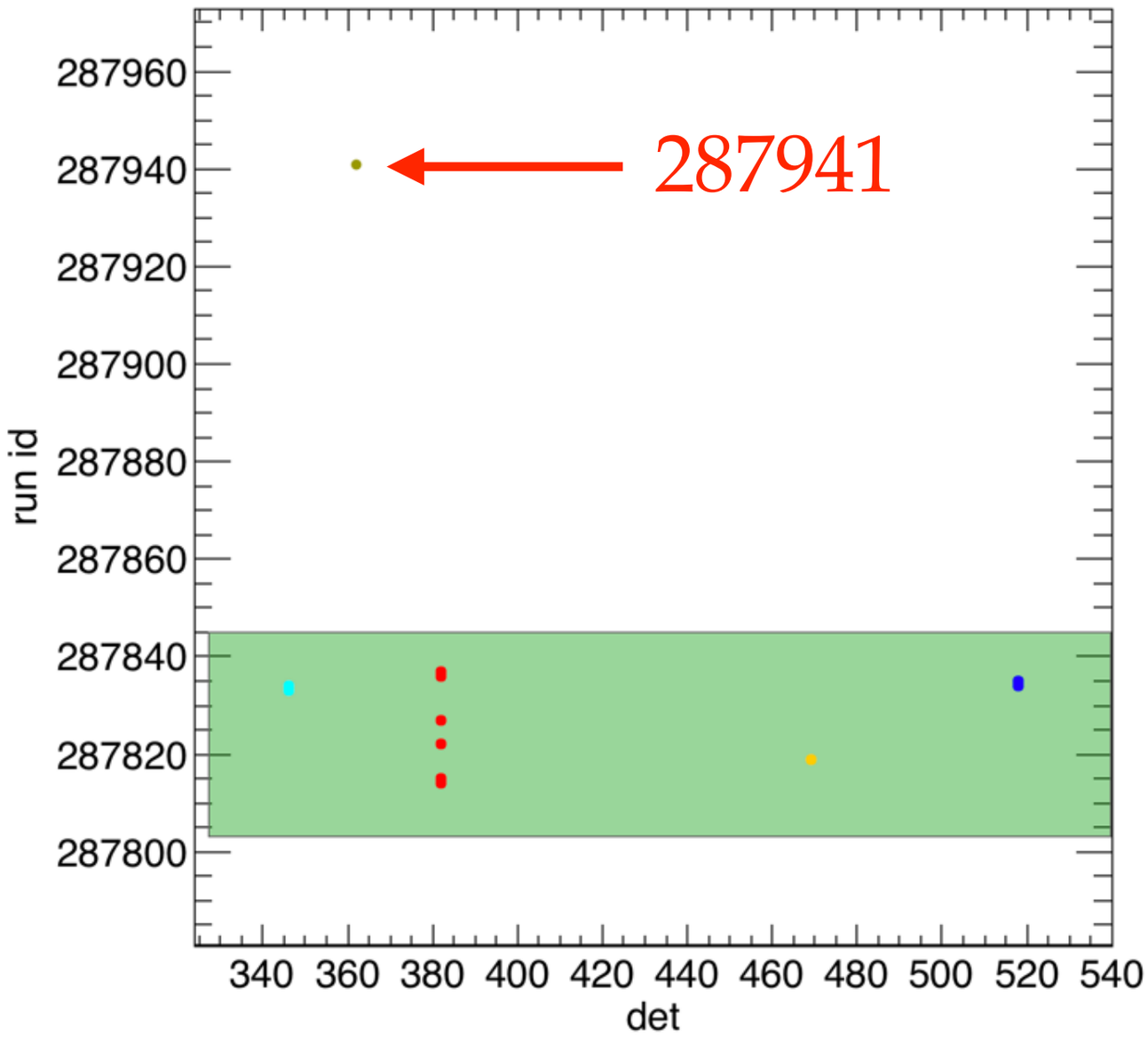
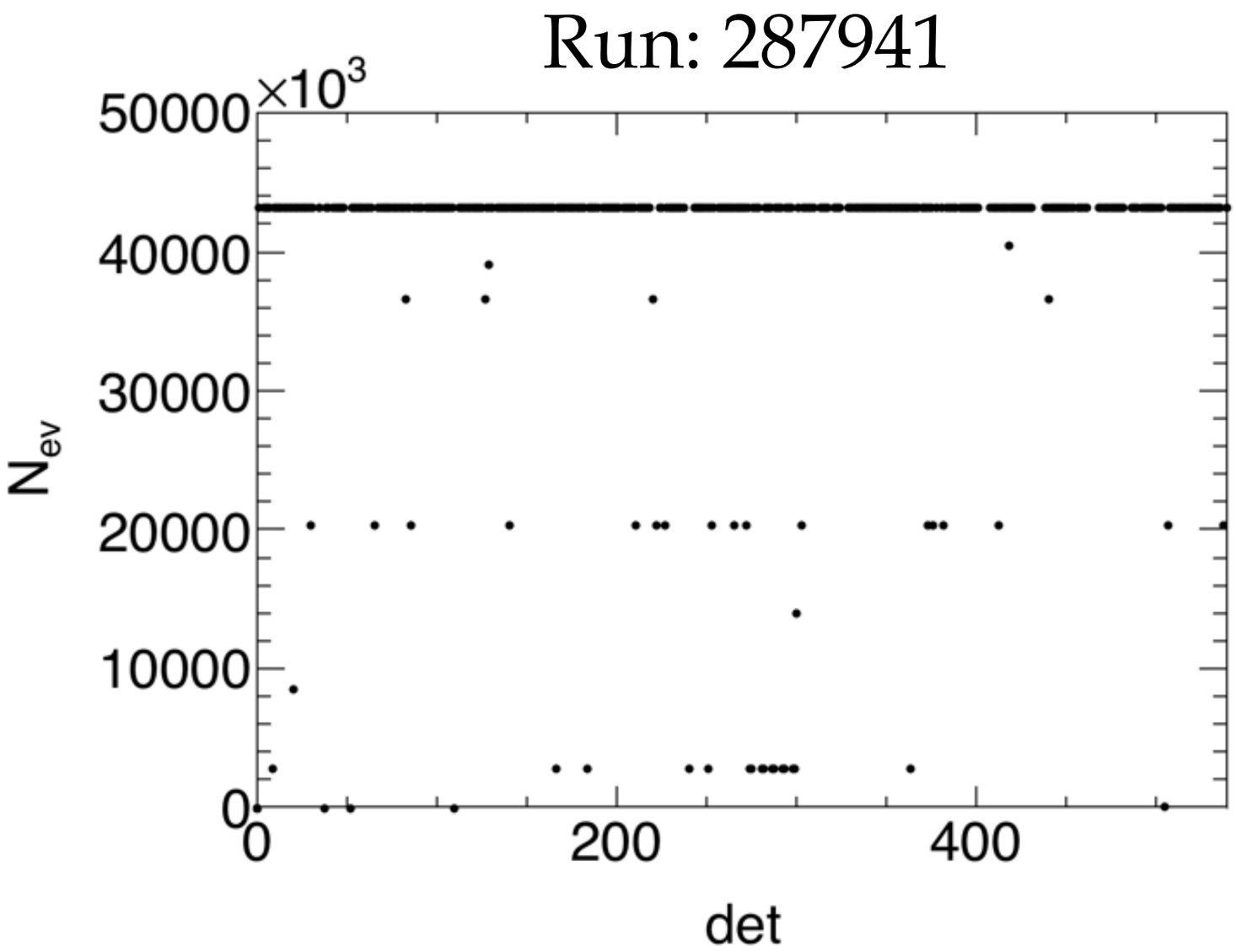


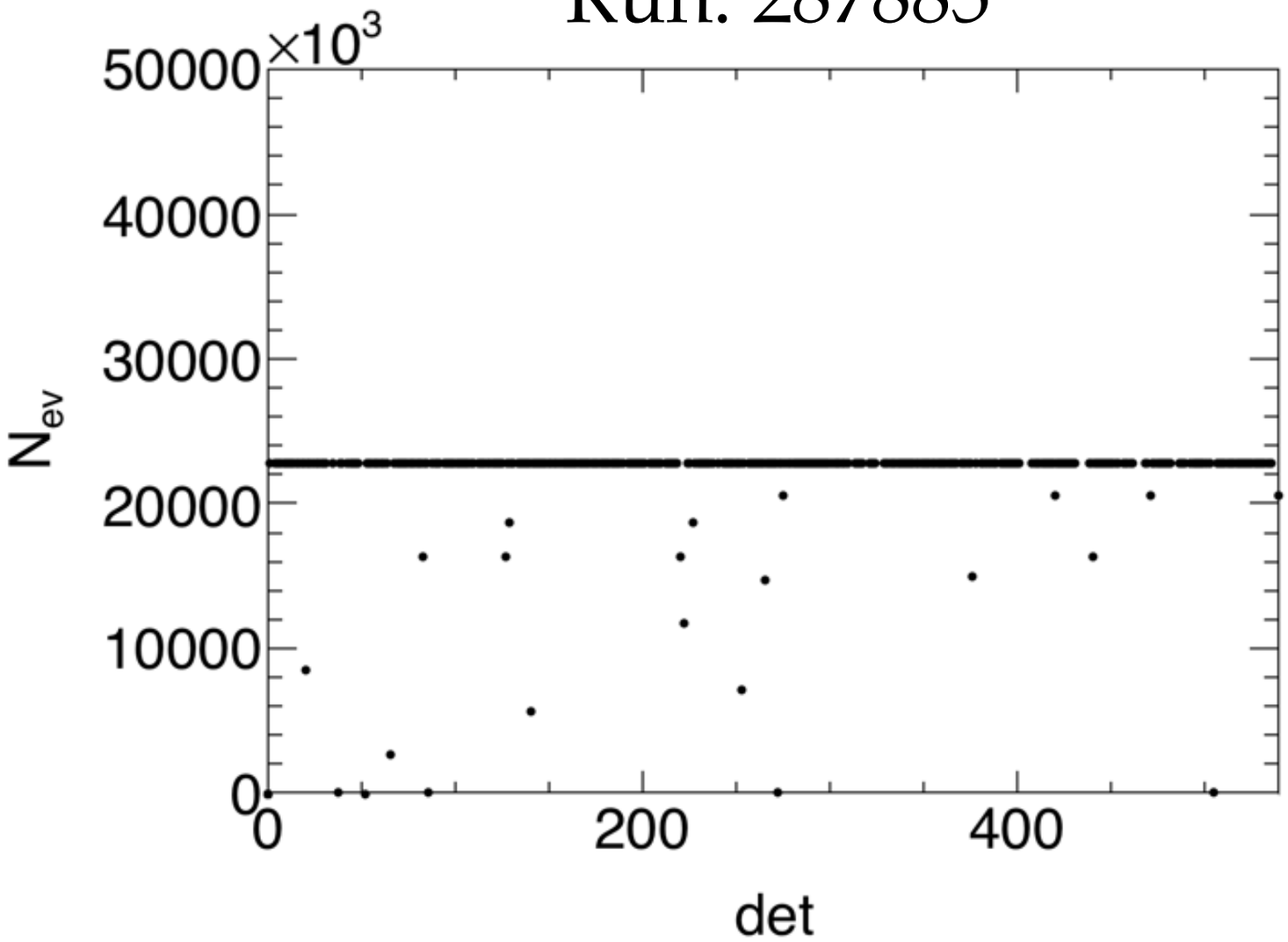
- Different color means different bit flipped, bits 0, 1, and 32 are excluded.
- Most of the bit flips occur during the high luminosity run.

Event Counter vs Detector



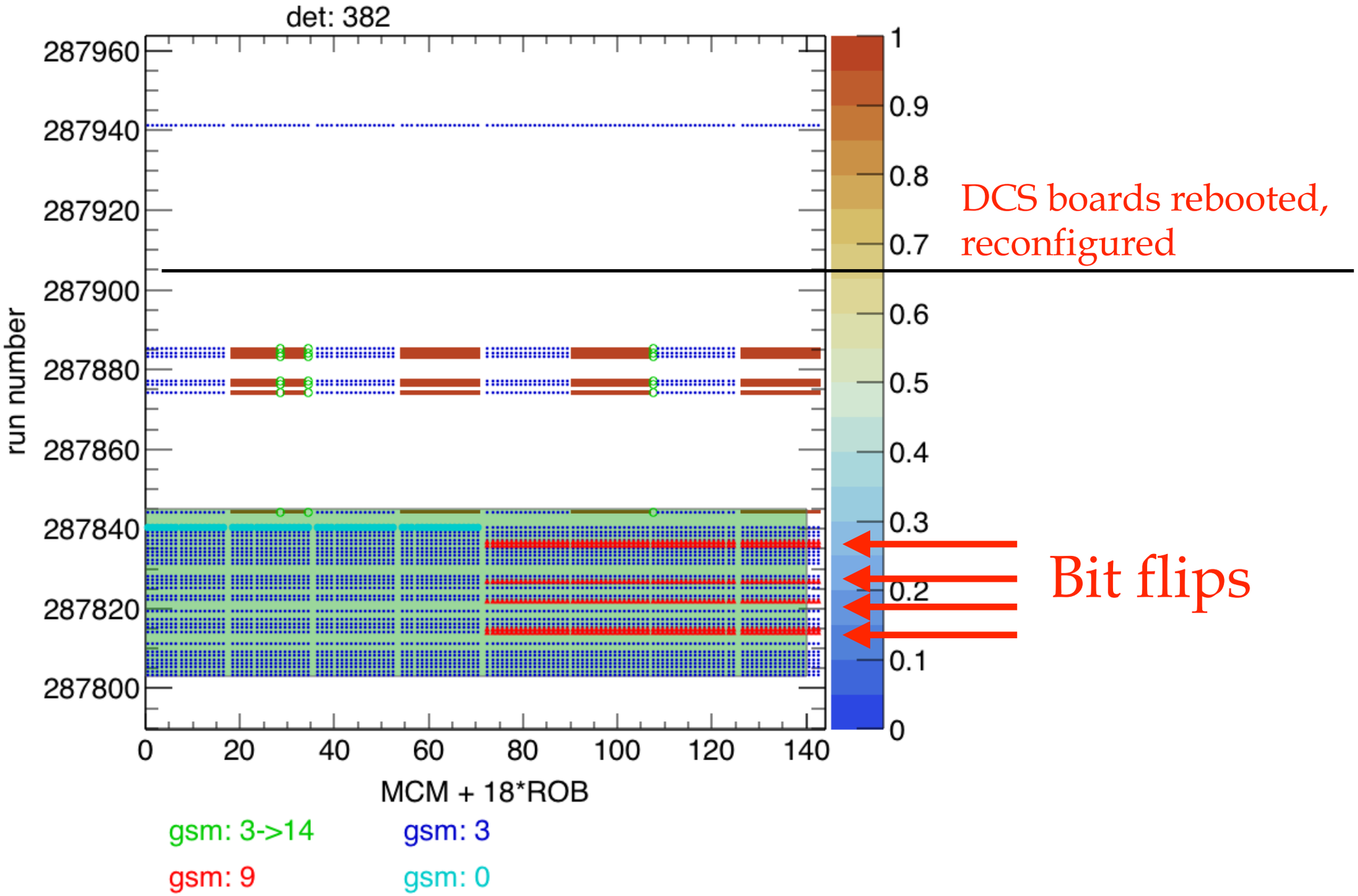
- Most of the detector have the same event counter.
- 17 stop simultaneously at an event counter of about 20M.
- At least two more simultaneous stops of event counters for this run.

Event Counter vs Detector



- This previous run shows much less simultaneous event counter stops.

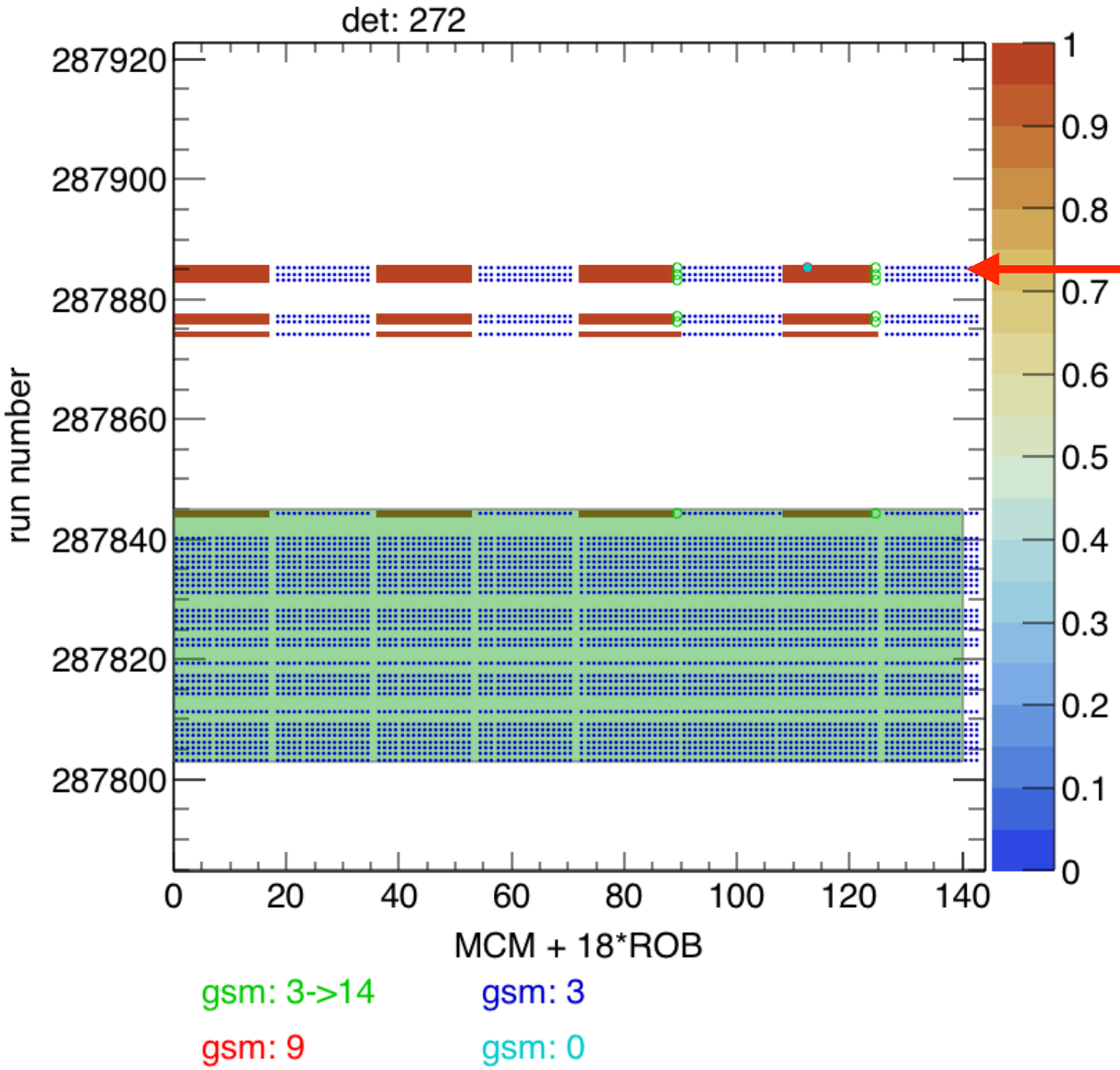
GSM States: TRD det. 382



DCS boards rebooted, reconfigured

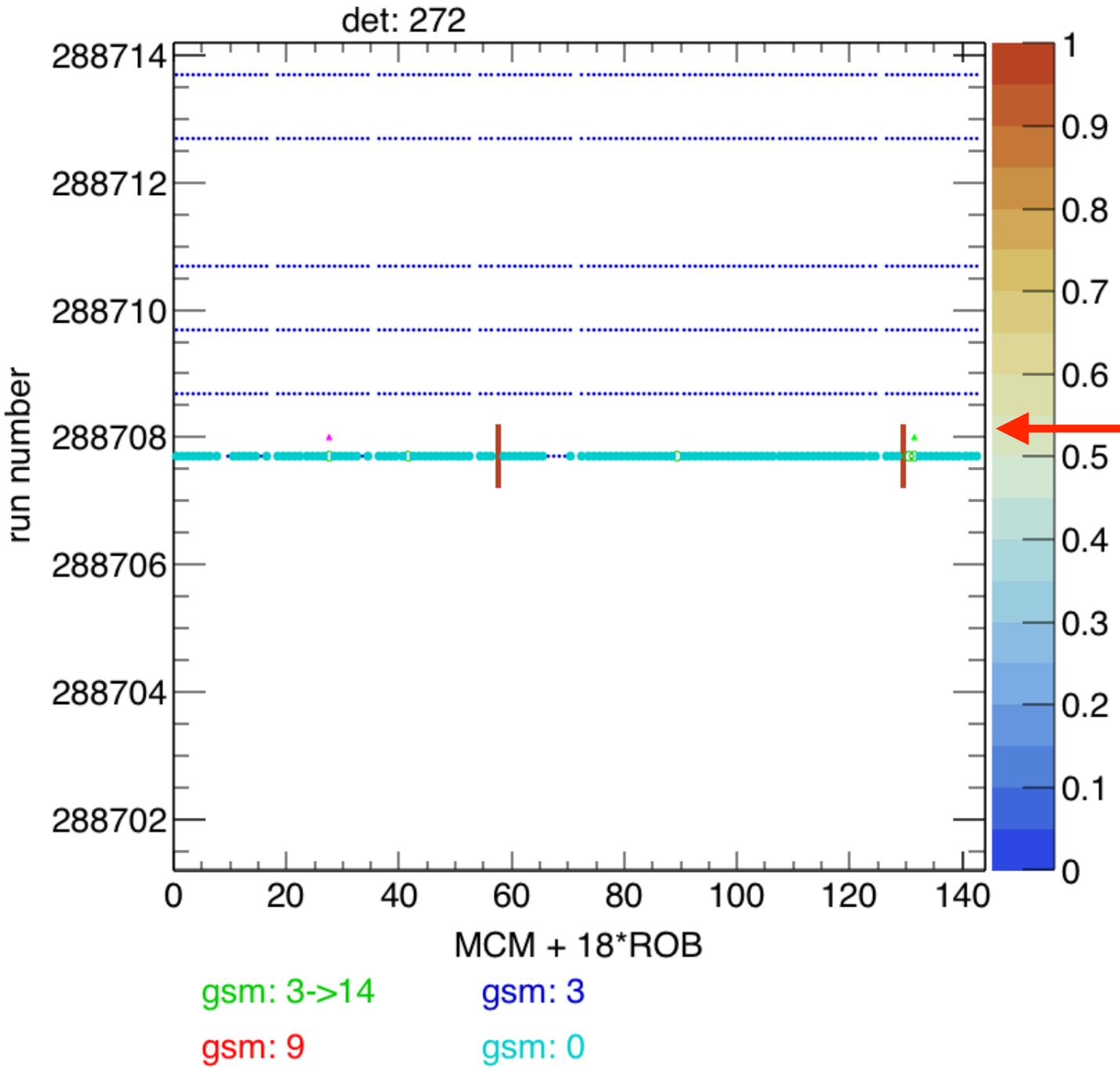
Bit flips

GSM States: TRD det. 272



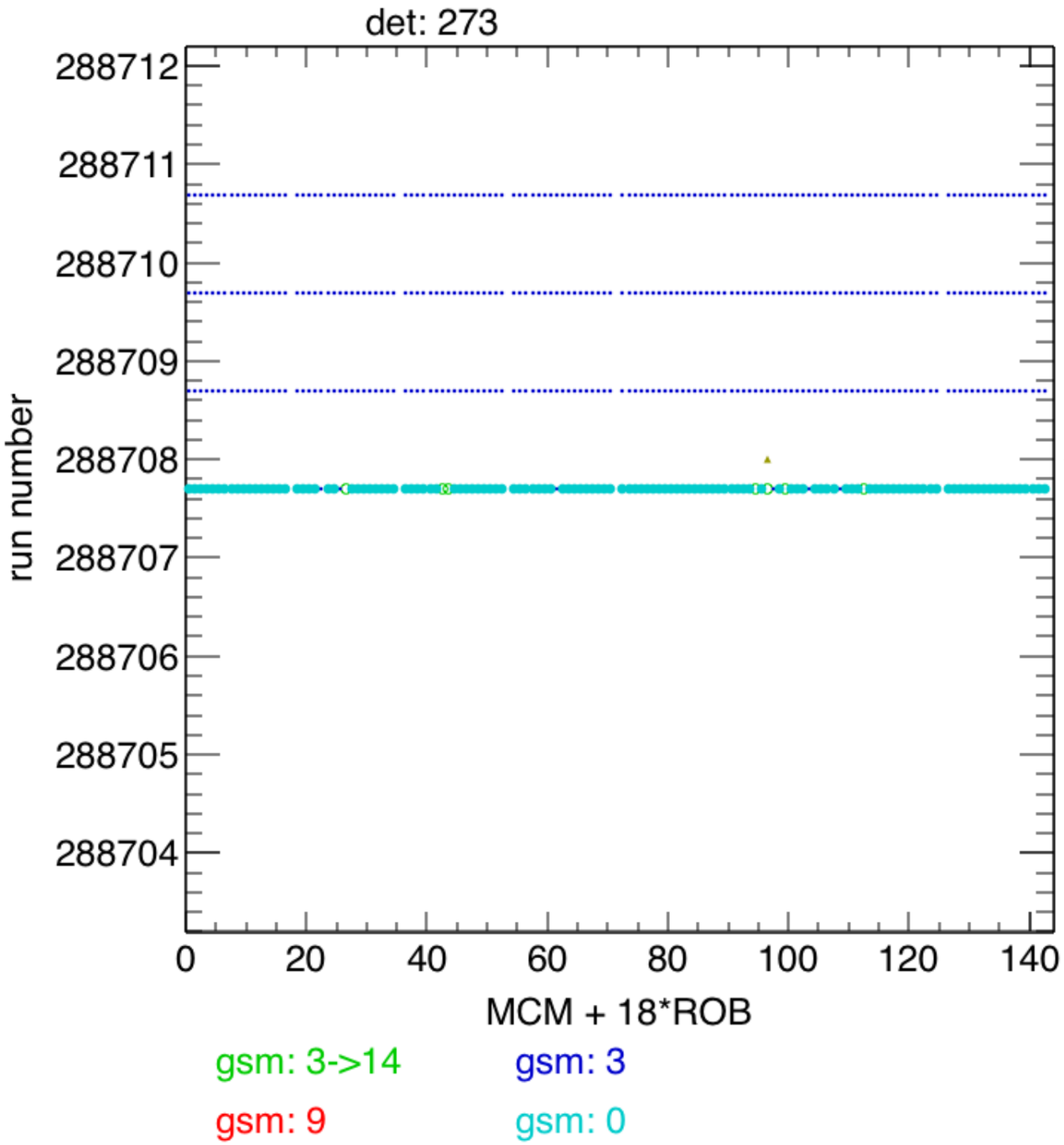
"Just" gsm state 0

GSM States: TRD det. 272



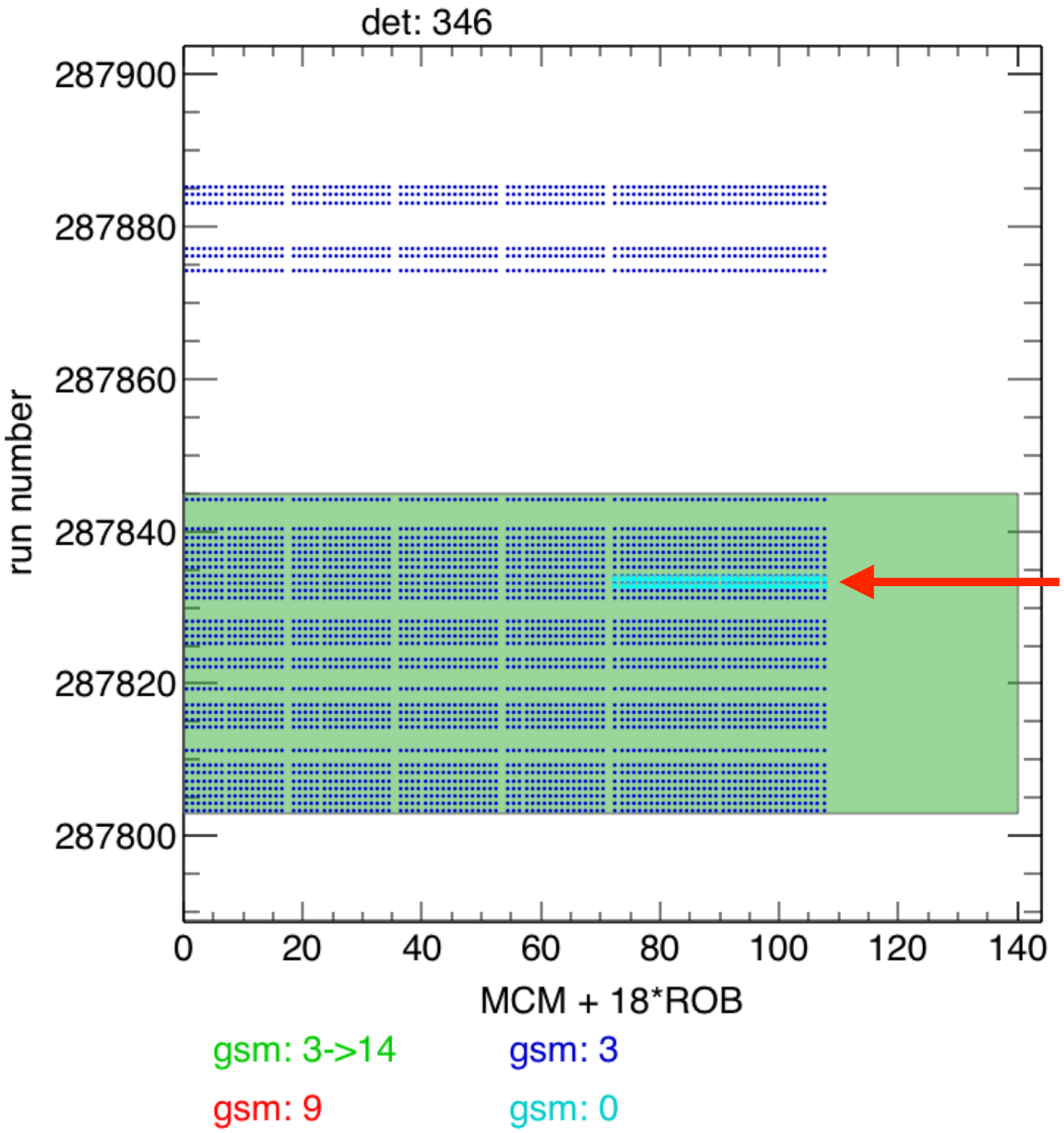
Bit flips

GSM States: TRD det. 273



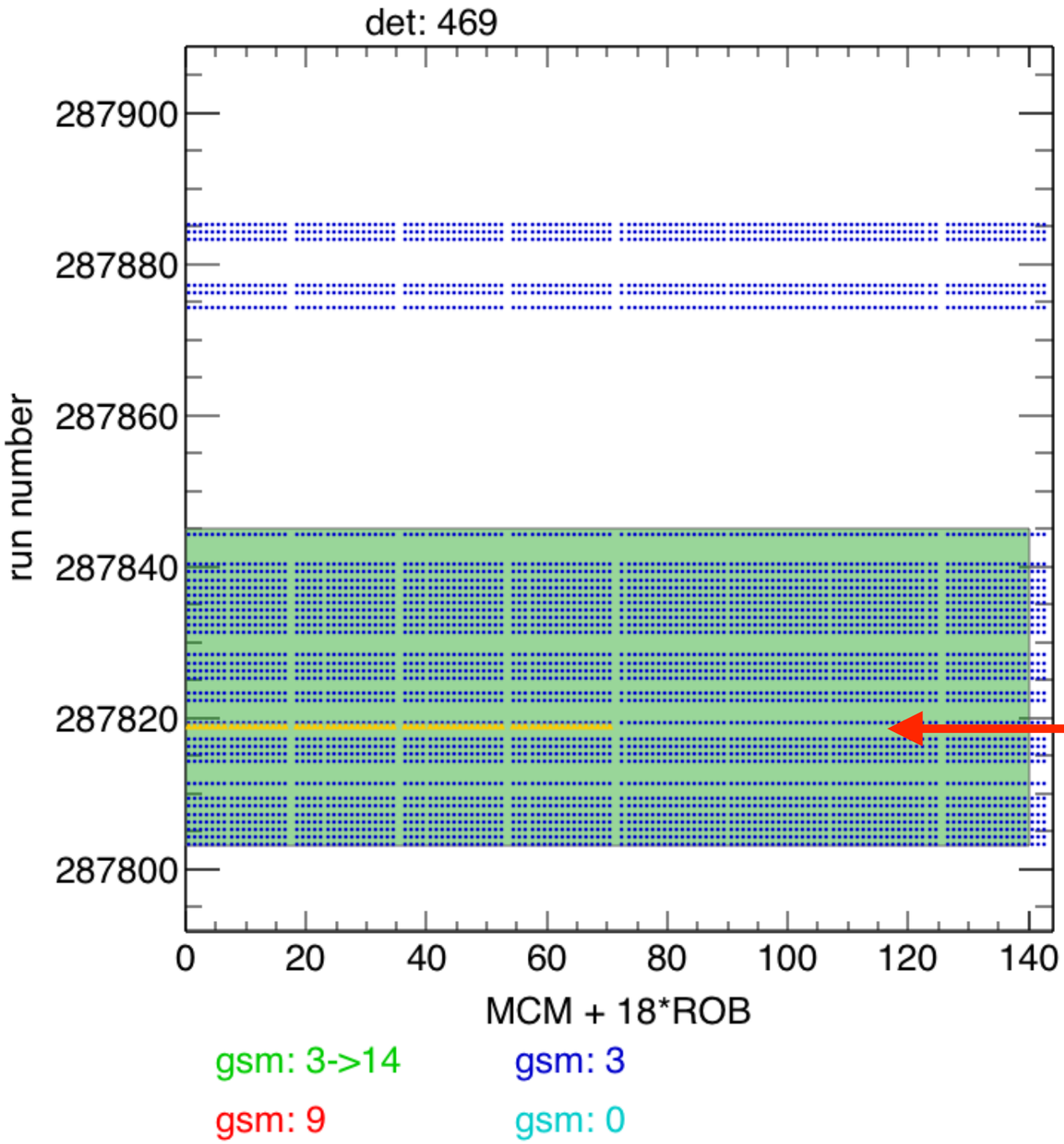
Bit flips

GSM States: TRD det. 346



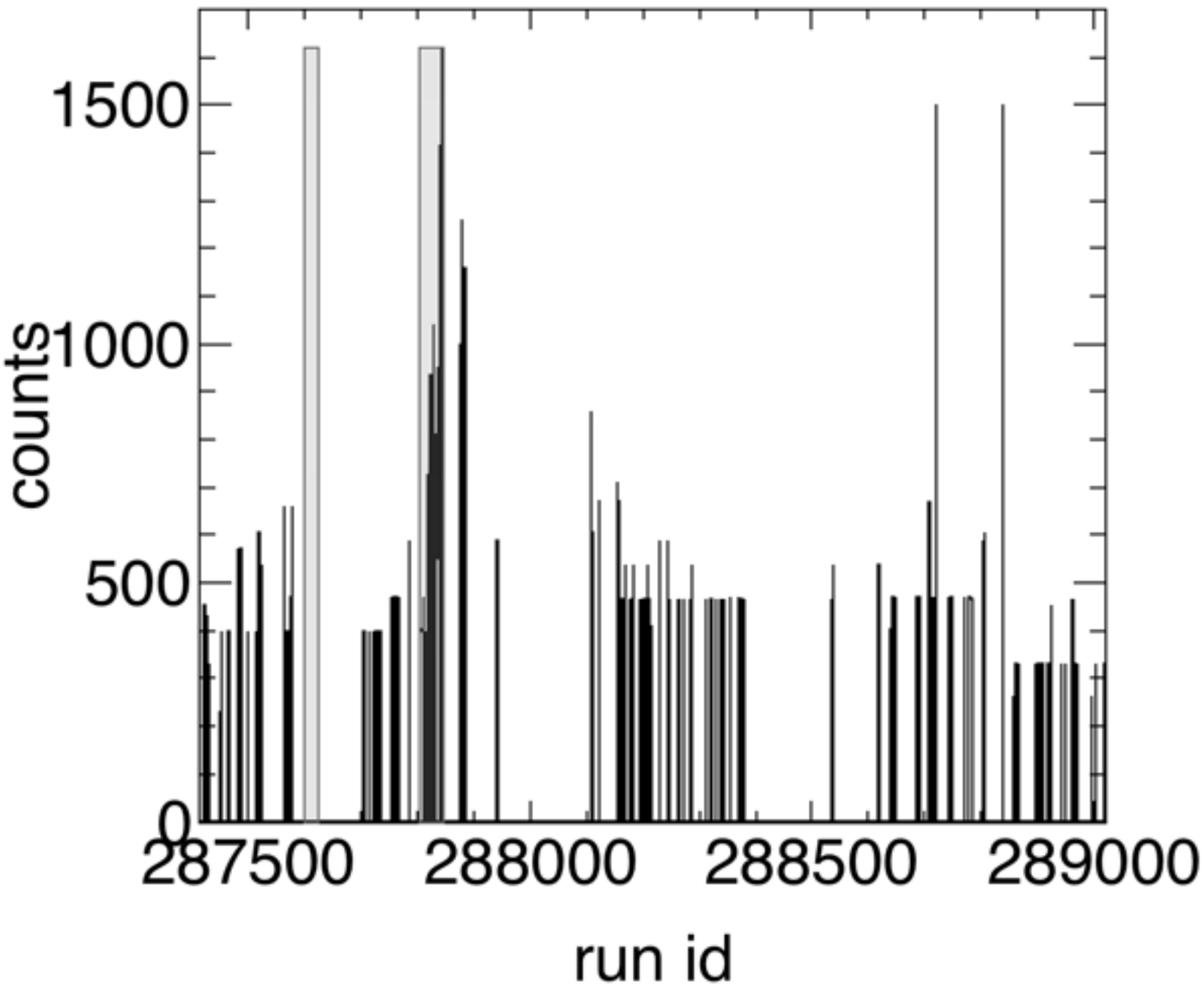
Bit flips

GSM States: TRD det. 469



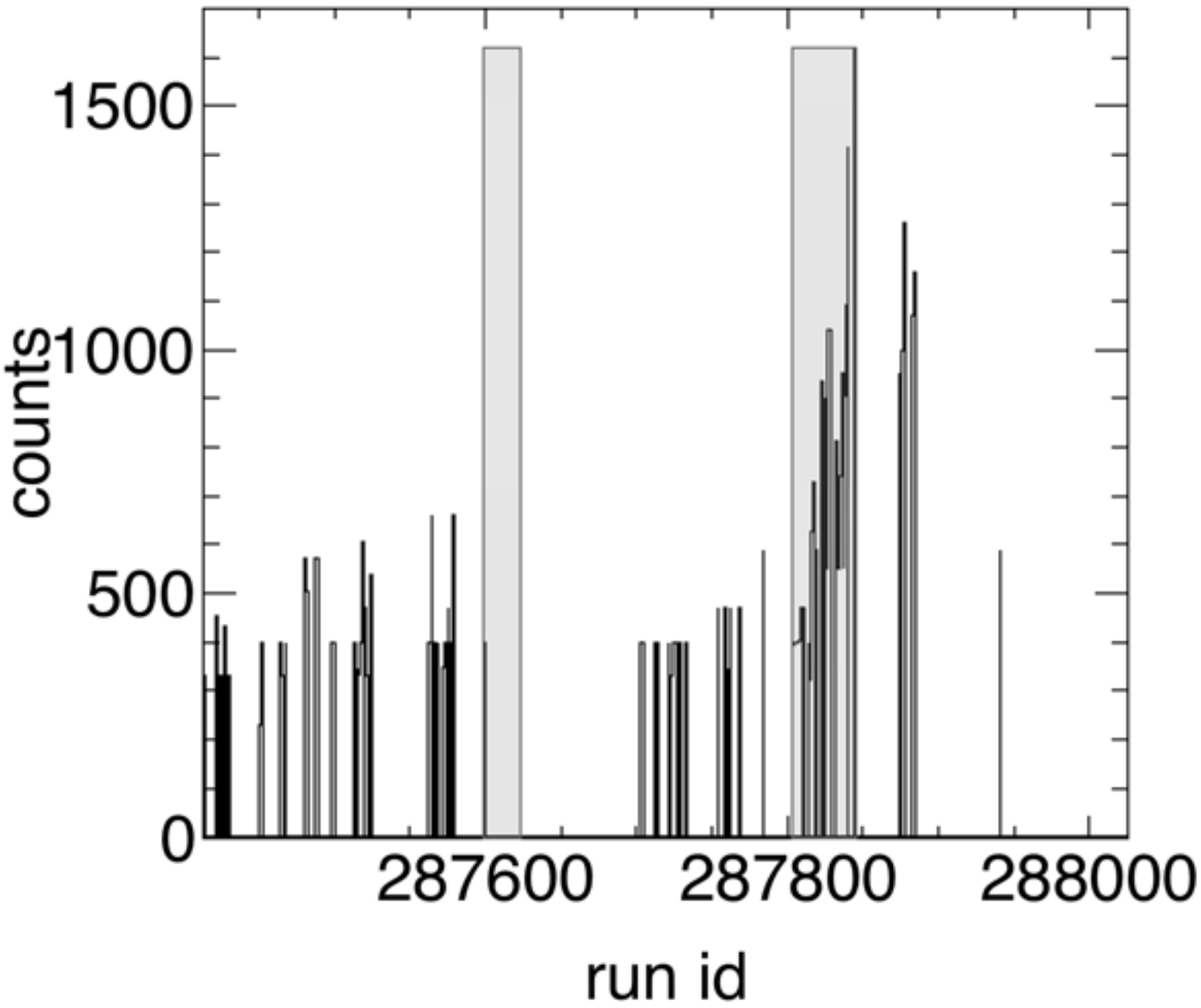
Bit flips

MCM Errors vs Run Id



- Errors seem to be more frequent during high luminosity run (gray shaded areas).

MCM Errors vs Run Id



- Errors seem to be more frequent during high luminosity run (gray shaded areas).
- Similar amount of errors just after second high luminosity run.

Conclusions and Next Steps

- Some MCMs shows the problem always at the very beginning of a run.
- No clear correlation with the high luminosity so far for the detectors analyzed but more detailed studies are needed to make a definite conclusion.
- Some information is not yet analyzed, e.g. the Network Interface (ni) states, which might give some additional information.
- I will also look into other detectors which do not create a problem at the very beginning of a run.
- More discussions with Venelin are needed to understand how some errors can happen.