Noisy pedestals

F. Brun, P. Sizun, B. Vallage, E. Delagnes,

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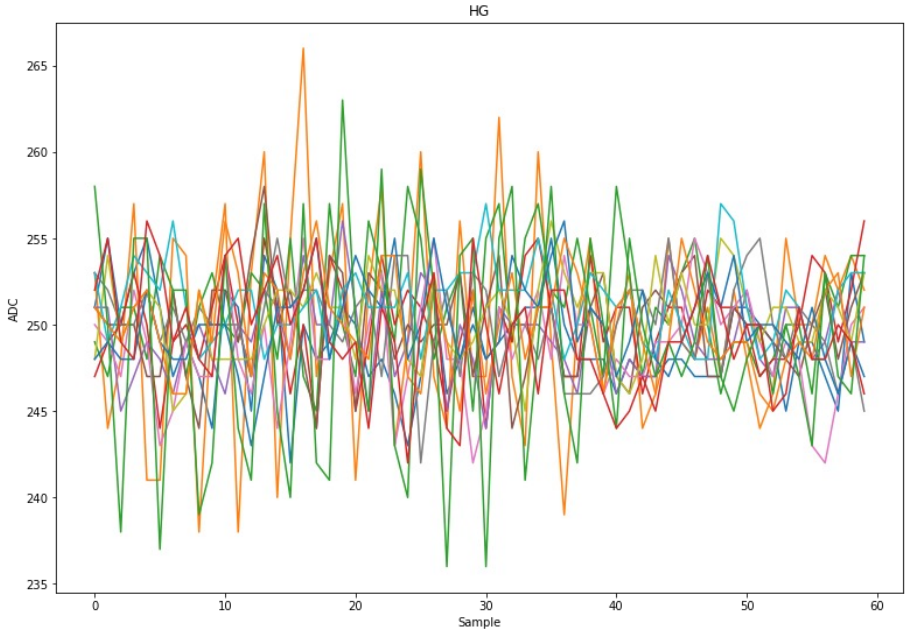
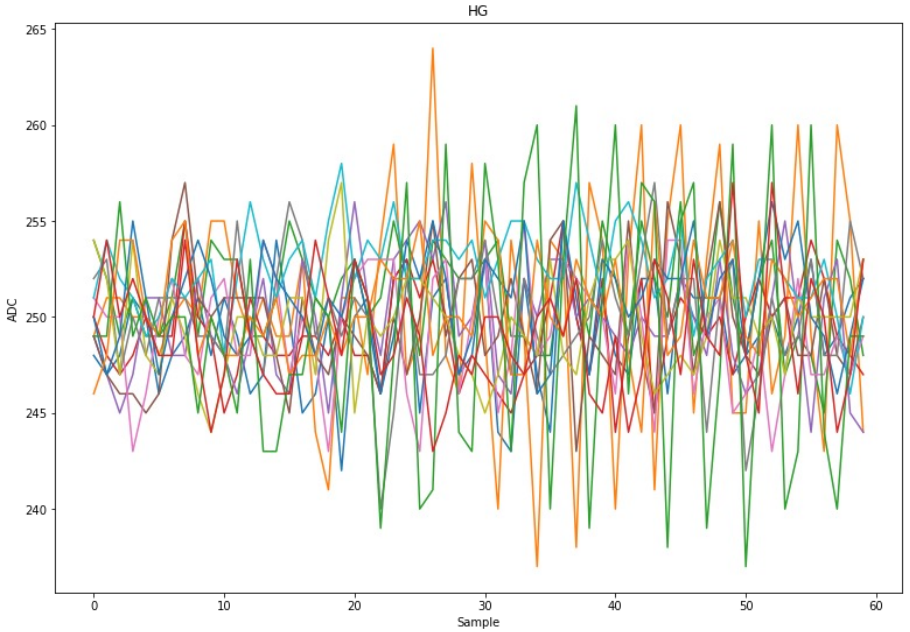
During FEB v6 tests

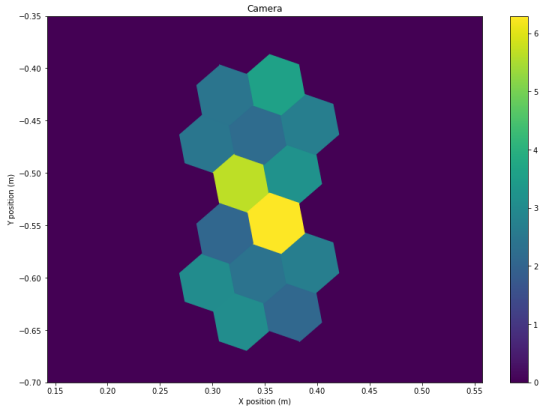
In March 2021 : Among other kind of noises : noisy events in HG with burst of oscillations

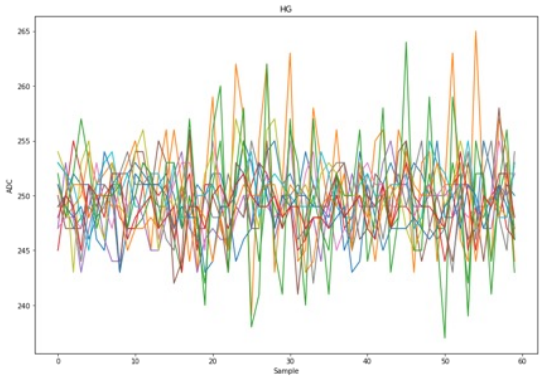




During FEB v6 tests

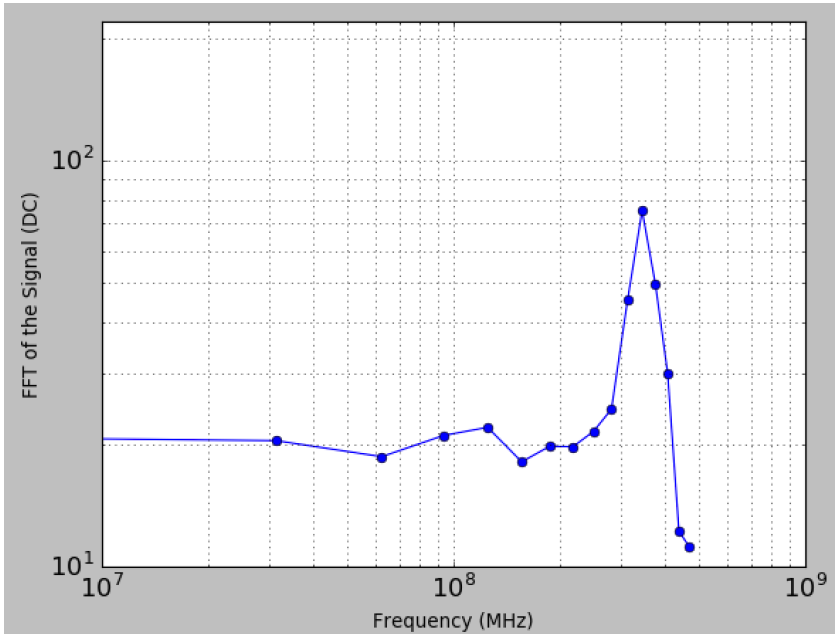
- Noisy HG events : burst of noise in some pixels
  - Pseudo-oscillations at ~300 MHz
  - Present with HV Off
  - Already present with FEB v5
  - Linked to the FPM?





Long-standing issue

- Also observed at IRAP :
  - In the FPM test bench
    - First seen using FF source without shielding
    - Observed on the FPMs used in adlershof (see IRAP analysis here)
    - Observed on the FPMs used in the QM (see here)
  - FPM is sensitive to electromagnetic noise



What we know (I)

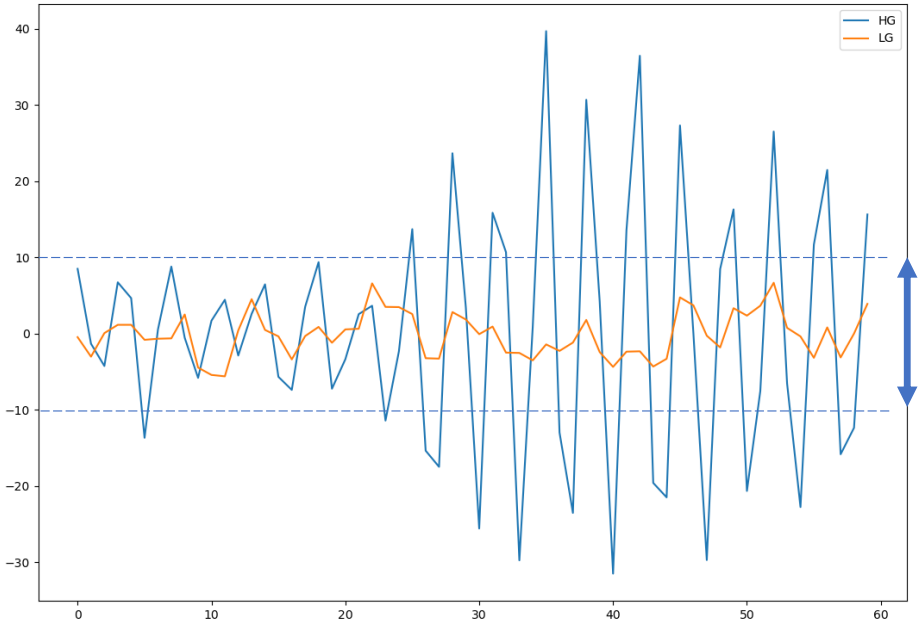
- On the noise signal :
  - 300 MHz damped oscillation signal
  - Amplitude ~ 0.1 to 1 pe
  - Only visible in HG
  - No « prefered » position in the waveform
  - Also no prefered time during the run (not all events at the beginning for instance)
- Still need investigations regarding stats :
  - Present in a non negligible amount of pixels (10% or more)
    - Not constant -> a noisy pixel can become quiet & vice-versa
    - Still need to verify if some pixels are never affected
  - For some pixels, can affect more than 50% of the events…

What we know (II)

- Affects FEB v5 and FEB v6
- Seems amplified when FPM is connected to the module
  - No obvious events in run 2522 which had all modules & no FPMs
  - Note from IRAP analysis : *« [presence of] noise events could depend on the way the FPM is connected »*
- Phase-locking of the oscillations when changing the trigger type
  - **Analysis comparison of runs 3311 and 3312**

Noisy pixels detection

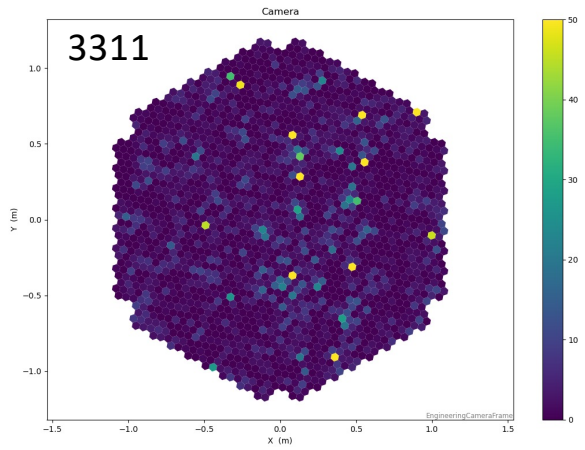
- Typical waveform (pedestal subtracted) :

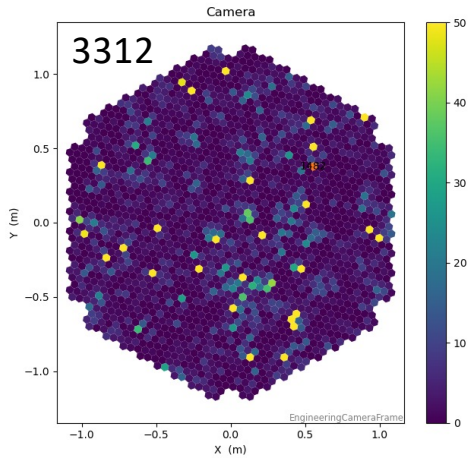


-> Select events that have a difference between min and max in the waveform > 20 ADC
-> Other estimators possible

Noisy pixels in Runs 3311 and 3312

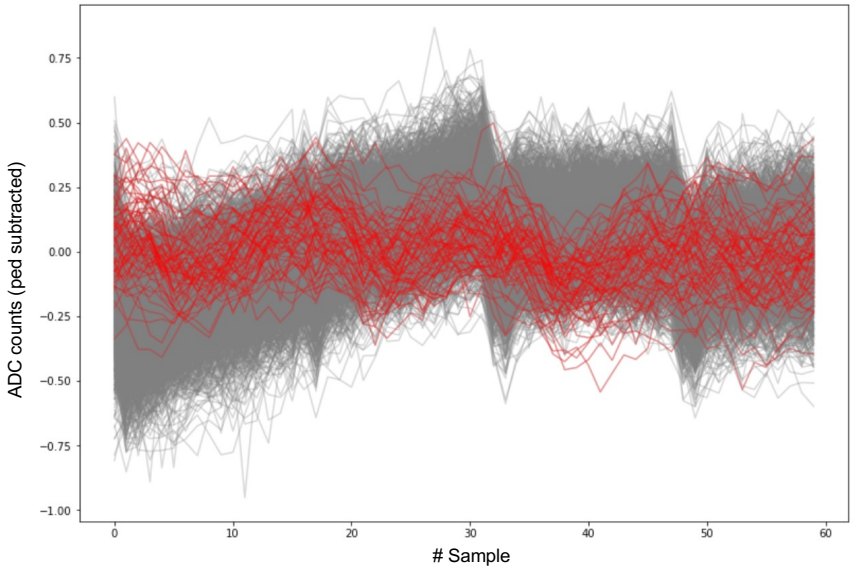
- Runs parameters :
  - 3311 : **pedestal** trigger mode at 7 kHz periodic with high voltages
  - 3312 : **calibration** trigger mode at 7 kHz periodic with high voltages **with 0 LED**
- #Noisy events per pixel (color max set to 50)





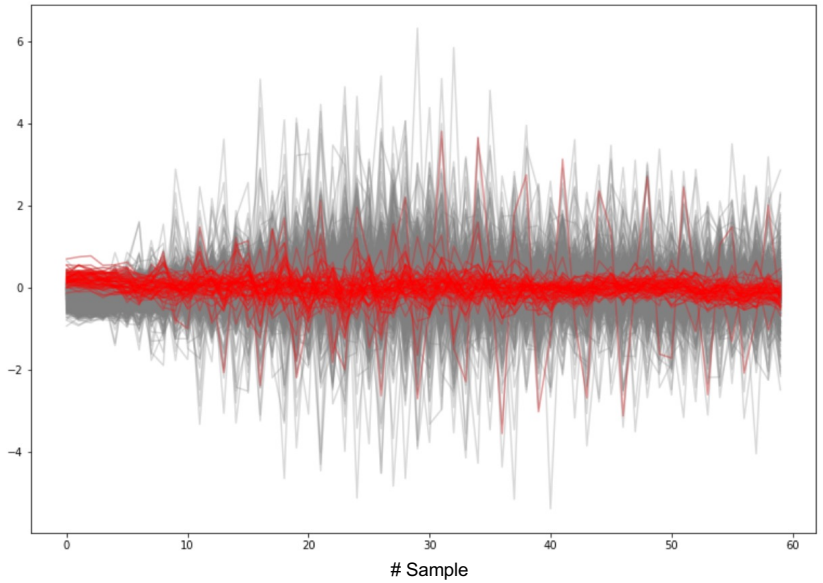
- Patrick's observations : mean waveforms show an oscillating pattern for run 3312 (calibration trigger mode) but not for run 3311.

For run 3311, the mean waveforms are the following (FEB v6 pixels indicated in red)



→ No pixel show particularly oscillating behavior

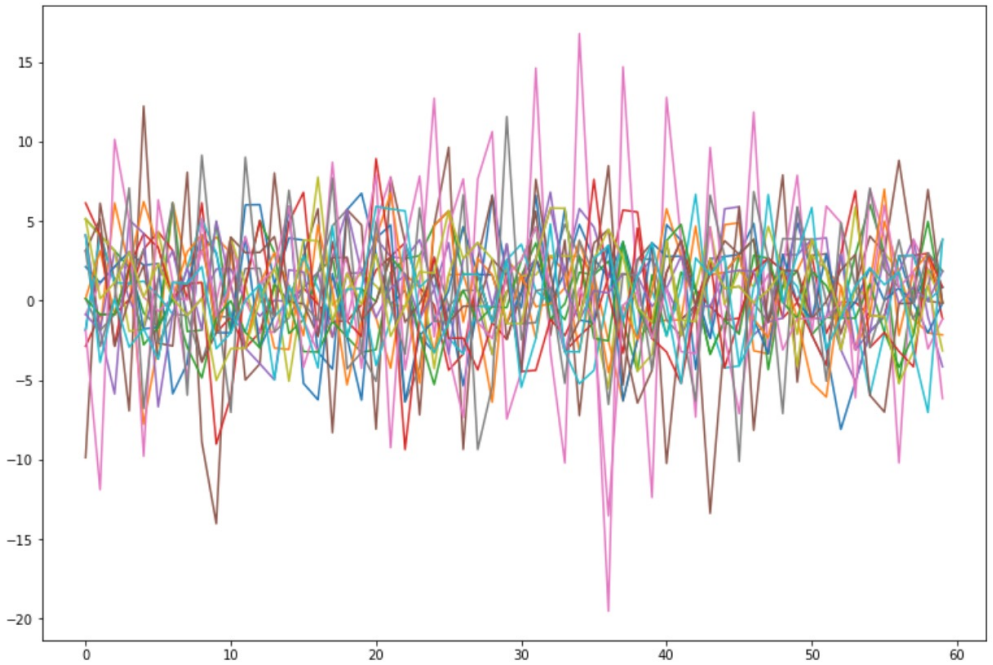
For run 3312, the mean waveforms are the following (FEB v6 pixels indicated in red):



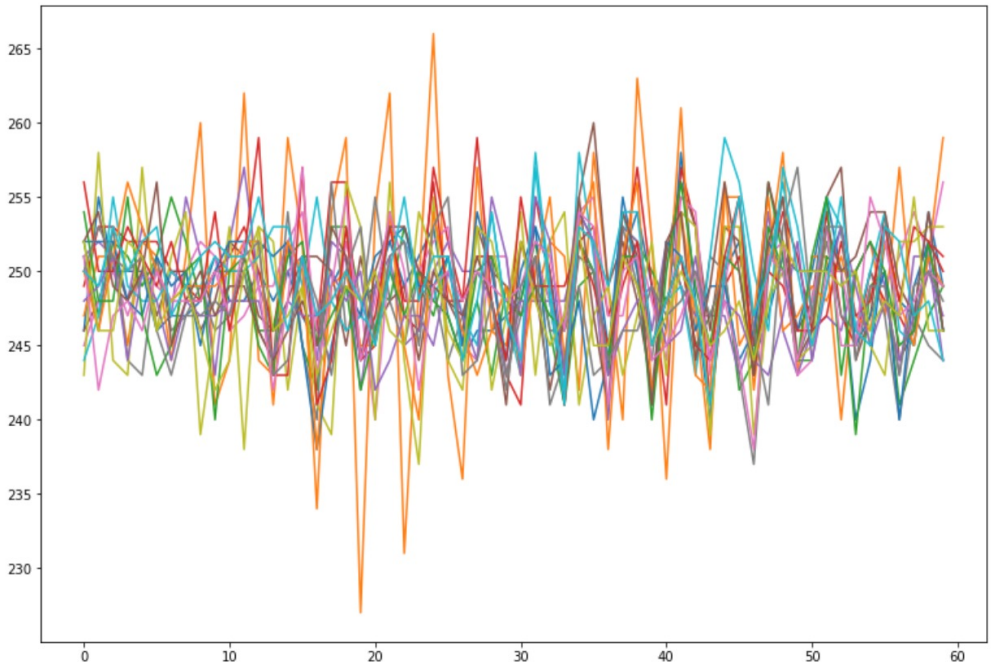
→ Some pixel show particularly oscillating behavior - no matter whether they are v5 or v6

Why ?

Run 3311 :



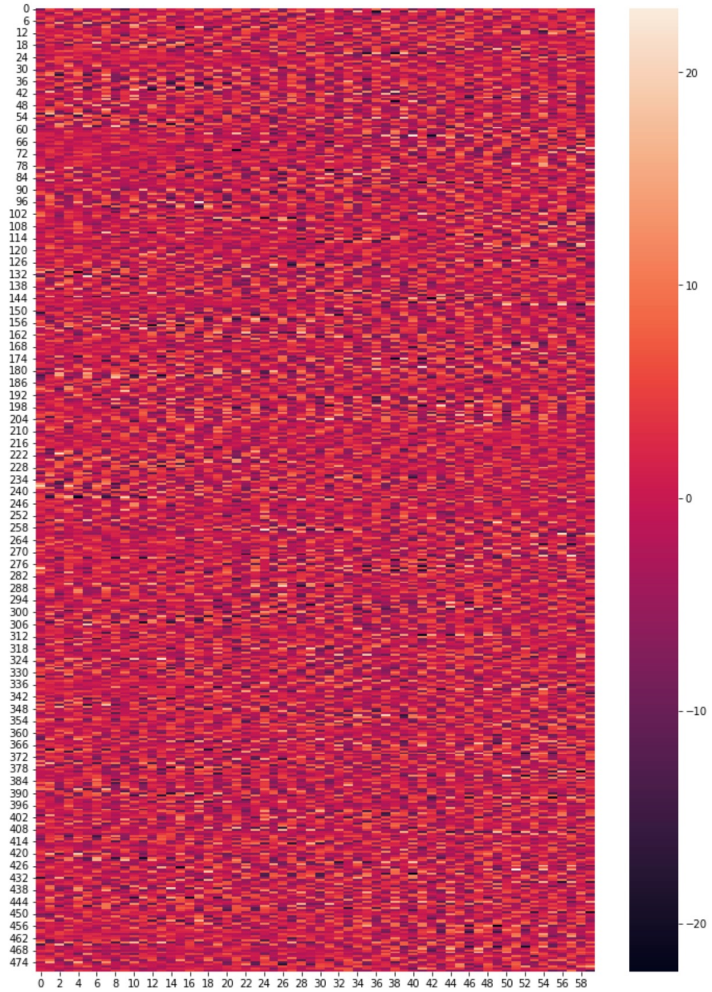
Run 3312 :



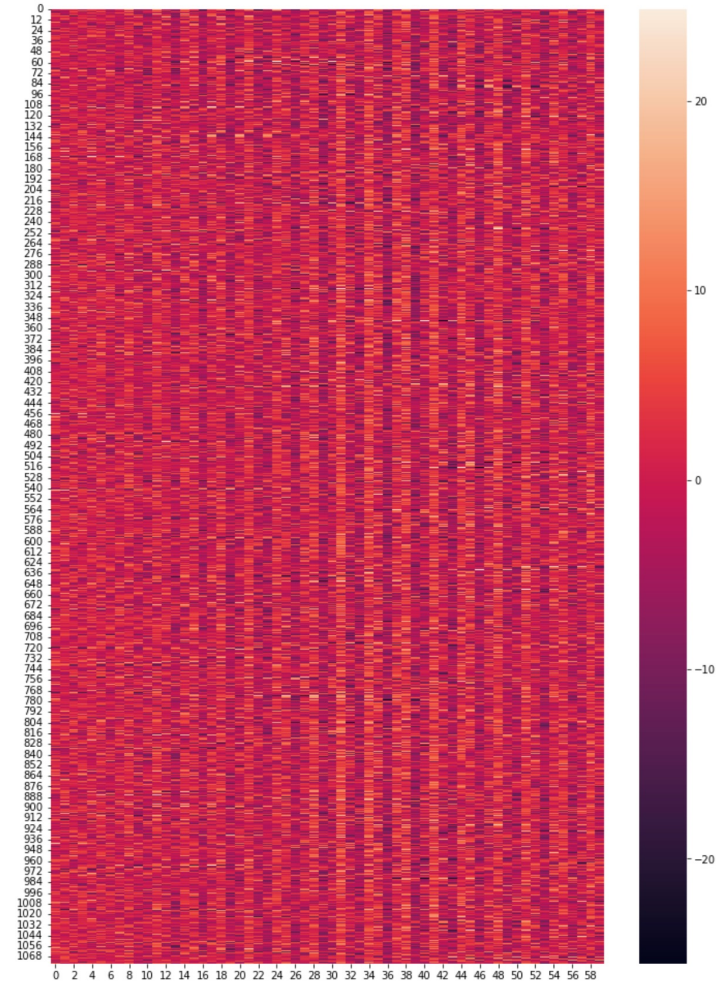
→ While there are oscillating events in both cases, for run 3312, they look to be more “in phase” an more “systematic”

- Noisy events of pixel 1482
- One ped-subtracted waveform per line
- Same for other pixels showing noisy events

For Run 3311 :

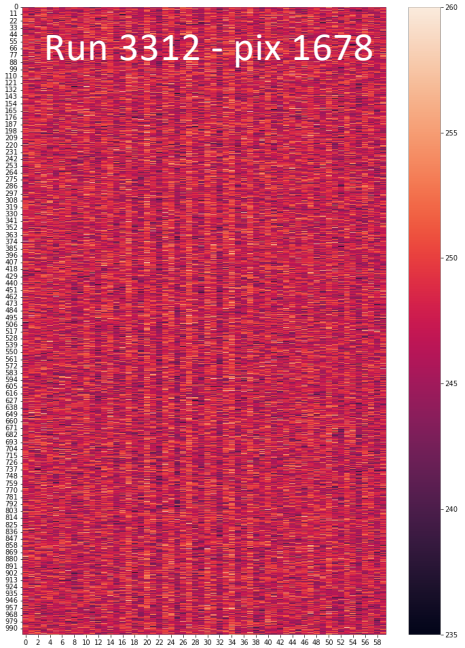


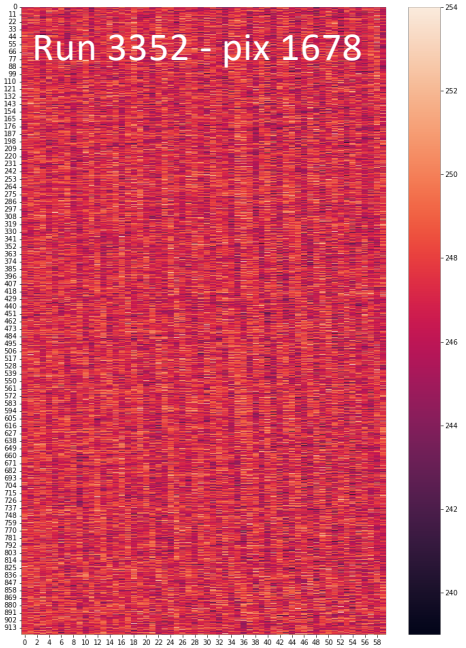
For Run 3312 :



With/without FPM test

- When the FPMs are removed, the effect is not seen anymore on the average waveform (run 3352)
- Without FPM :
  - Phase drift
  - Amplitude of the effect reduced





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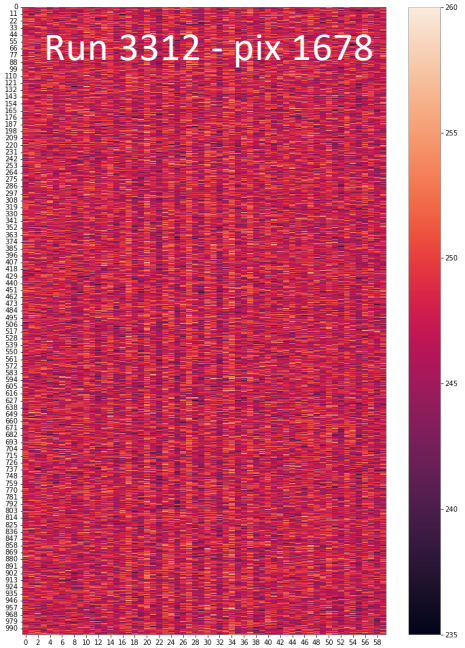
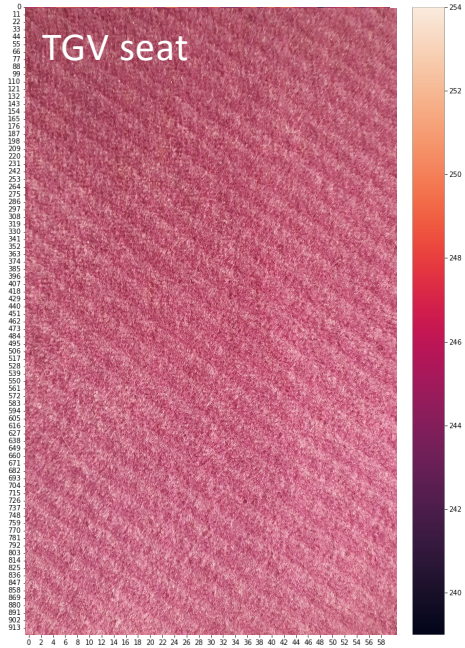
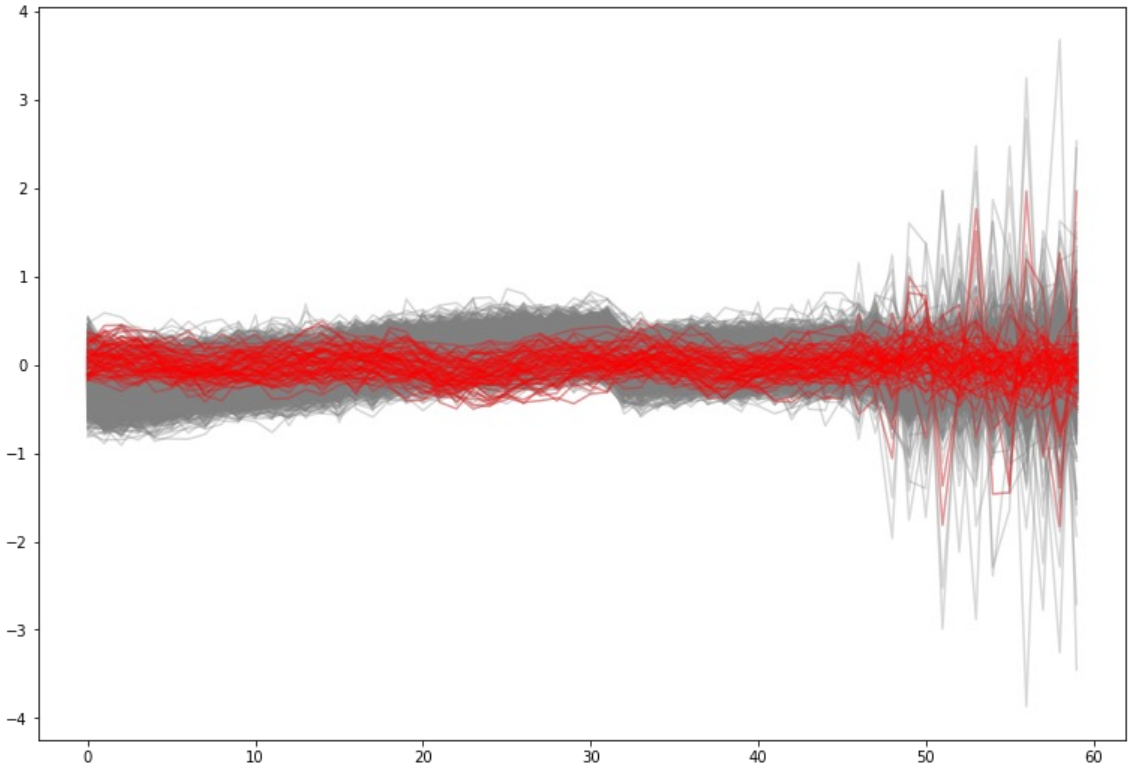




Other tests

- Changing the delay allows to read other area of the memory
  - Run 3354 : delay is 0ns instead of 49ns
  - Mean waveforms show that some part of the memory are not affected by oscillations
- The “phase-locked” oscillating behavior is also observed:
  - In case of random trigger instead of periodic
  - No matter the frequency



Power tests

- Elog : http://nectarcam.in2p3.fr/elog/nectarcam-data-qm/631
- Runs without HV, 1 kHz periodic Calibration triggers with no LED. Noisy event counts / 1000.

  - Run #3500 : all modules **powered through the digital trigger crate** :
    - Oscillations are particularly visible in pixels 70, 1026, 1083, 1482 (not in phase)...
    - 191 noisy events in pixel 1482
  - Run #3501: module 211 still at its position inside the camera but **powered through a lab supply** (24V by L2 jumper removed)
    - 295 noisy events in pixel 1482
  - Run #3502: module 211 **outside the camera** (on top of a ladder), powered through a lab supply, with a **different backplane** (no. 68)
    - 0 noisy events in pixel 1482
  - Run #3505: outside the camera but **powered through the digital trigger crate** (with backplane no. 68)
    - 8 noisy events in pixel 1482
  - Run #3507: module 211 still outside the camera but with the **same backplane as usual**, powered through the digital trigger crate
    - 0 noisy event in pixel 1482
  - Run #3509: same as run #3500, module 211 is **back inside the camera**, powered through the digital trigger crate
    - 0 noisy event in pxiel 1482, 206 noisy events in pixel 1479 !
  - Run #3511: same as run #3510 but 2 days after
    - No noisy event in module 211 !

Summary

- Despite a lot of tests, noisy events not understood yet...

- Open questions
  - Is the trigger channel affected?
  - Is it an issue for camera operation? Not clear but things not well understood are not welcomed ☺ (if grounding problem at the system level, we need to understand it as soon as possible)