FEB v6 tests : Next and Previous events perturbations

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FEB v6 tests

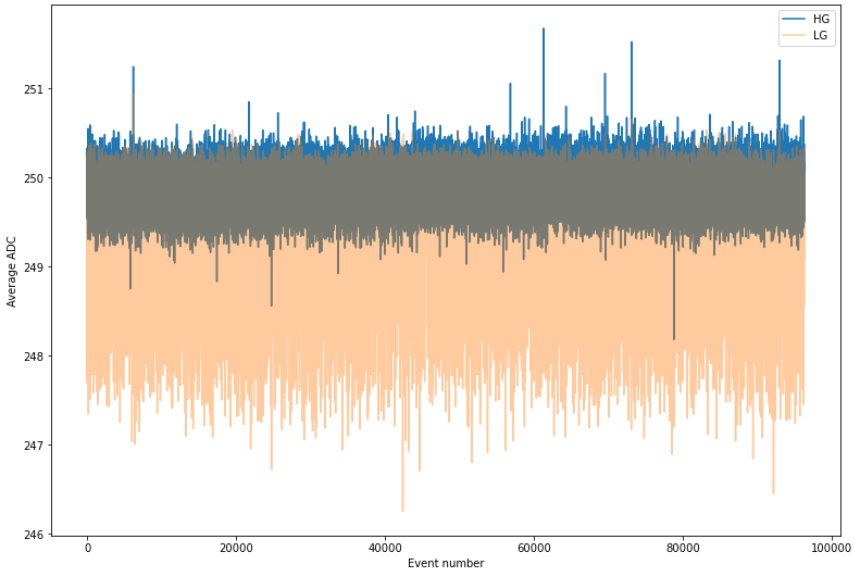
- Test campaigns in the QM at IRFU :
  - March 2021
  - July 2022

- First campaign of tests allowed to identify & correct some issues

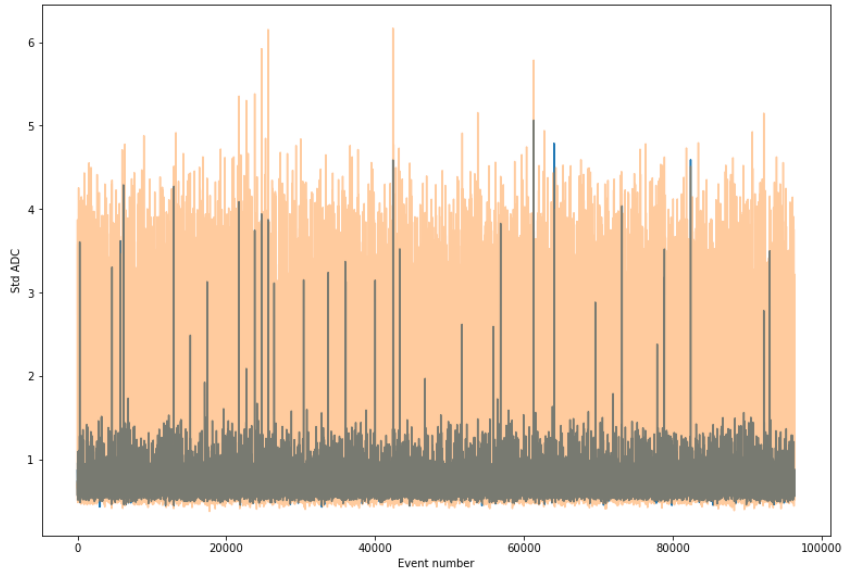
Study of the pedestals with the FEB v6

- Dark pedestal runs (March 2021) with 2 FEB v6

Average value over all 14 pixels and all samples :
- Spike and dips

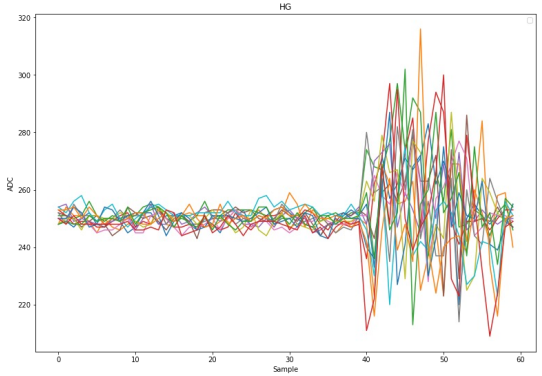


Standard deviation over all 14 pixels and all samples :
- Noisy events in HG and LG

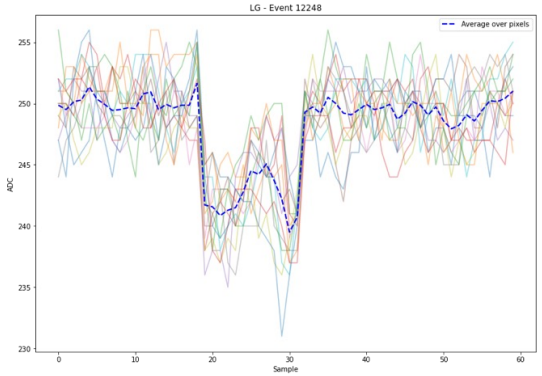


Study of the pedestals with the FEB v6

- High noise in HG & LG -> empty memory events
  - Events not completely written in memory
  - Exemple of event -> HG waveforms of the 14 pixels :
    - Can be resolved by adjusting the DelayBusy parameter of the FEB

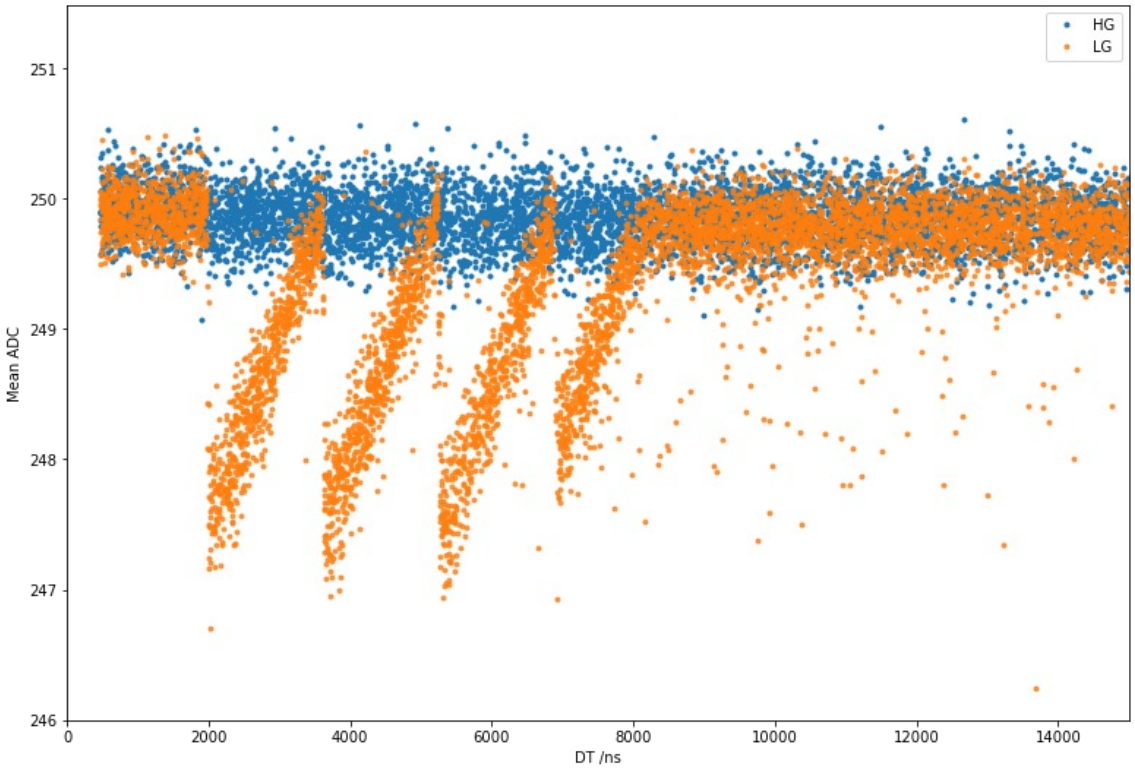


- « Dips » in LG : 1 to 16 samples affected :
  - Due to a trigger occuring during the readout
    - Known and understood -> chip modified after March 21
    - FEB v5 not affected (dead time while readout)



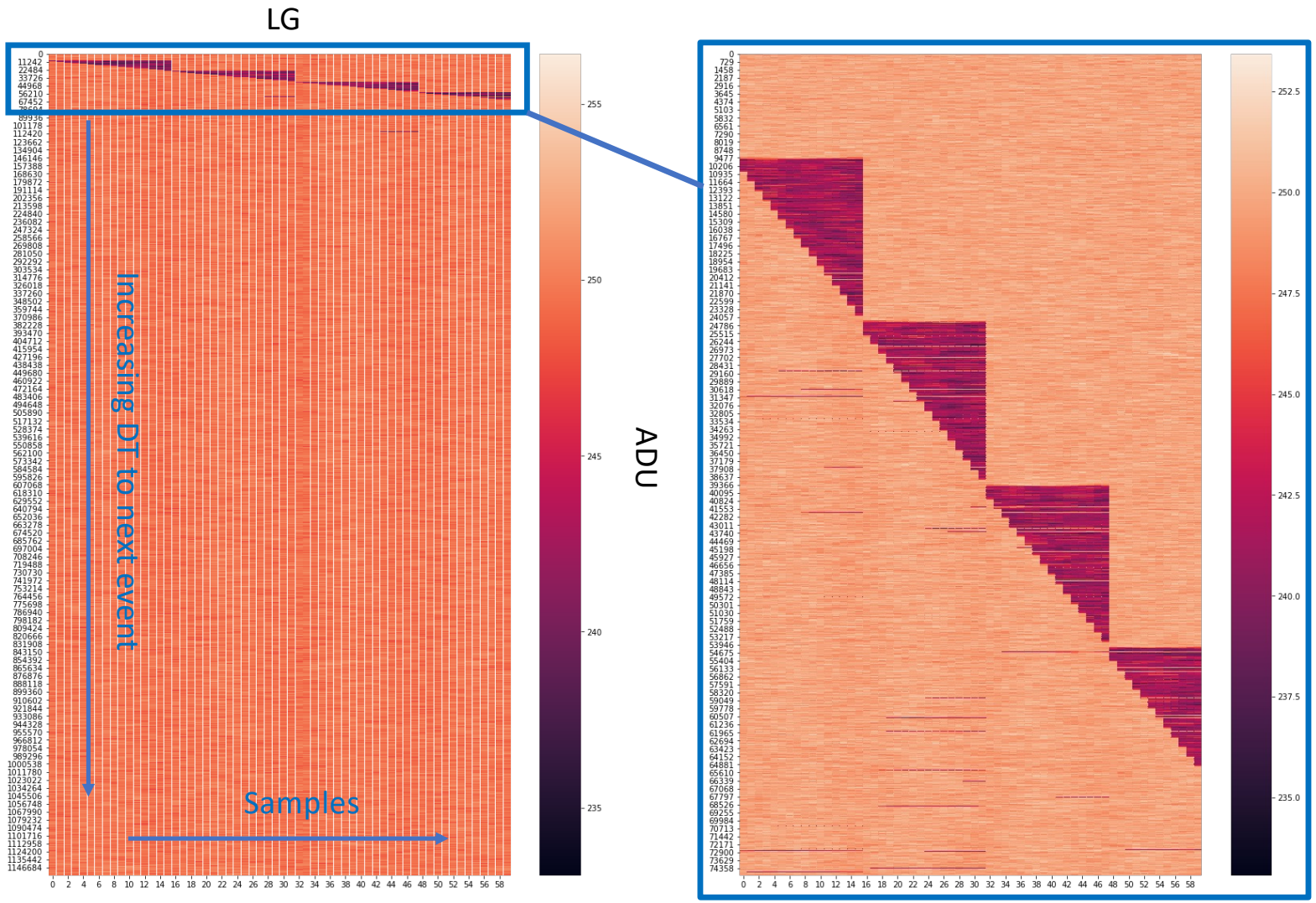
« Dips » in LG : exemple of run 2372

Mean ADC (average value over all 14 pixels and all samples for each event) as a function of the time to the next event



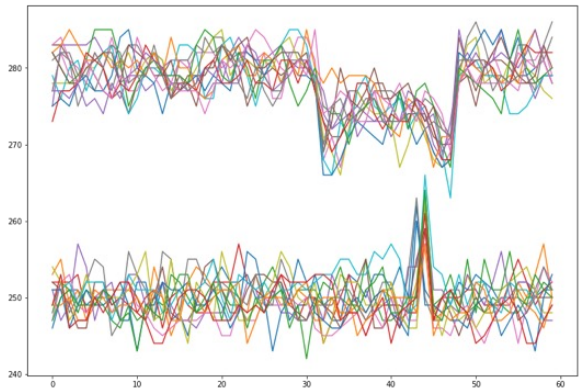
Events sorted by increasing time interval to the next event

Each line in this plot is one (14 pixels-)averaged waveform



Study of the pedestals with the FEB v6

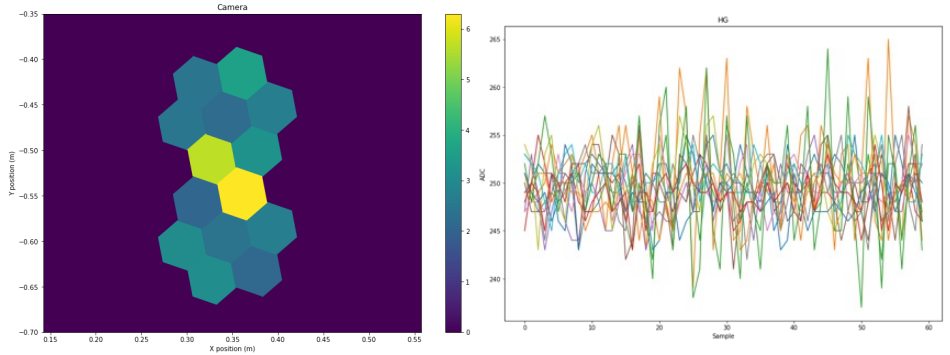
- Spike in HG when dip in LG
  - Spike of ~10 ADU in HG for ~0.01% of the events (at 9kHz)
  - Issue with the chip, correction implemented



LG *(+ 30 ADU, for visibility)*

HG

- 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?



September 2022 tests

- Runs (among other) :
  - With flashes + pedestals (3493)
  - With only pedestals (3462)

- Looking at average waveforms over all pixels (<waveform>) :
  - Study its standard deviation (<waveform>.std())
  - Study its mean (<waveform>.mean())

- Study next & previous events perturbations

Looking at std of average

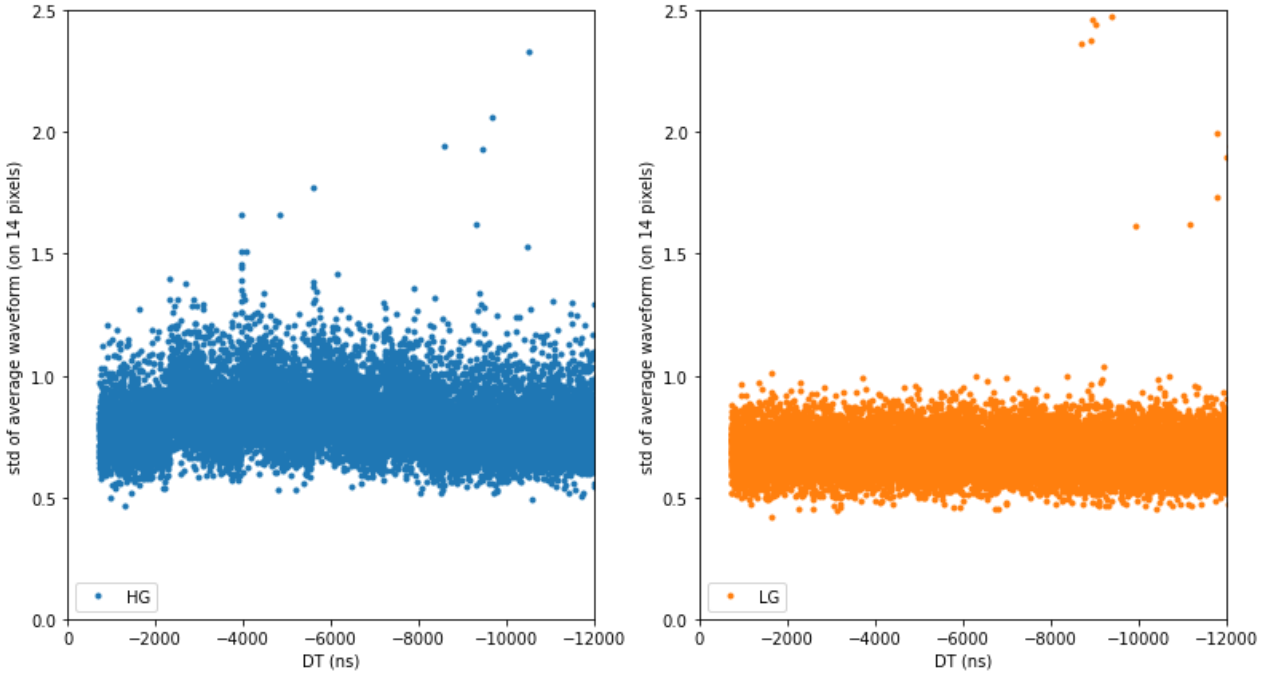
- Runs (among other) :
  - With flashes + pedestals (3493)
  - With only pedestals (3462)

- Looking at average waveforms over all pixels (<waveform>) :
  - **Study its standard deviation (<waveform>.std())**
  - Study its mean (<waveform>.mean())

- Study next & previous events perturbations

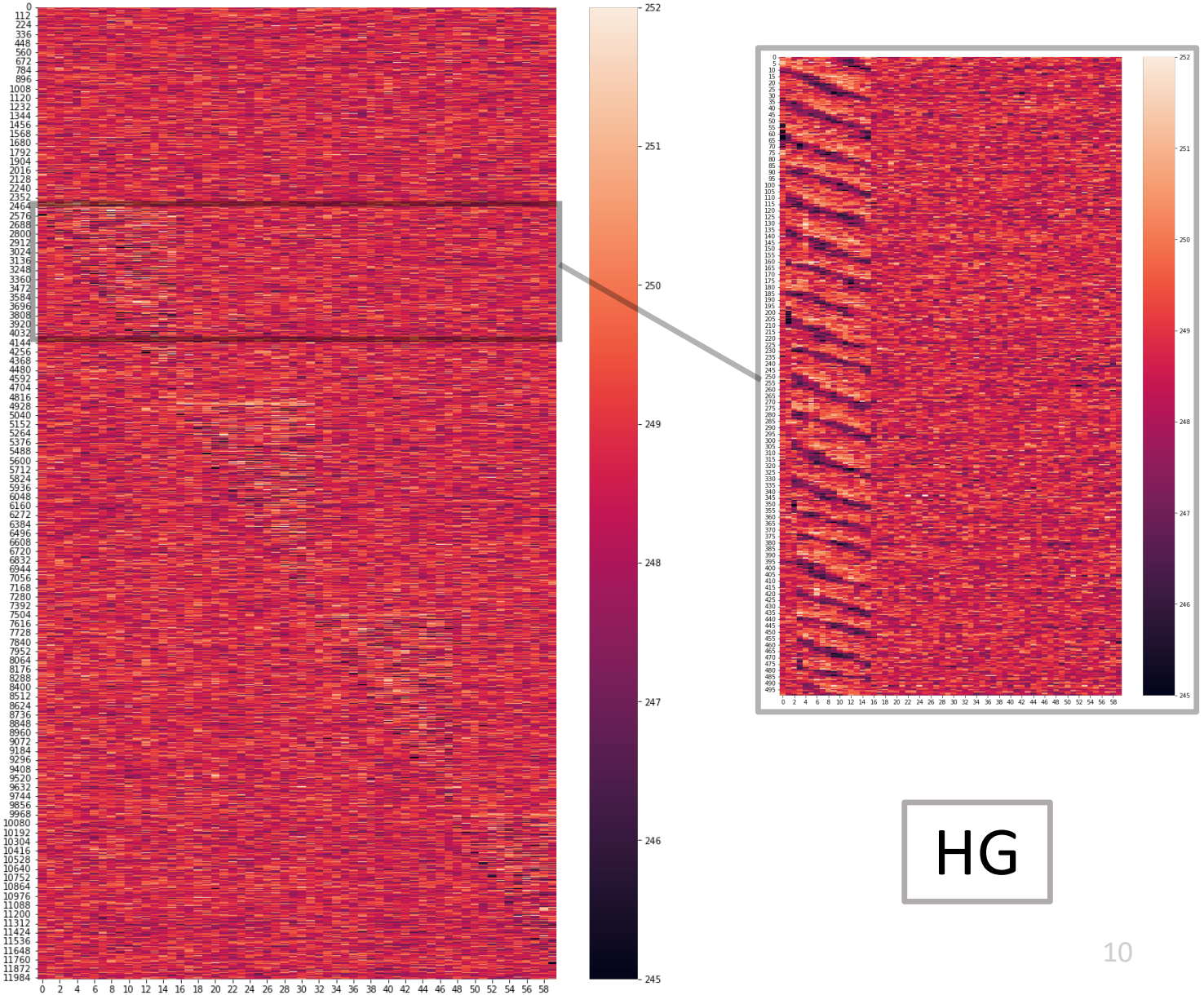
Run 3493 : Ped + Flashes with 5 LEDs @ 16V

- <waveform>.std() vs time to the next event
- Look at pedestals only
- No strong effect anymore



Run 3493

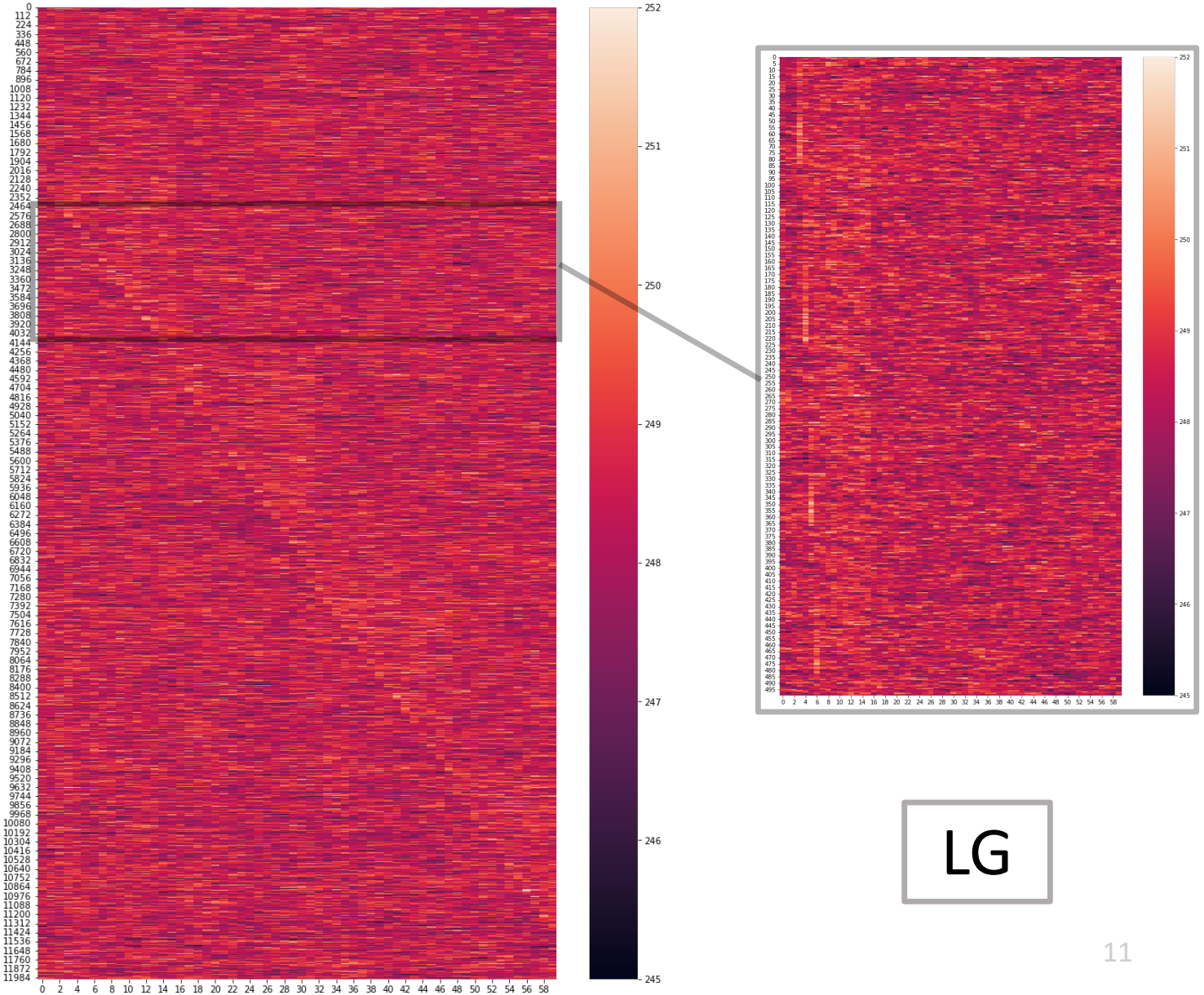
-> Marginal remaining effect



HG

Run 3493

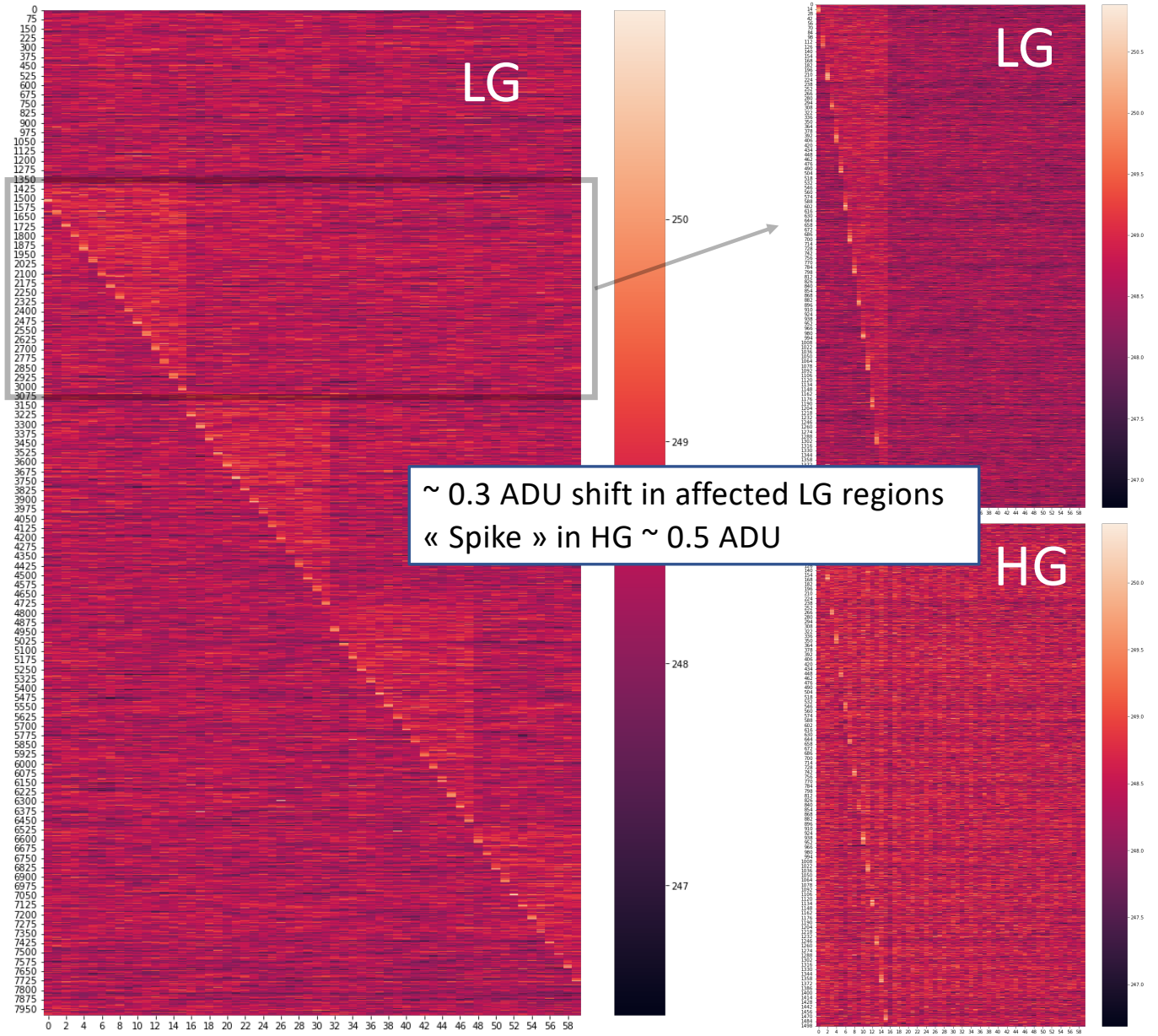
-> Marginal remaining effect



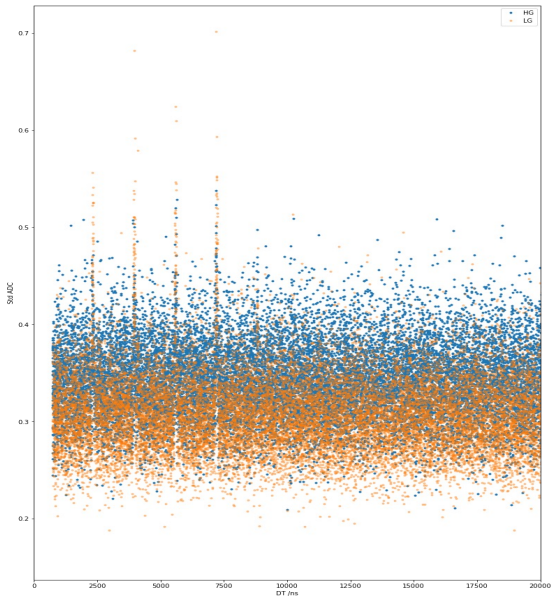
LG

Run 3462

- Run in calibration trigger mode, No HV, Random trigger generator at ~ 8 kHz (2.45 V)
- Only pedestals
- 10 FEB v6
- Effect with the **next** event

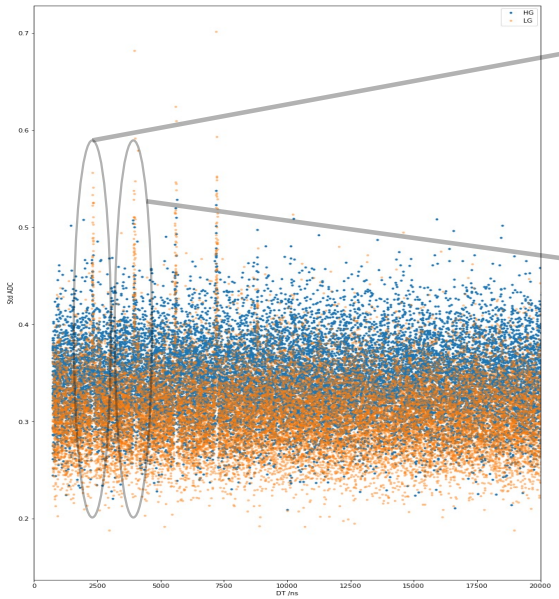


Run 3462

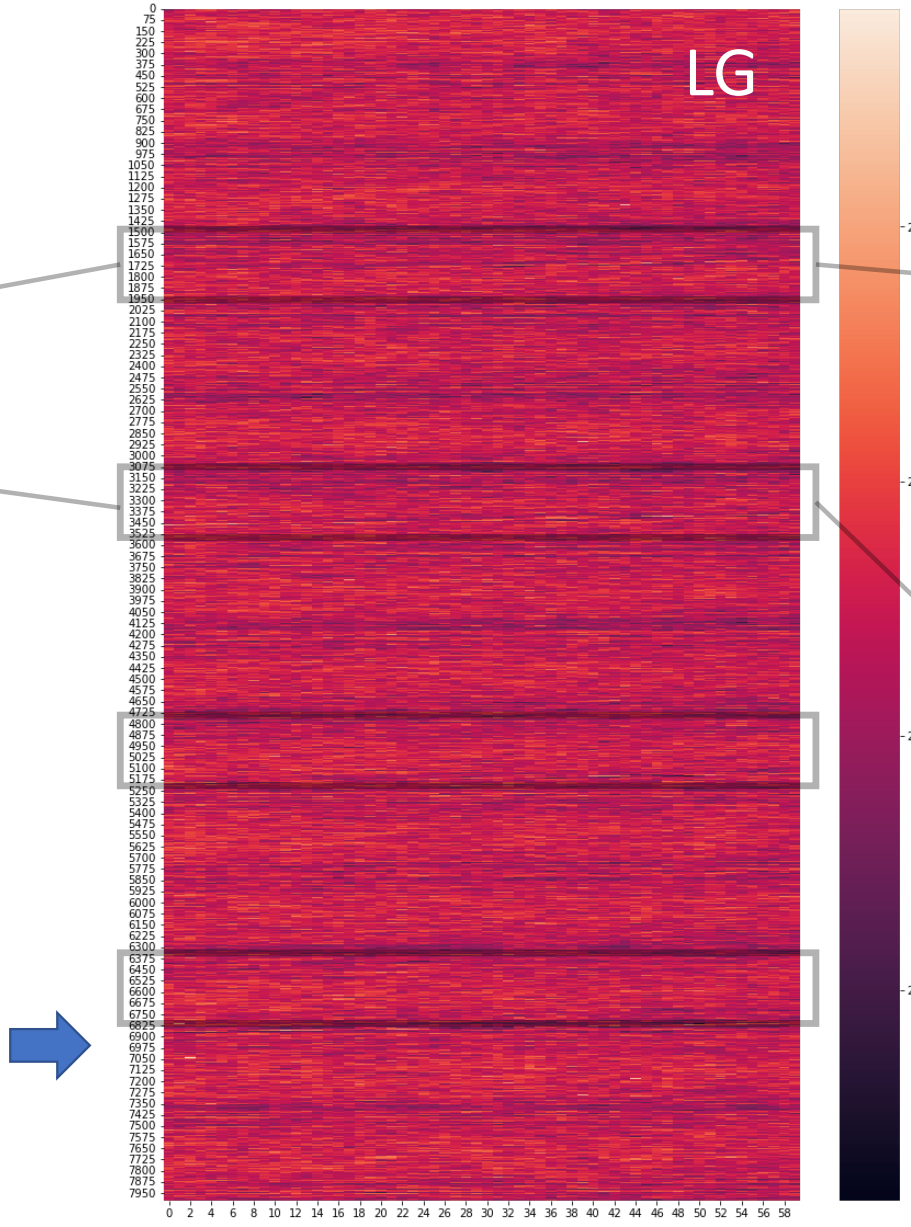


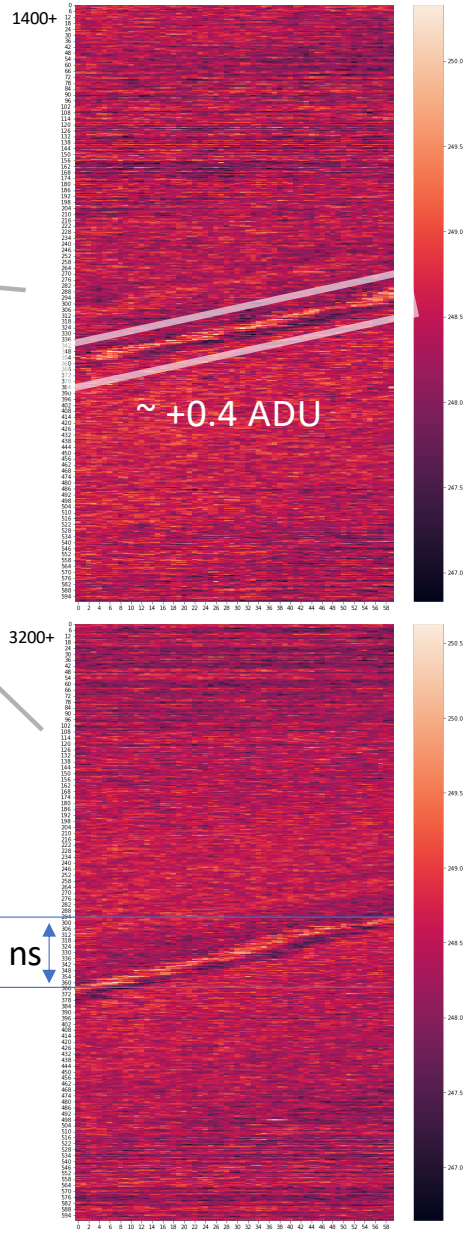
- Looking at time since **previous** event :
  - An effect is visible

Run 3462



- One line = average waveform for one event
- Events sorted by increasing DT **since the previous event**
- On the y-axis are event numbers (in the list of DT sorted events)





Looking at average of average

- Runs (among other) :
  - With flashes + pedestals (3493)
  - With only pedestals (3462)

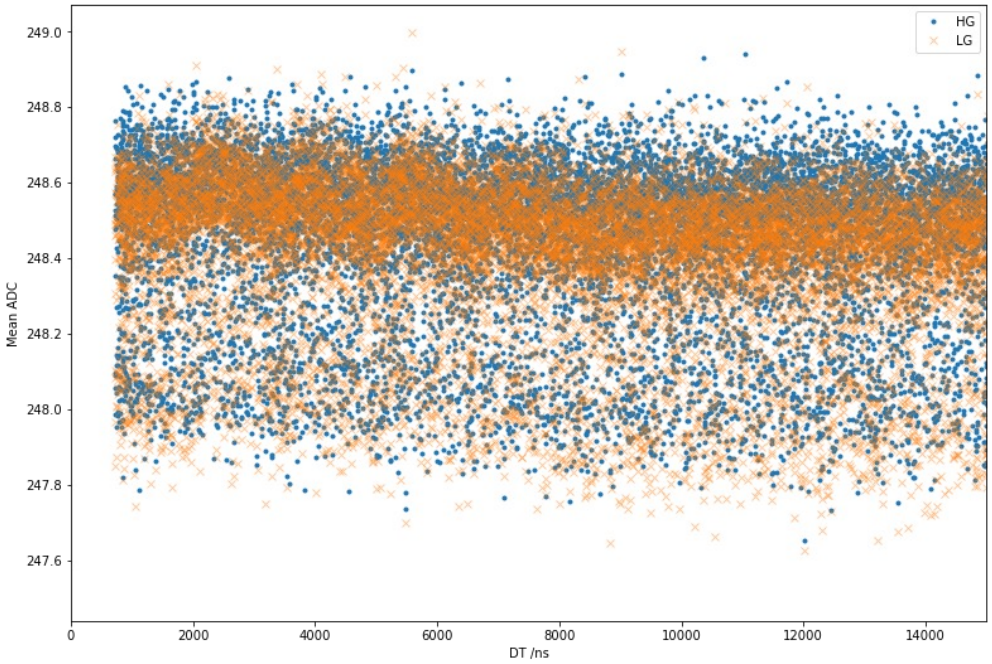
- Looking at average waveforms over all pixels (<waveform>) :
  - Study its standard deviation (<waveform>.std())
  - **Study its mean (<waveform>.mean())**

- Study next & previous events perturbations

Looking at average of average

Run 3462 : mean vs dt to next event

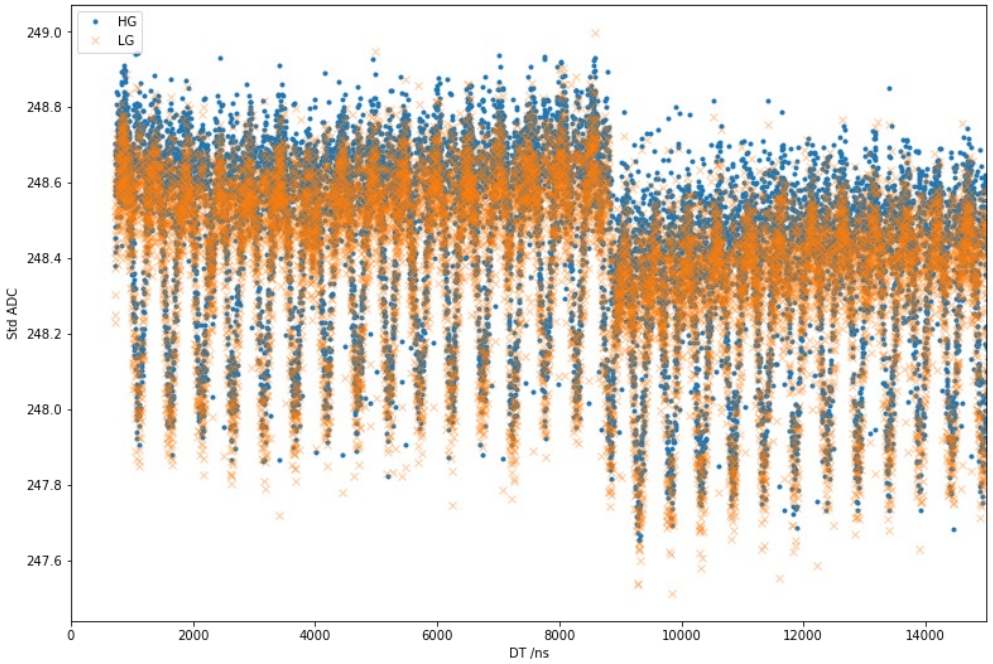
10 FEB v6 -> 70 pixels



Looking at average of average

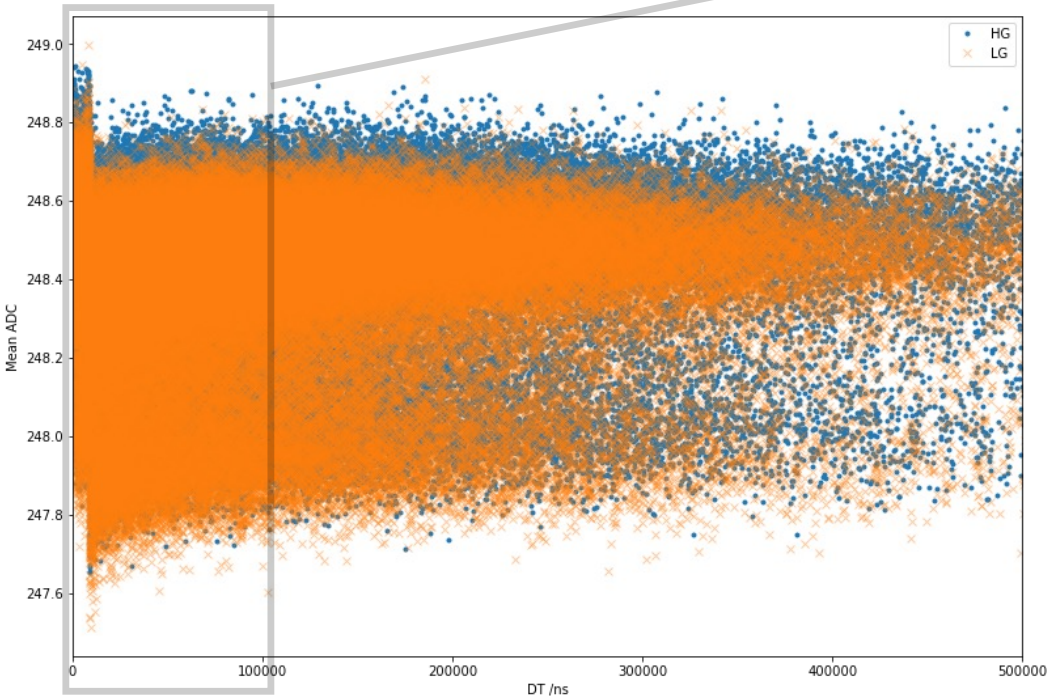
Run 3462 : mean vs dt since **previous** event

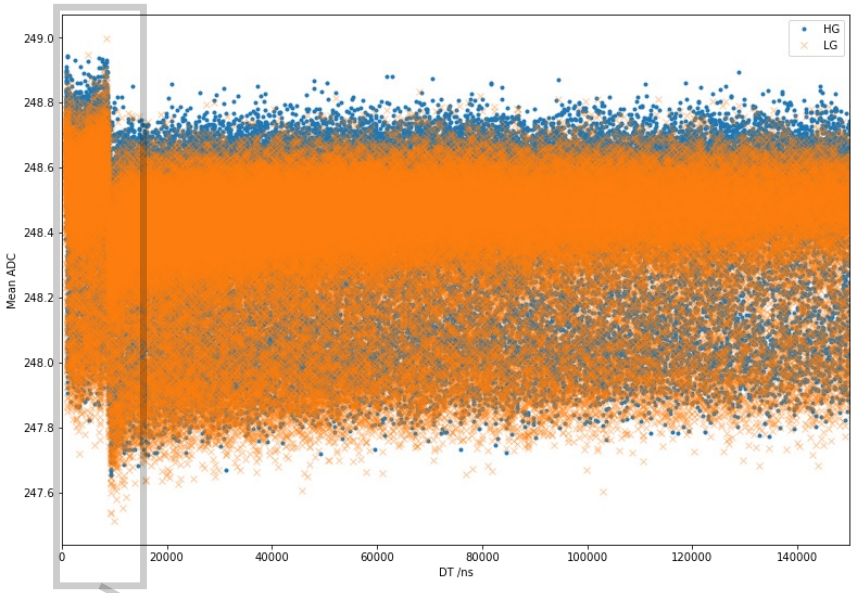
10 FEB v6 -> 70 pixels

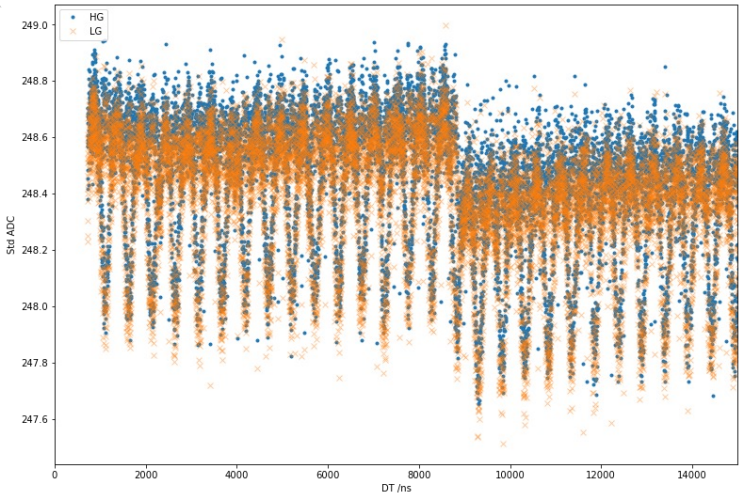


Amplitude ~ 0.8 ADU
Period ~ 500 ns

- On larger dt scales:

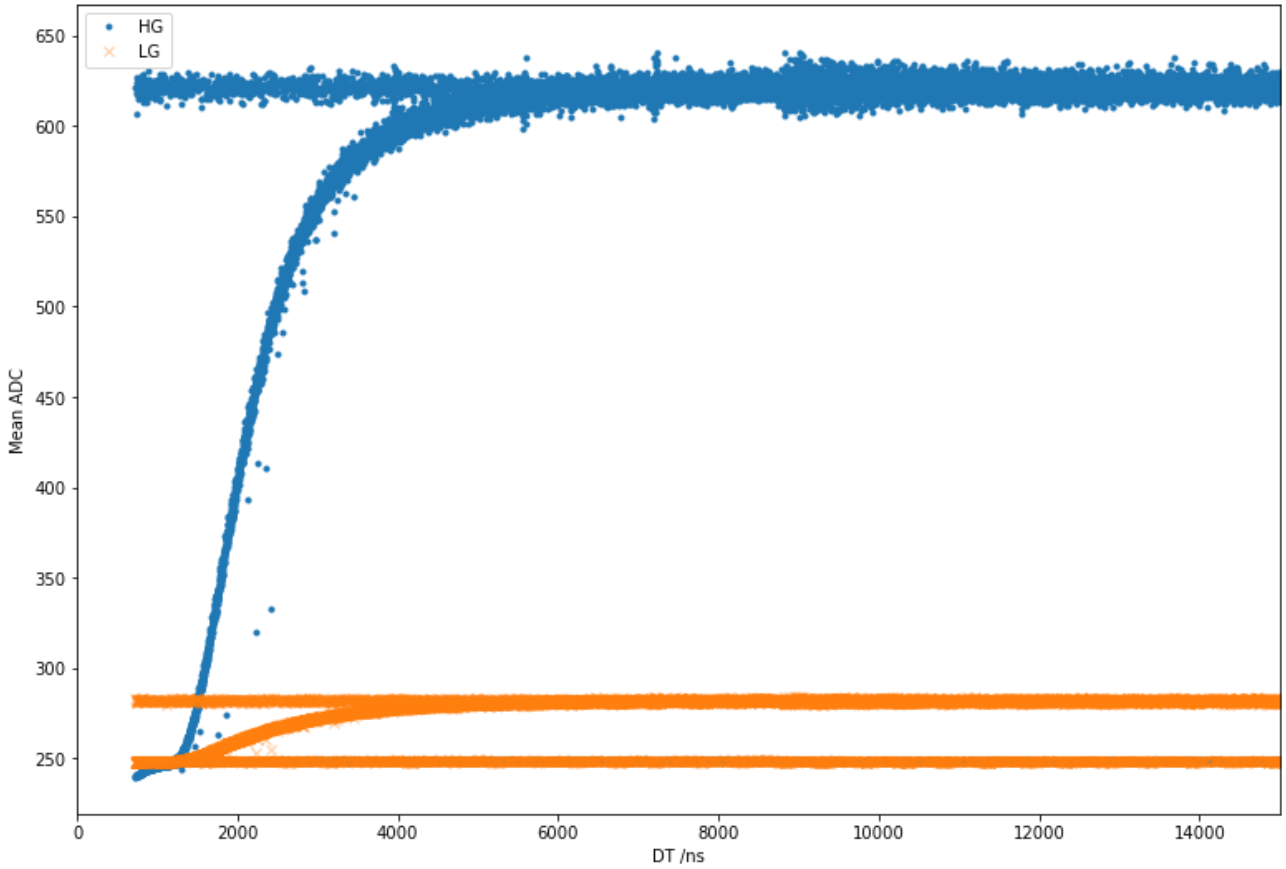




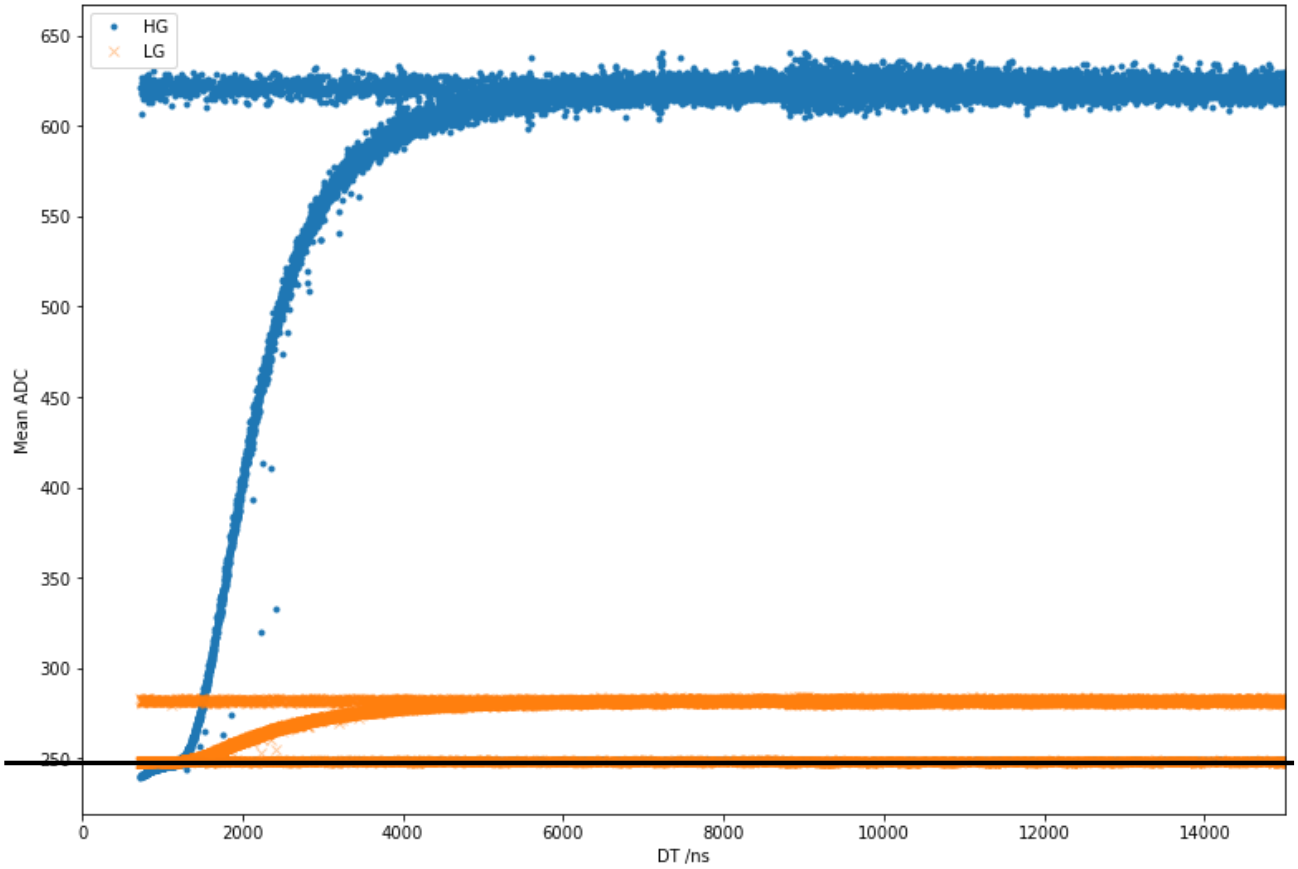


Average of average : Run 3493

- 2 FEB v6 -> 14 pixels
- Run 3493 has FF events + Ped events

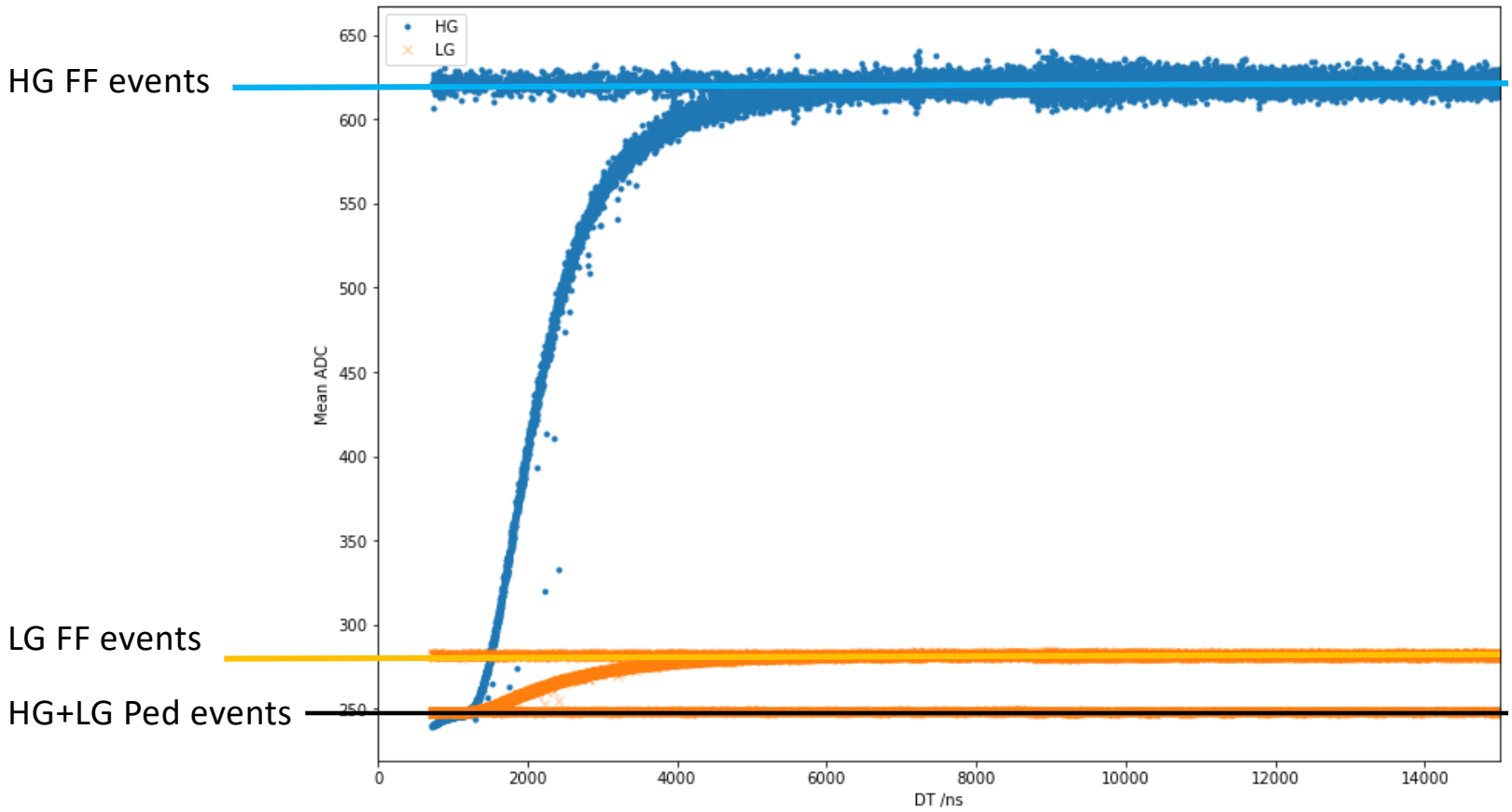


Average of average : Run 3493

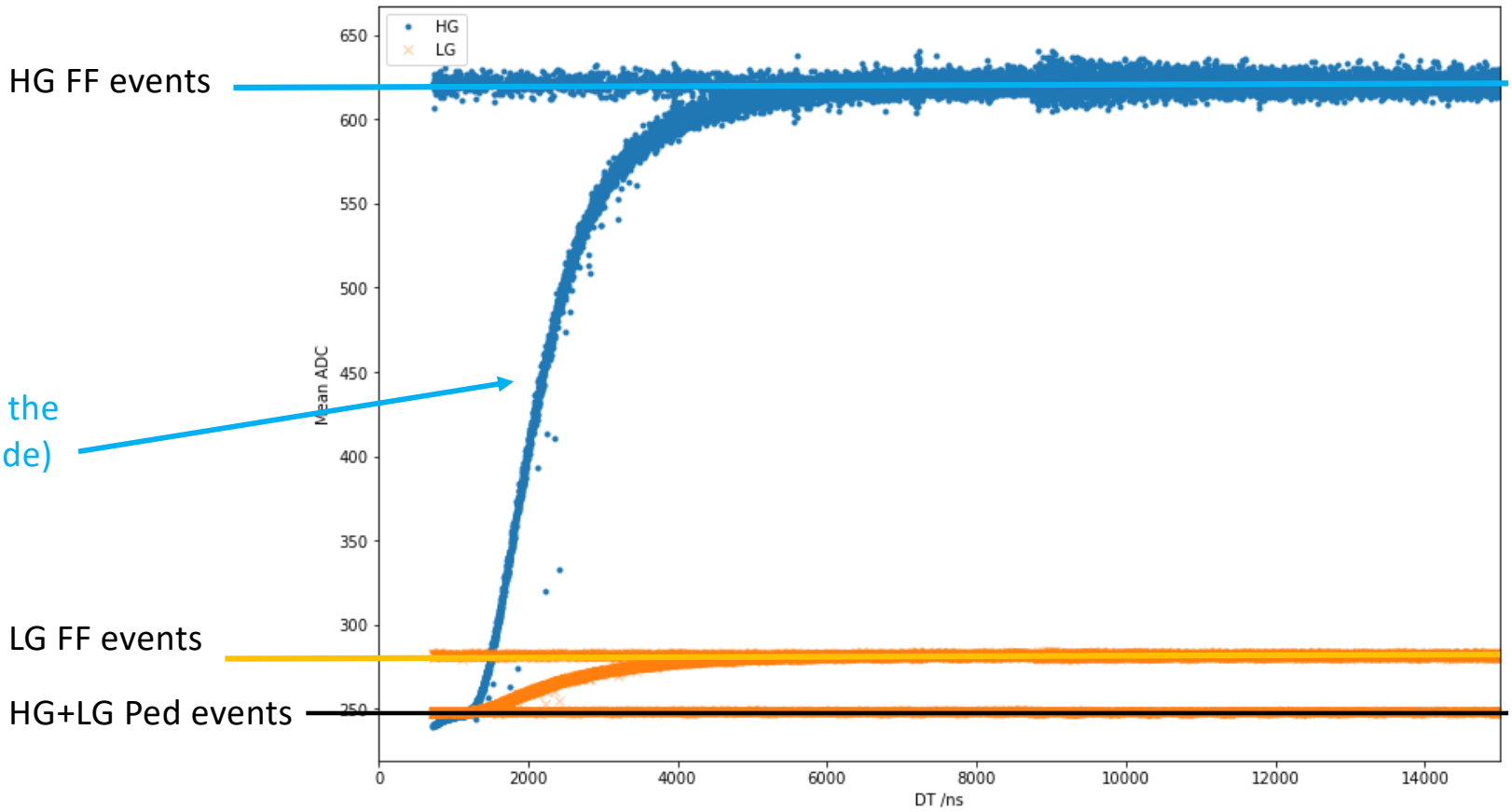


HG+LG Ped events

Average of average : Run 3493

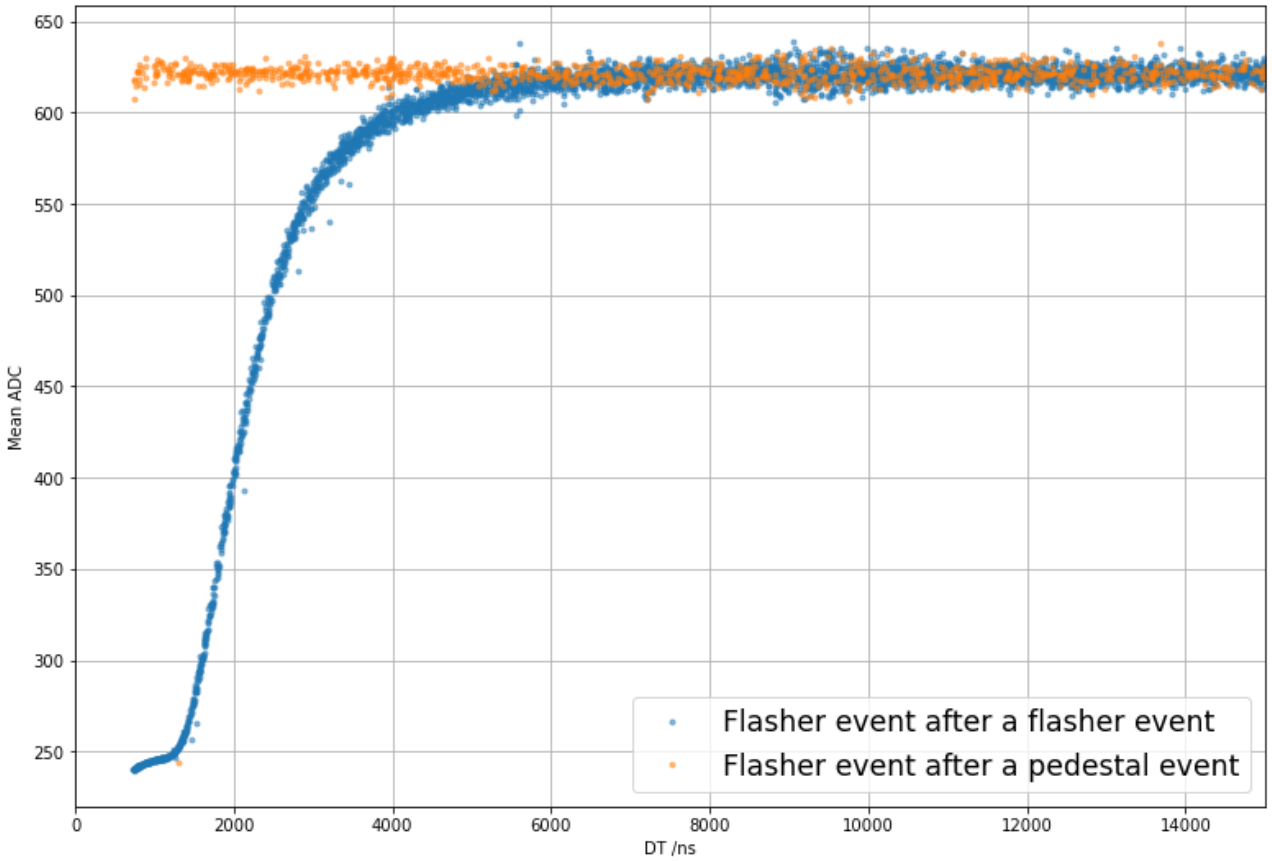


Average of average : Run 3493

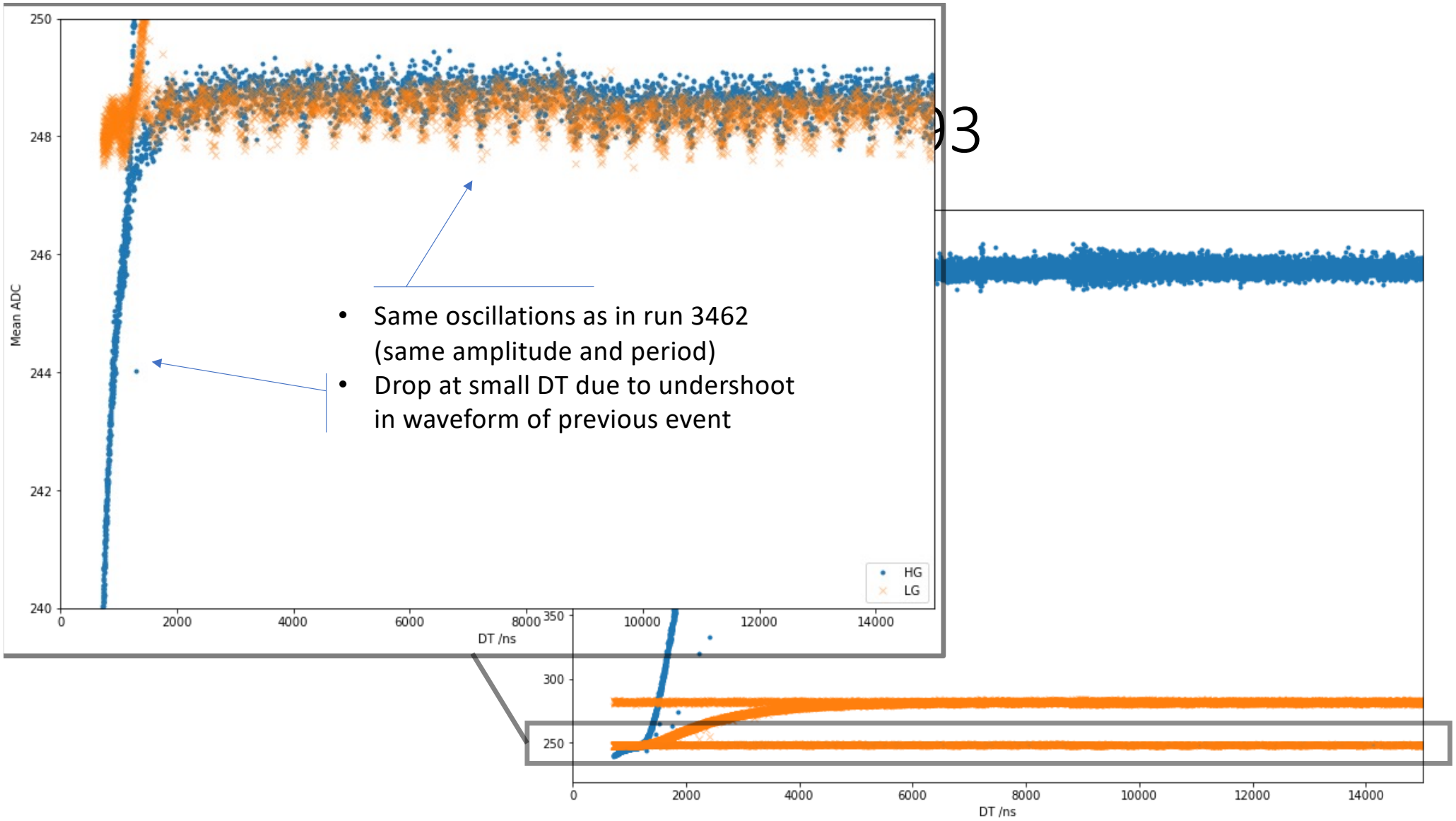


Average of average : Run 3493

- Looking at events following a flasher event :
  - Decrease in flashes intensites only for flashes right after another flash
  - Pointing to a FFCLS issue (but not supposed to work at these frequency)



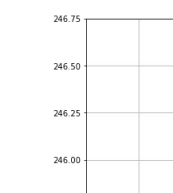
93



- Same oscillations as in run 3462 (same amplitude and period)
- Drop at small DT due to undershoot in waveform of previous event

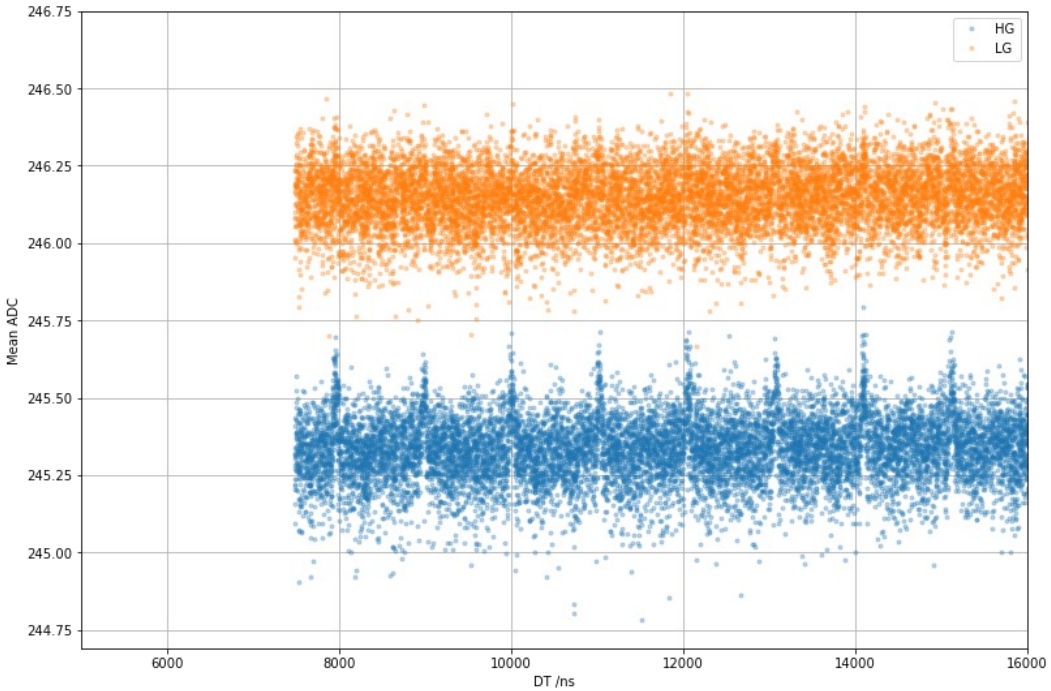
Run 3513 : Same as run 3462 but with 10 FEB v5

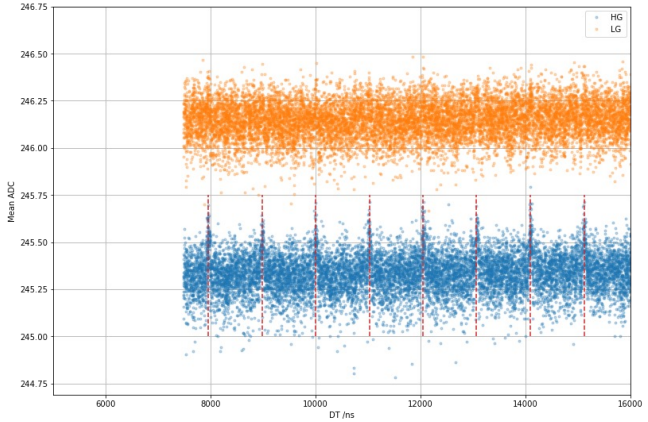
Period seen in the HG : ~1000ns (red lines are separated by 1024ns)



FEB v6 : ~500ns
FEB v5 : ~1000ns

Linked to the memory depth





Summary

- Issues linked to FEB v6 observed in March 2021 are not there anymore
  - Only marginal effects remain
- When looking at DT since previous event : oscillations linked to memory depth
  - Minor effect, not only in FEB v6
  - Under investigation