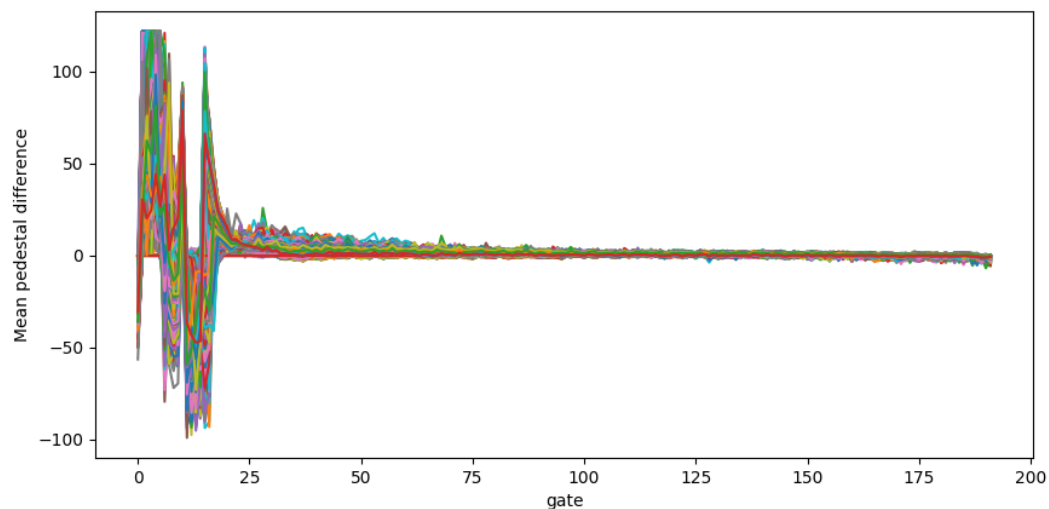# Gated Mode Tests

Felix J. Müller
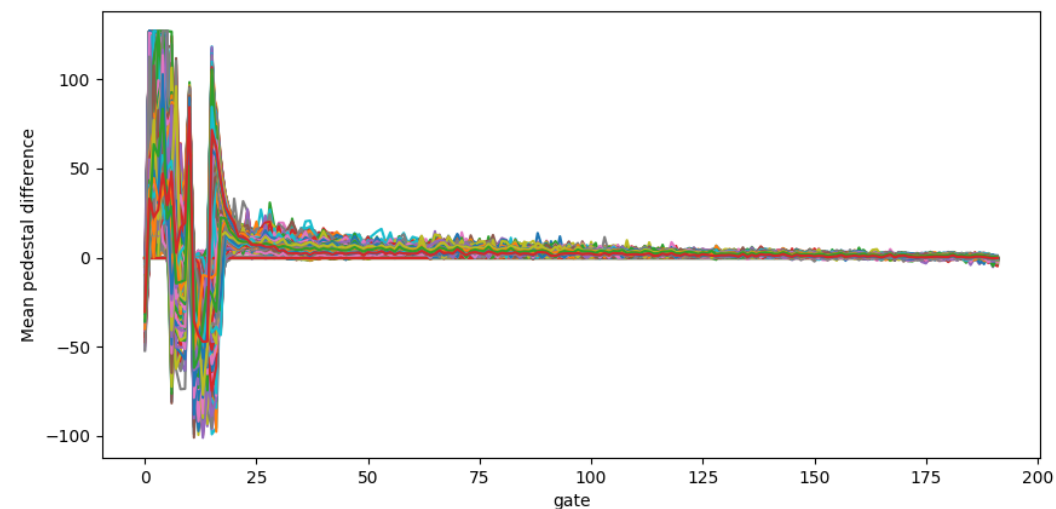24.09.2019

Overview.

- No new plots, just a review of everything which I showed during the weekly meetings

    - General overview

    - Systematic effects

    - Impact on occupancy

    - Stability tests

- Necessary steps for KEK
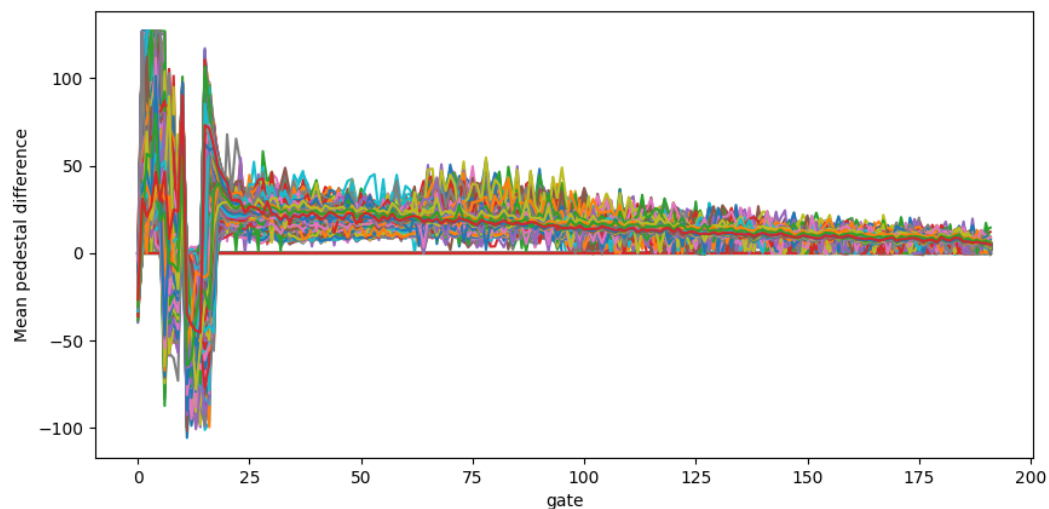
Oscillations/Damping W/o ACMC.

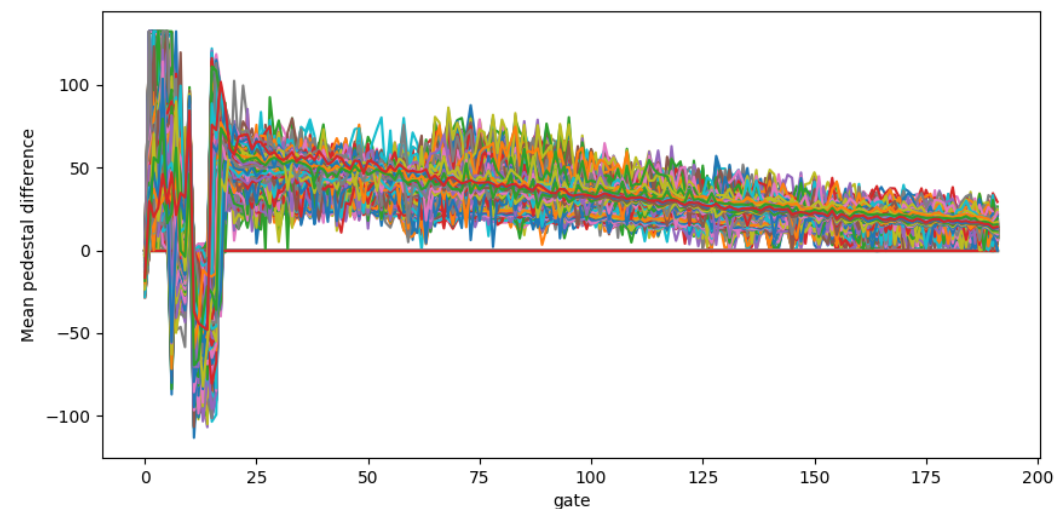Change of mean pedestalsH1011, clear on = 15000 mV

Change of mean pedestalsH1011, clear on = 16000 mV

Change of mean pedestalsH1011, clear on = 18000 mV

Change of mean pedestalsH1011, clear on = 19000 mV

Oscillations/Damping With ACMC.

Zoom.

Change of mean pedestalsH1011, clear on = 15000 mV

Change of mean pedestalsH1011, clear on = 16000 mV
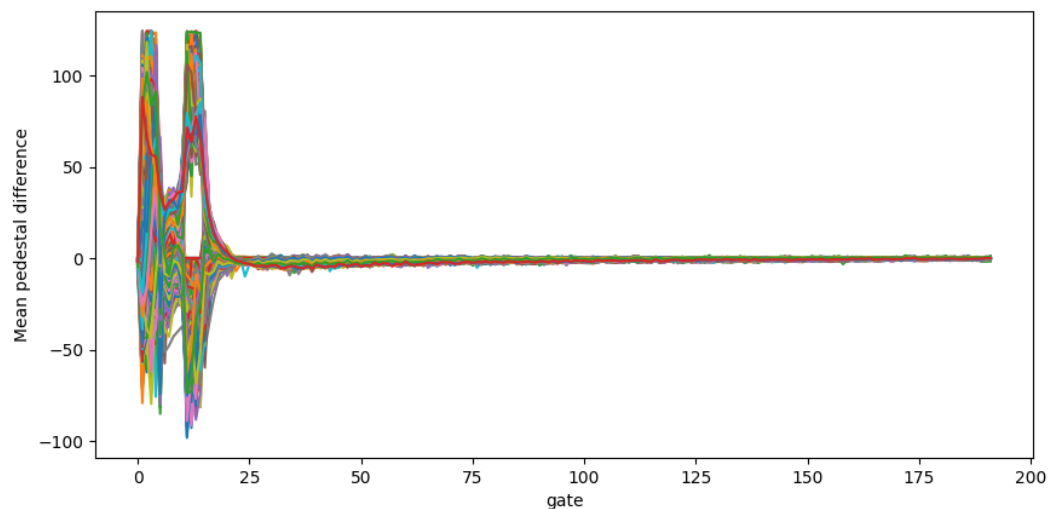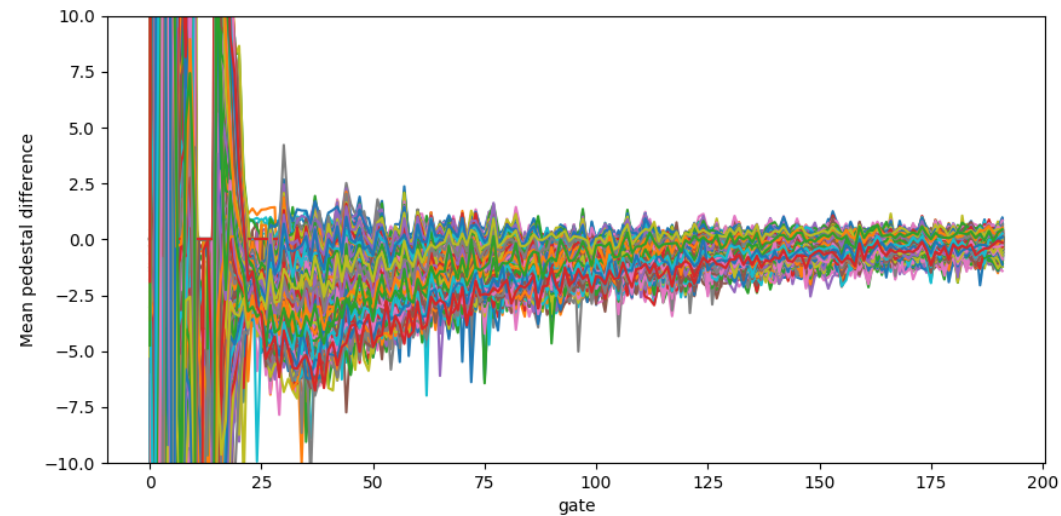
Change of mean pedestalsH1011, clear on = 18000 mV

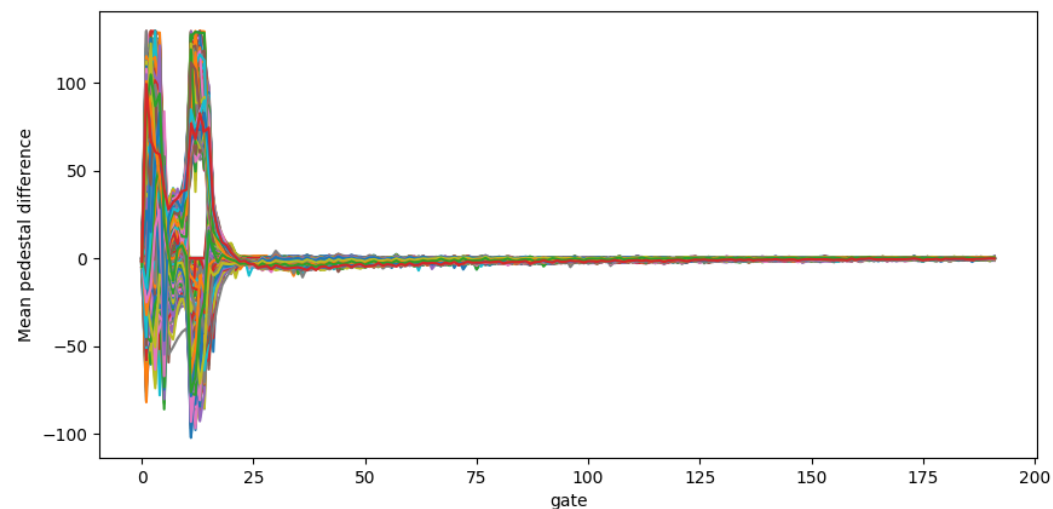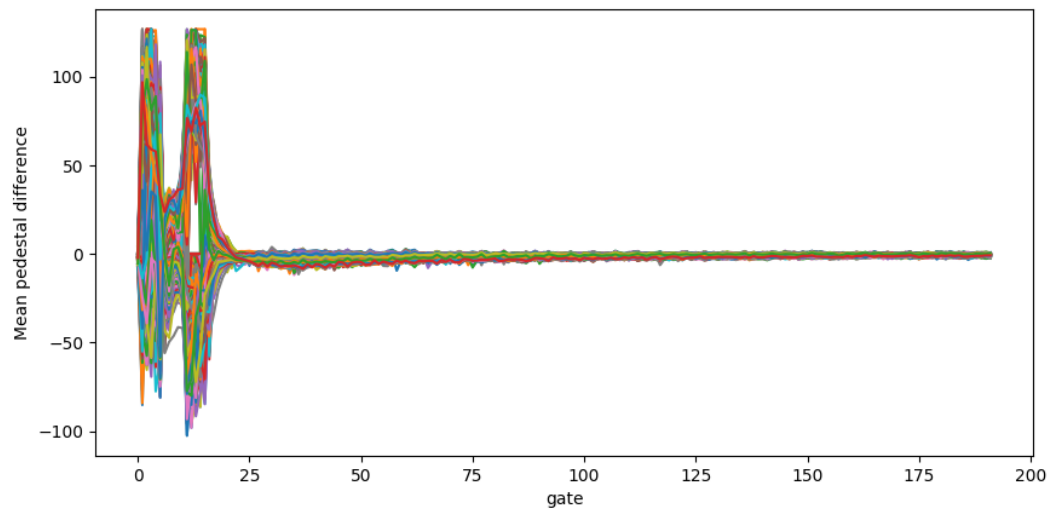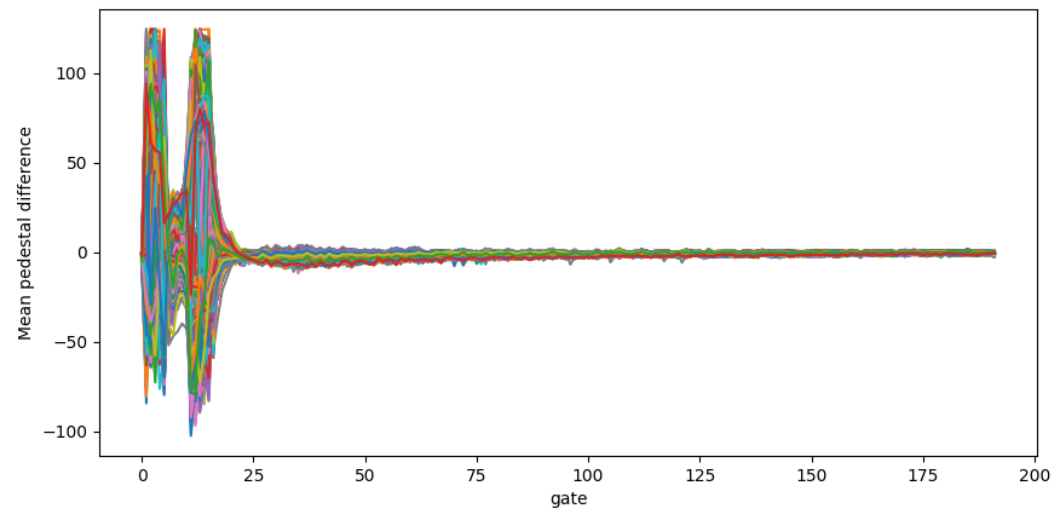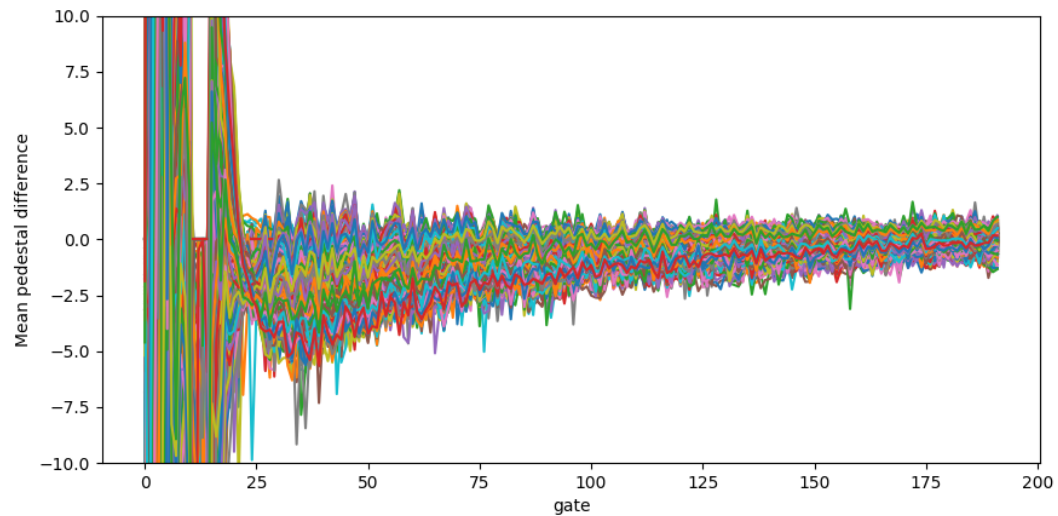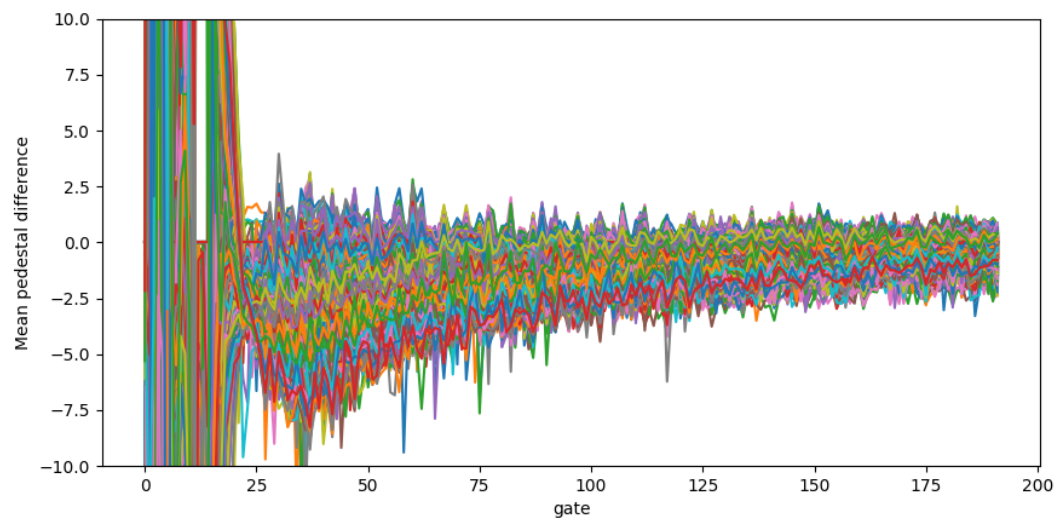Change of mean pedestalsH1011, clear on = 19000 mV
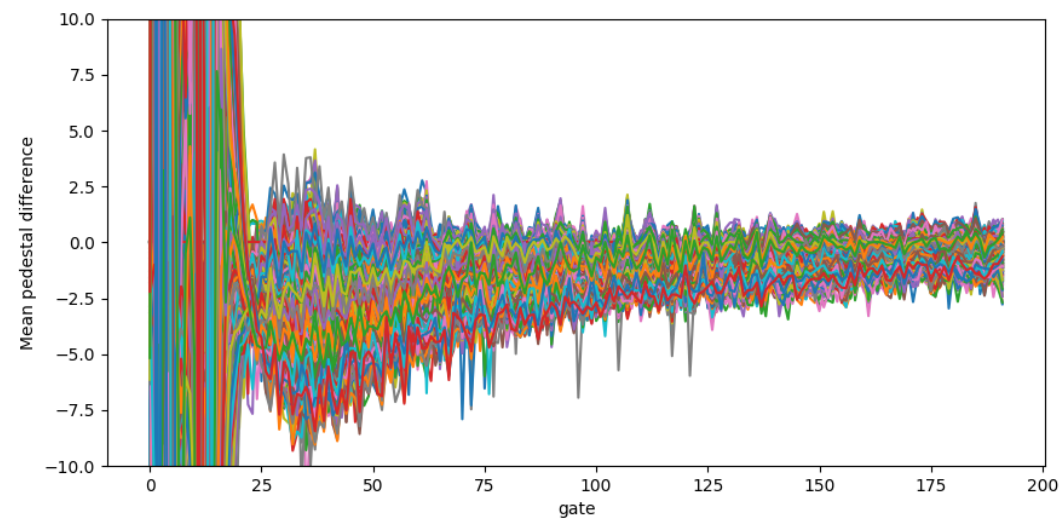
Digital CMC on Top.

Change of mean pedestals with digital CM H1011, clear on = 15000 mV
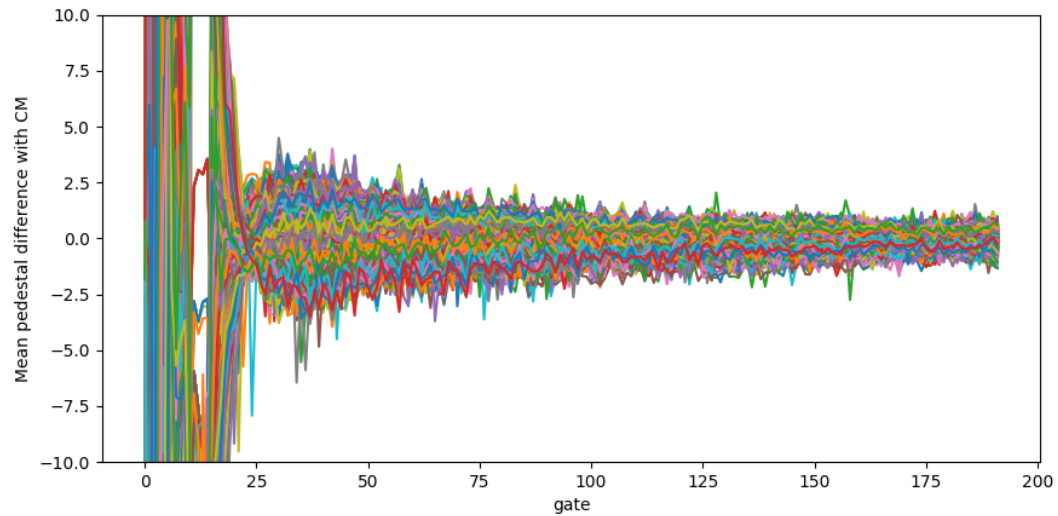
Change of mean pedestals with digital CM H1011, clear on = 16000 mV
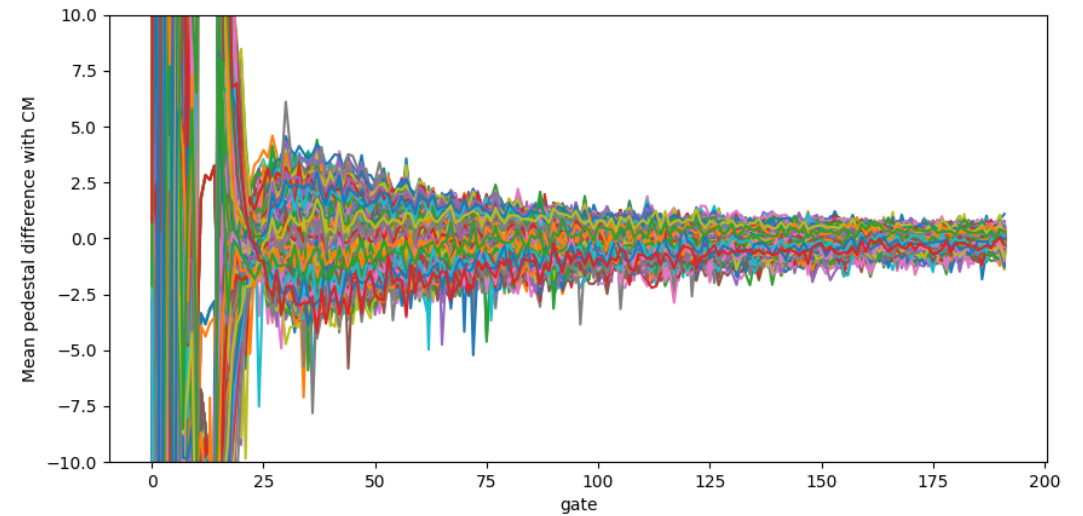
Change of mean pedestals with digital CM H1011, clear on = 18000 mV
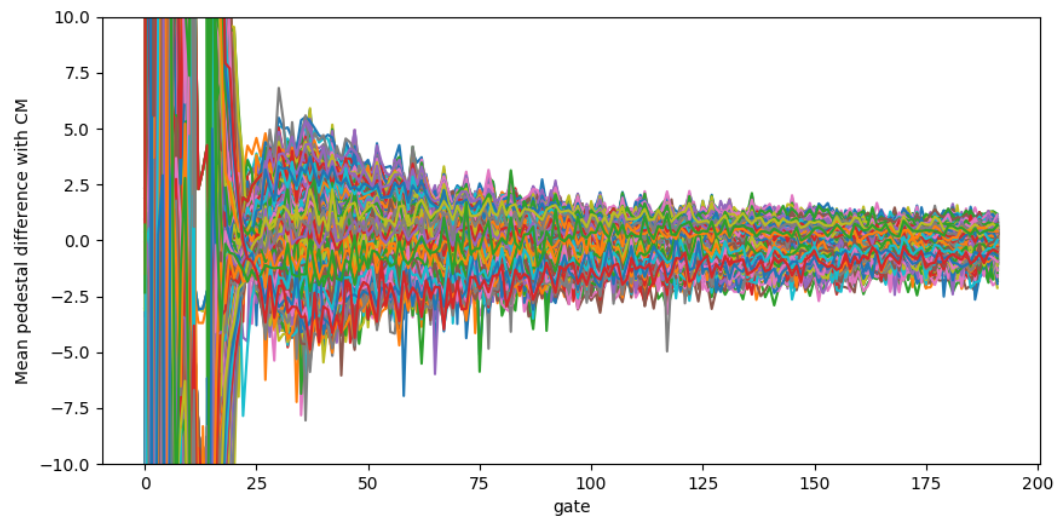
Change of mean pedestals with digital CM H1011, clear on = 19000 mV
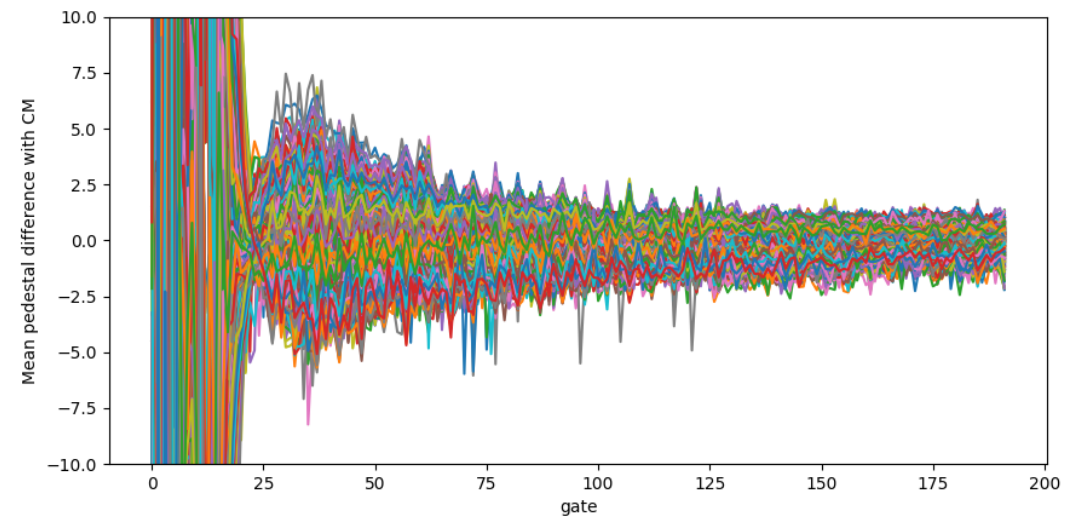
Systematic Effects.

- Overall damping effect depends on the time/position of gated mode

- Overshoot and undershoot depend on drain lines

- Overshoot weaker for drain lines closer to switcher

Change of mean pedestals H1011, clear on = 15000 mV

Change of mean pedestals

Change of mean pedestals
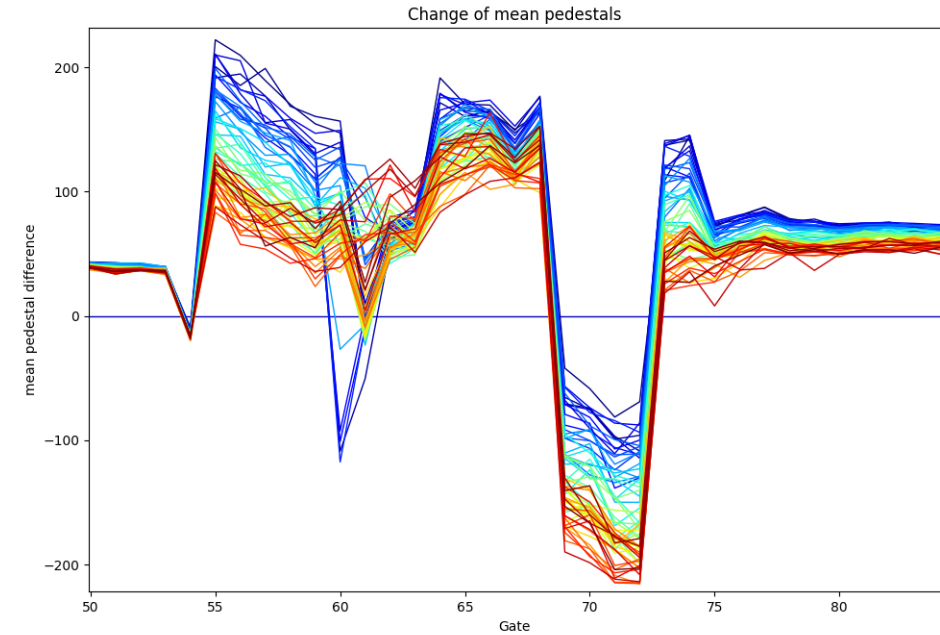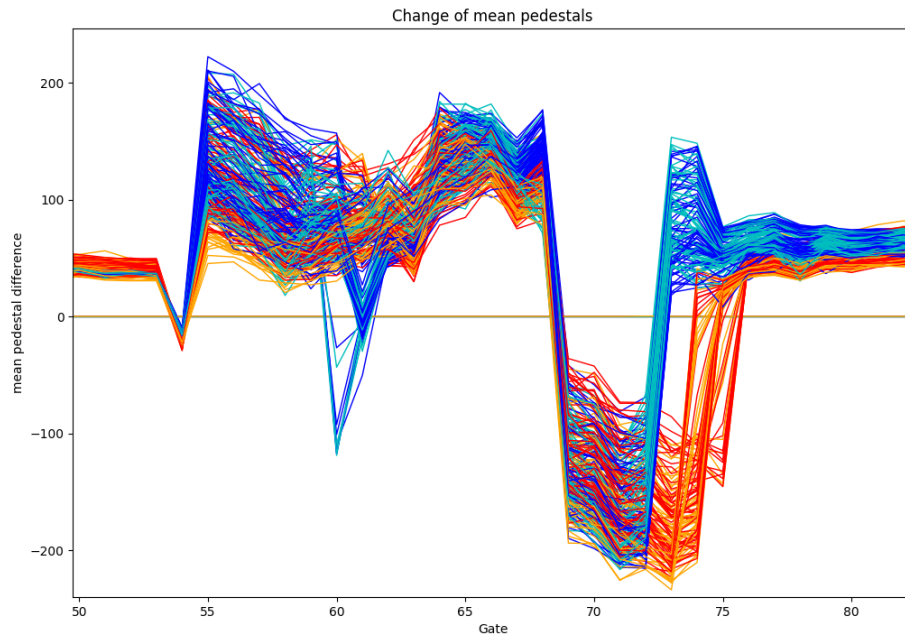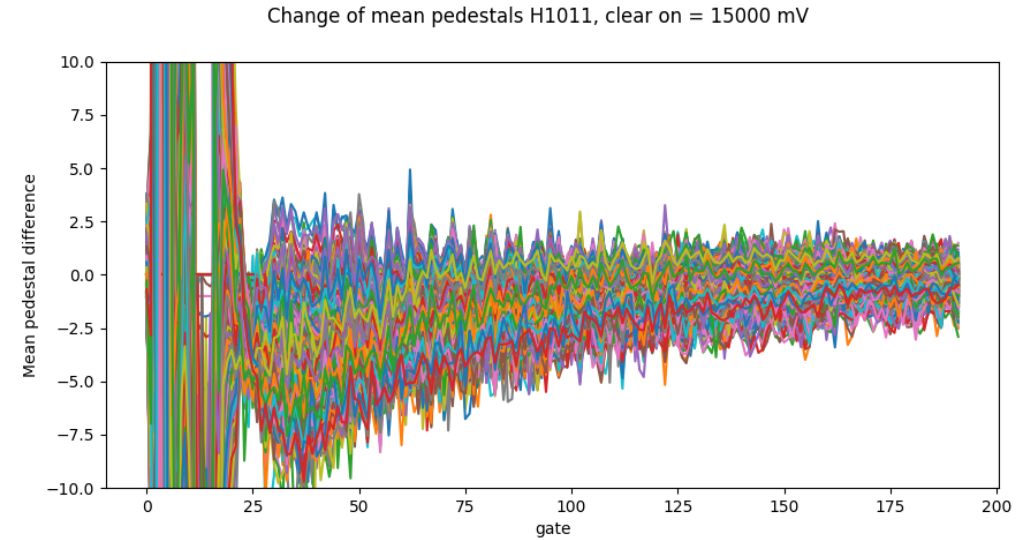
Systematic Effects.

- Drain line feature

- Regular pattern visible (2 high – 1 low and 1 high two low)

- Compare with mapping to pixel unit cells
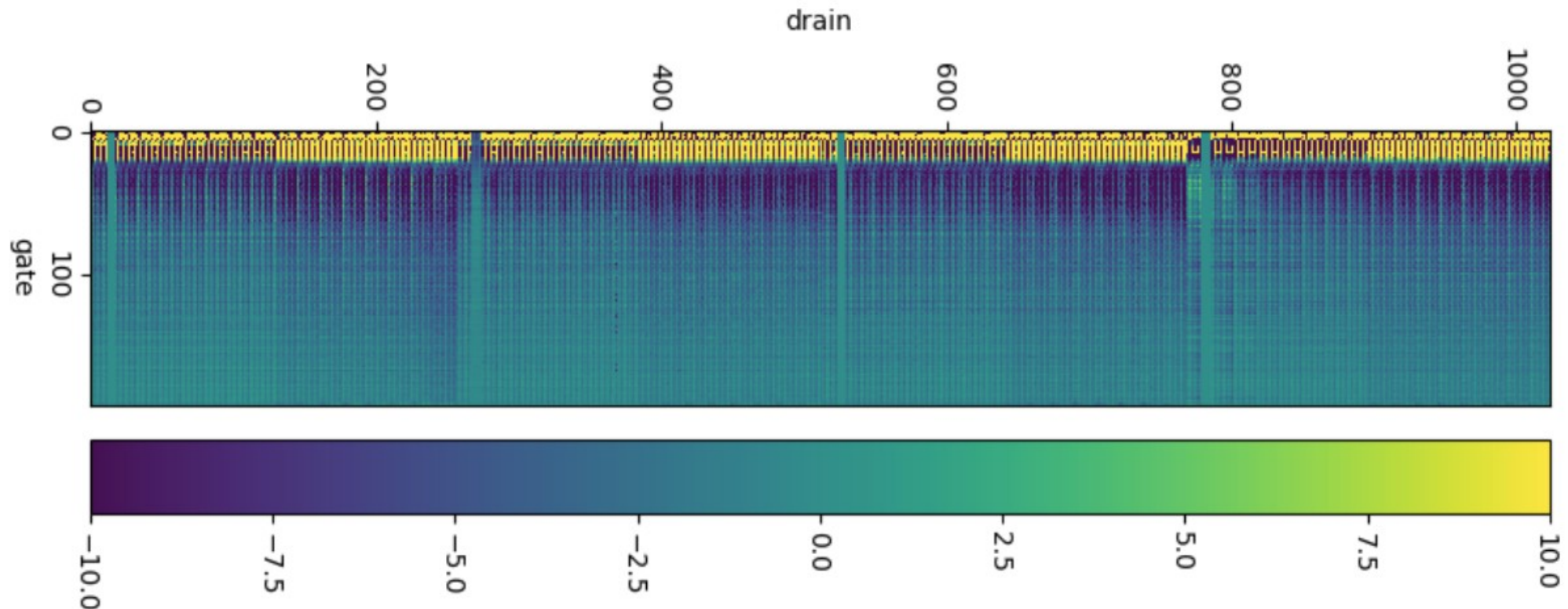
Systematic Effects.

- If oscillations depend only on time after gated mode:

  - Measure pedestal variations due to GM at some position of the detector (e.g. 0 gates offset)

  - Apply these results shifted for a different position of the GM

- If oscillations depend more on the physical position of the pixel:

  - Correct the pedestals again, but do not shift the results

- Different scales! Second correction is much better

$\rightarrow$ Correction for individual pixels + overall damping should provide best correction

  - Needs to be tested

  - Calculating pedestals after each run possible

    - 2 additional pedestal scans (2 seconds each)

Change of mean pedestals H1011, offset 5 vs 20
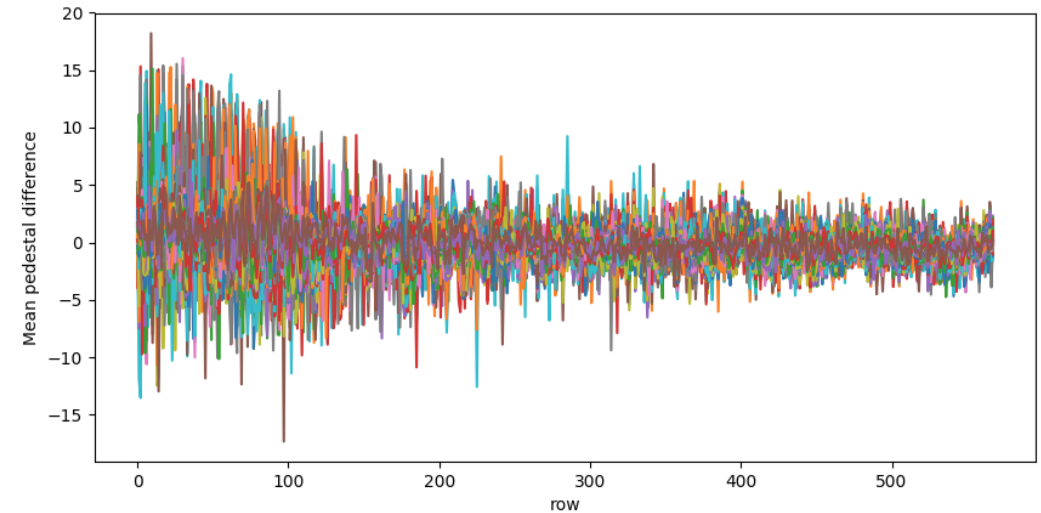
Change of mean pedestals H1011, offset 5 vs 20
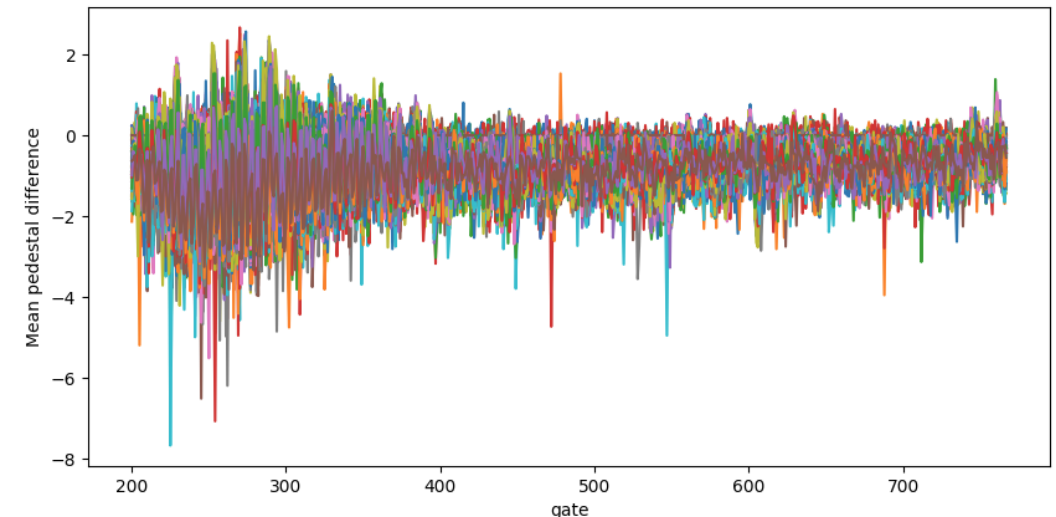
Noise.

- No large effect visible on the noise performance outside the gated mode region

  → Just a constant and stable pedestal shift due to GM

- Lesson learned:
  – Pedestal scan needs to include only GM frames
    - Cut in analysis possible?
    - Recheck GM trigger parameters

H1011, clear on = 15000 mV

H1011, clear on = 15000 mV
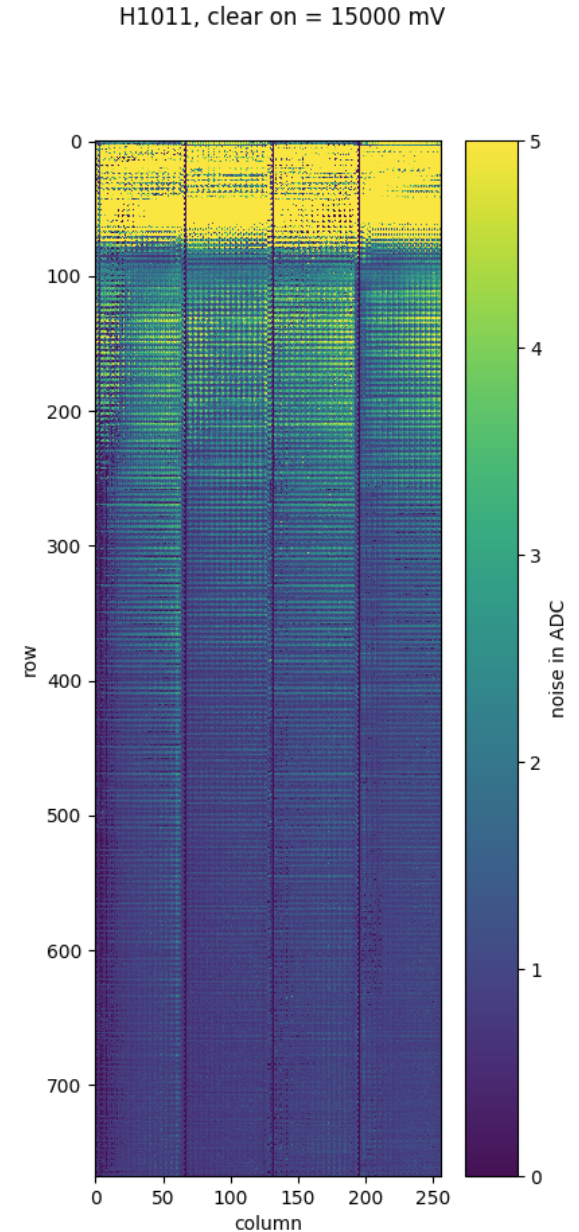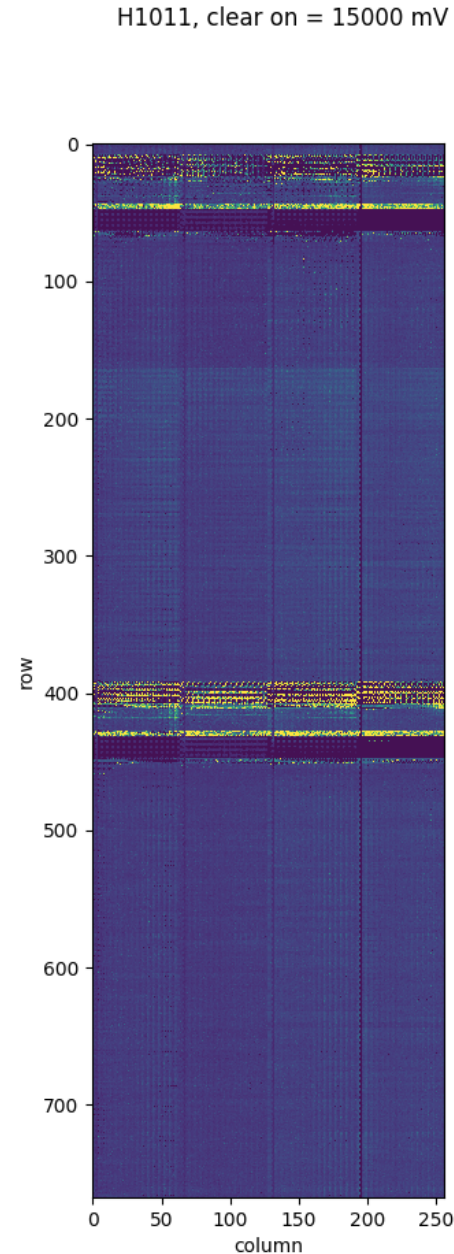
Occupancy.

- Increase threshold to reduce no. of noise hits

- Lower clear on also reduces the number of noise hits

- Impact on data taking w/o GM needs to be determined

- Large module by module variations

- Predict the occupancy from pedestal changes should be possible

threshold scan module H1021, W44_IF

Occupancy.

threshold scan module H1011, W43_IF

threshold scan module H1021, W44_IF
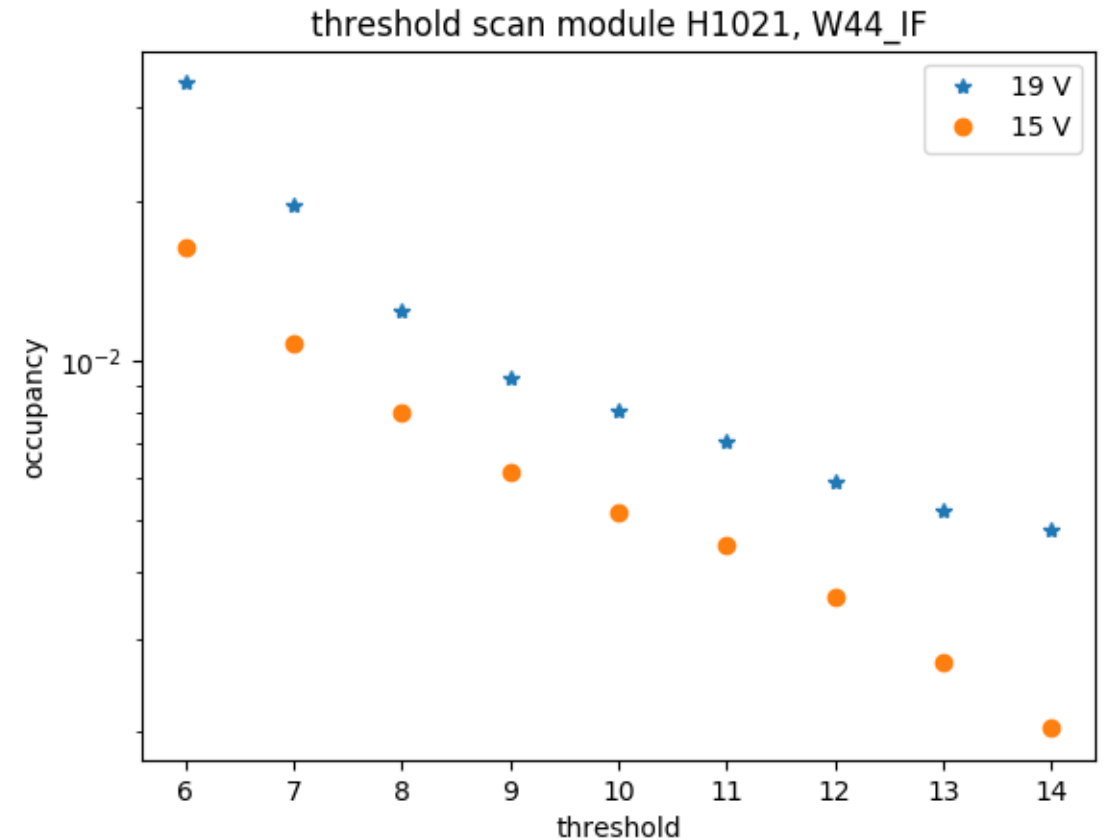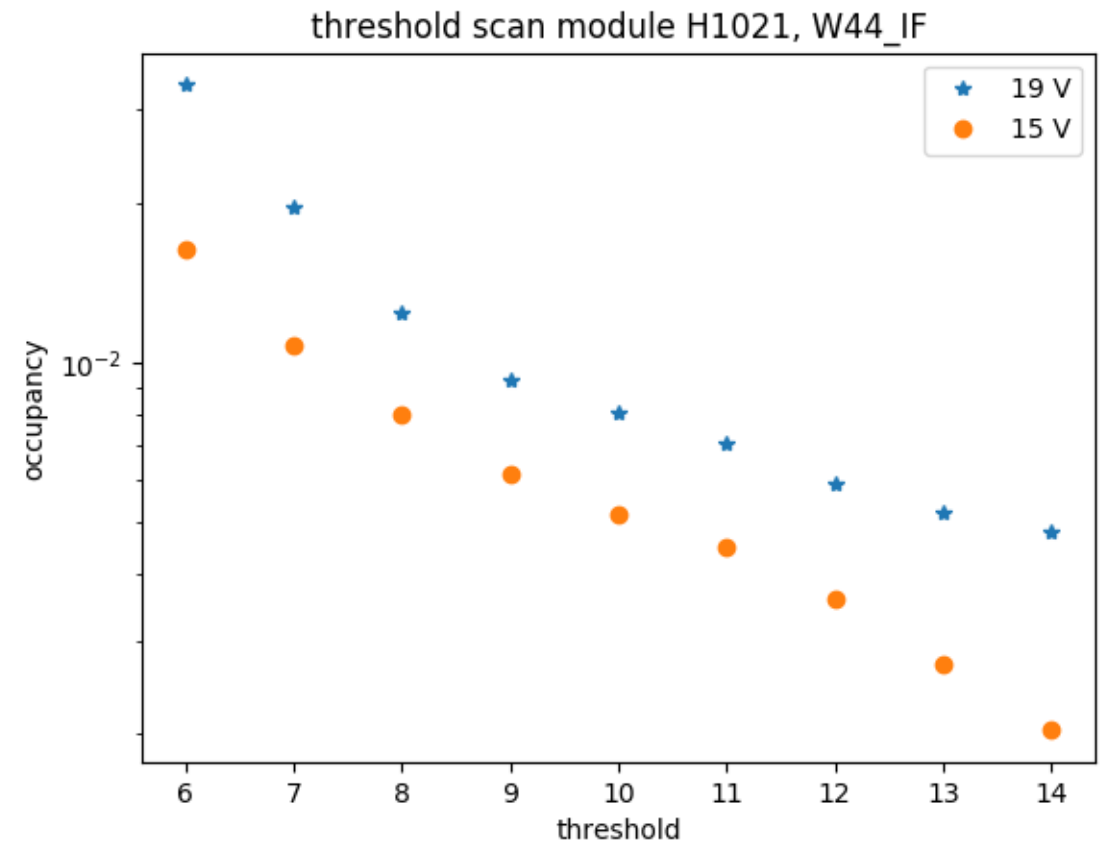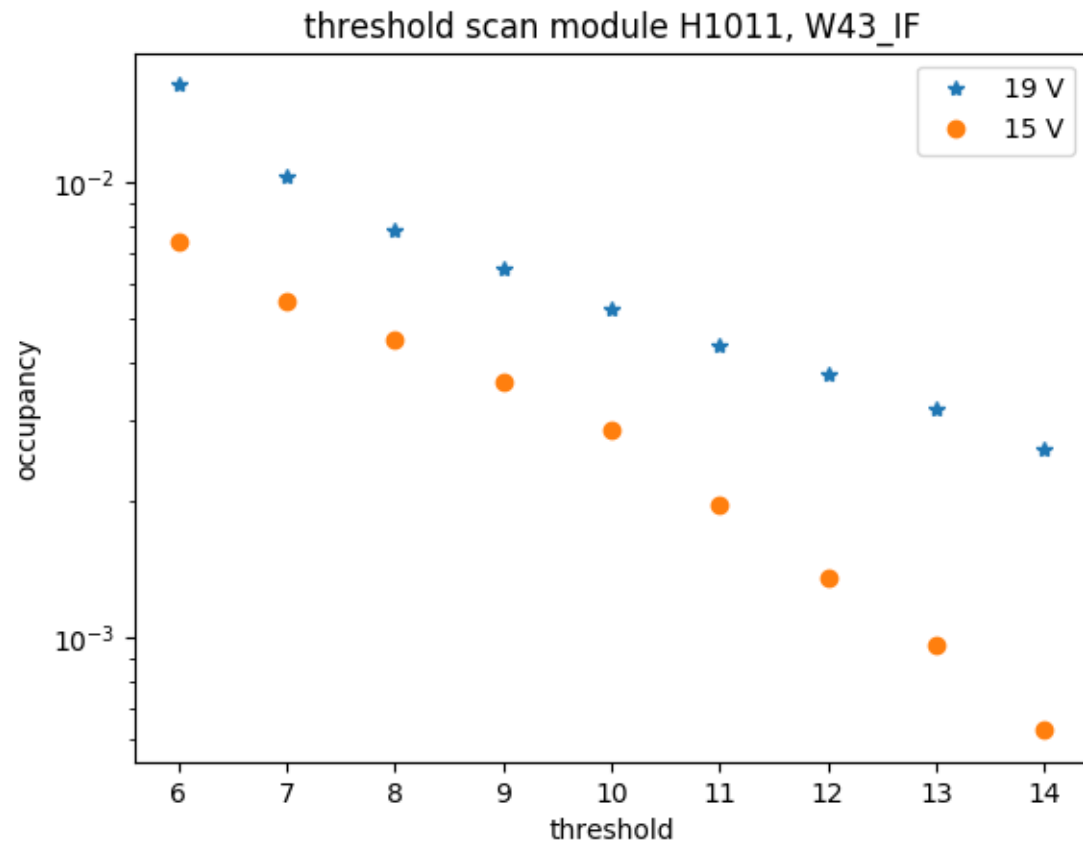
Stability Test.

After 1 hour

Change of mean pedestals H1011 run 0 vs 1, clear on = 15000 mV

Stability Test.

After 2 hour

Change of mean pedestals H1011 run 0 vs 2, clear on = 15000 mV

Stability Test.

After 3.5 hour

Change of mean pedestals H1011 run 0 vs 3, clear on = 15000 mV

Stability Test.

After 5 hour

Change of mean pedestals H1011 run 0 vs 4, clear on = 15000 mV
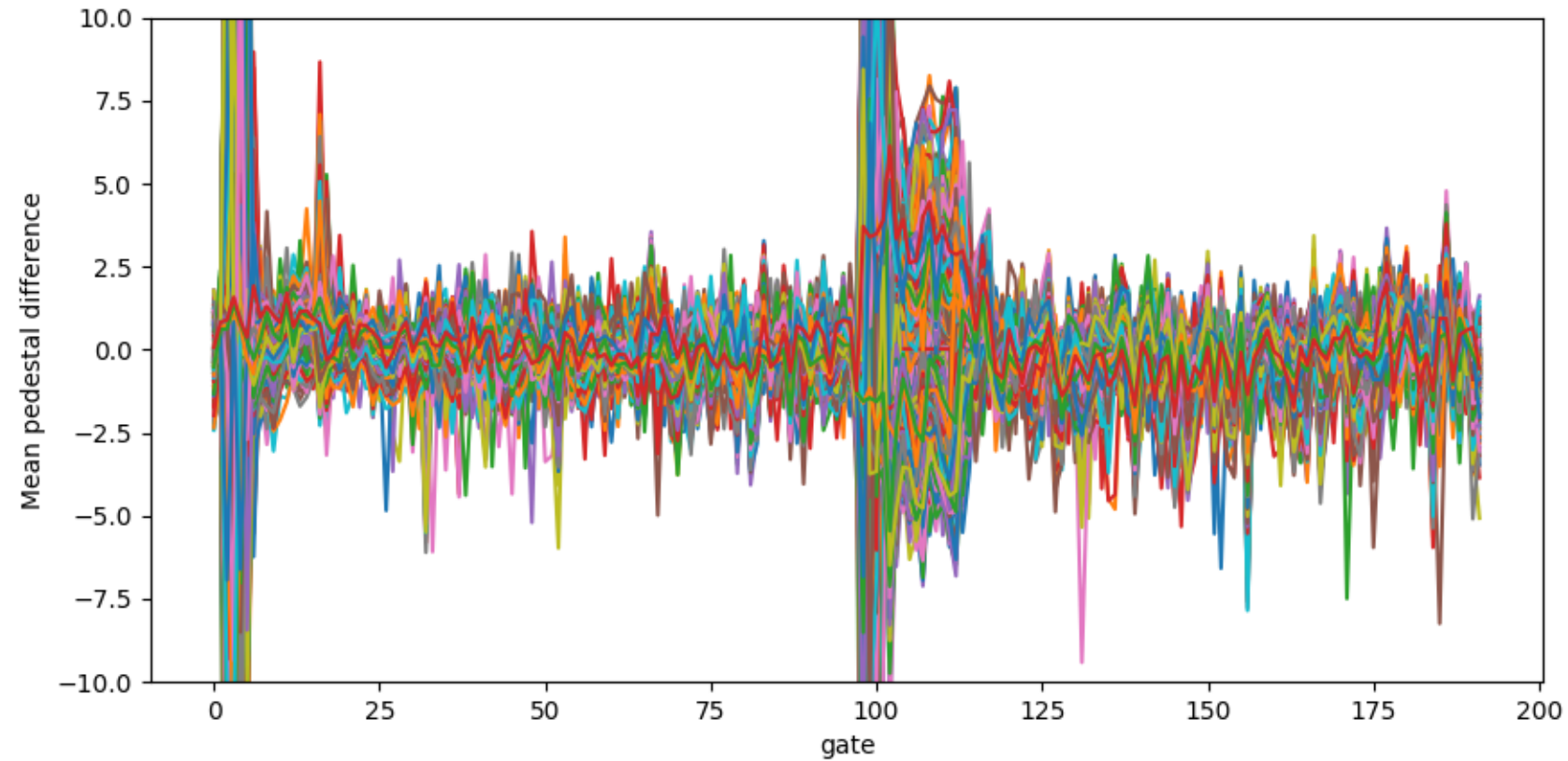
Stability Test.

After 6 hour

Change of mean pedestals H1011 run 0 vs 5, clear on = 15000 mV
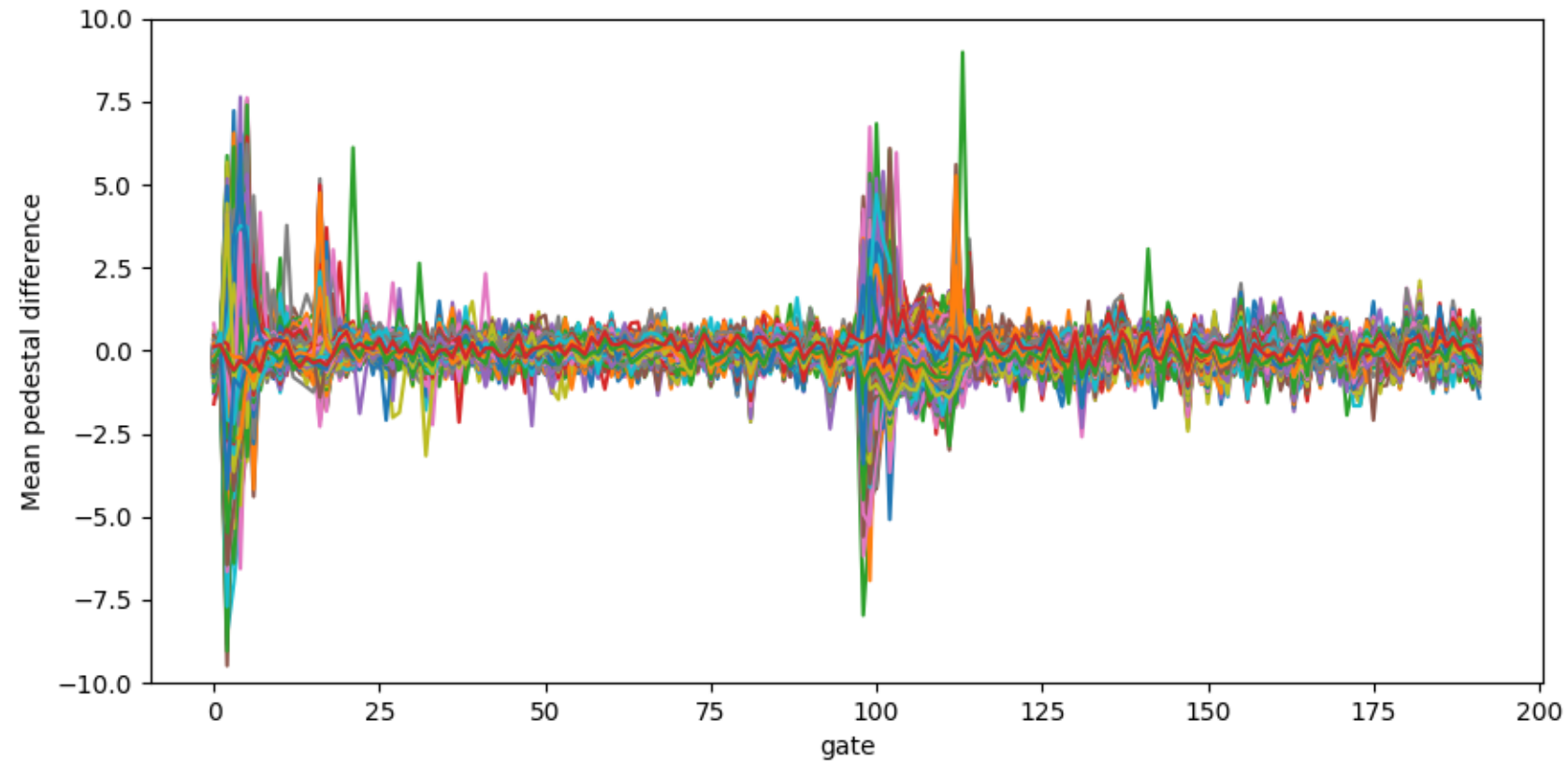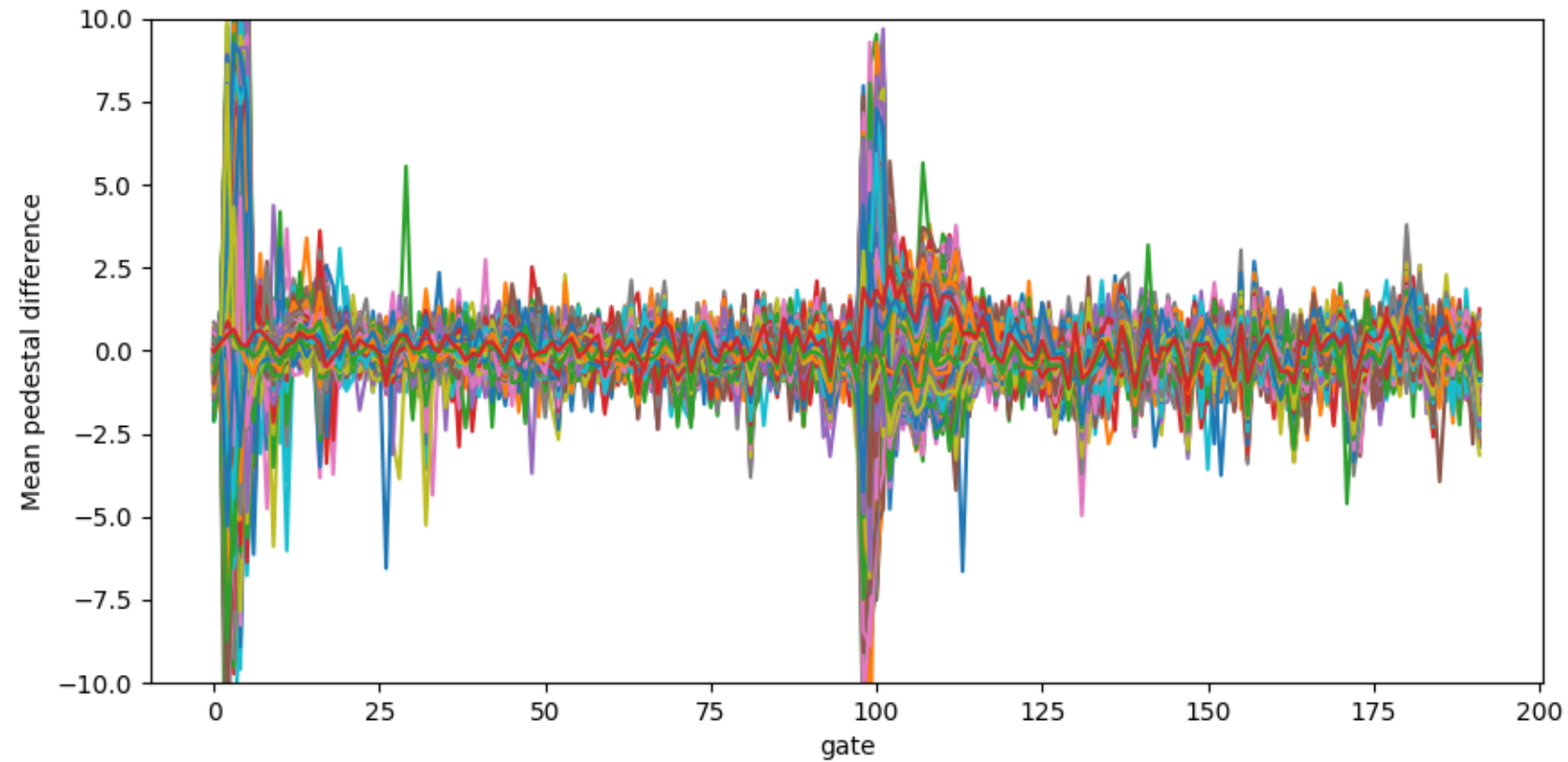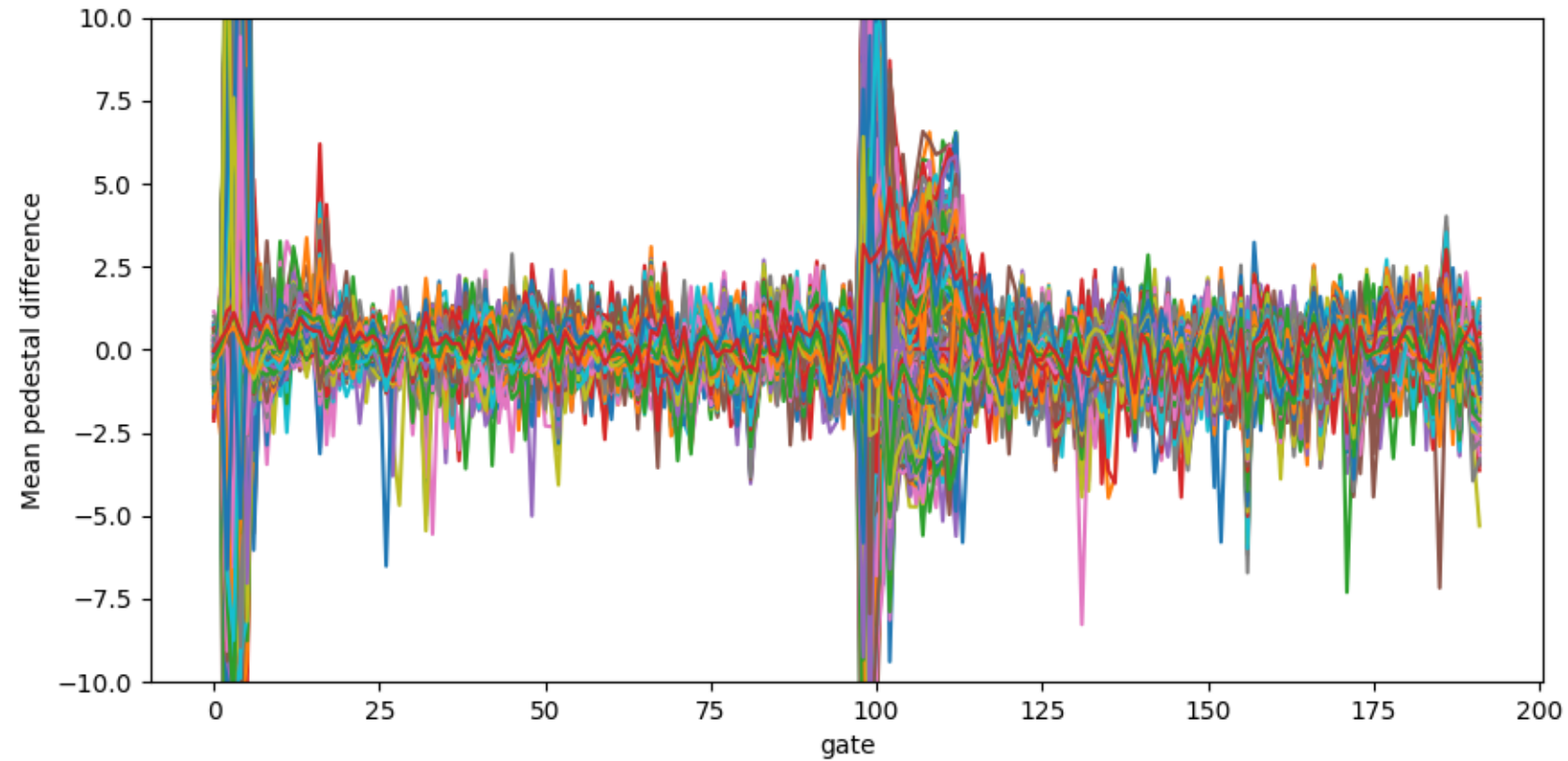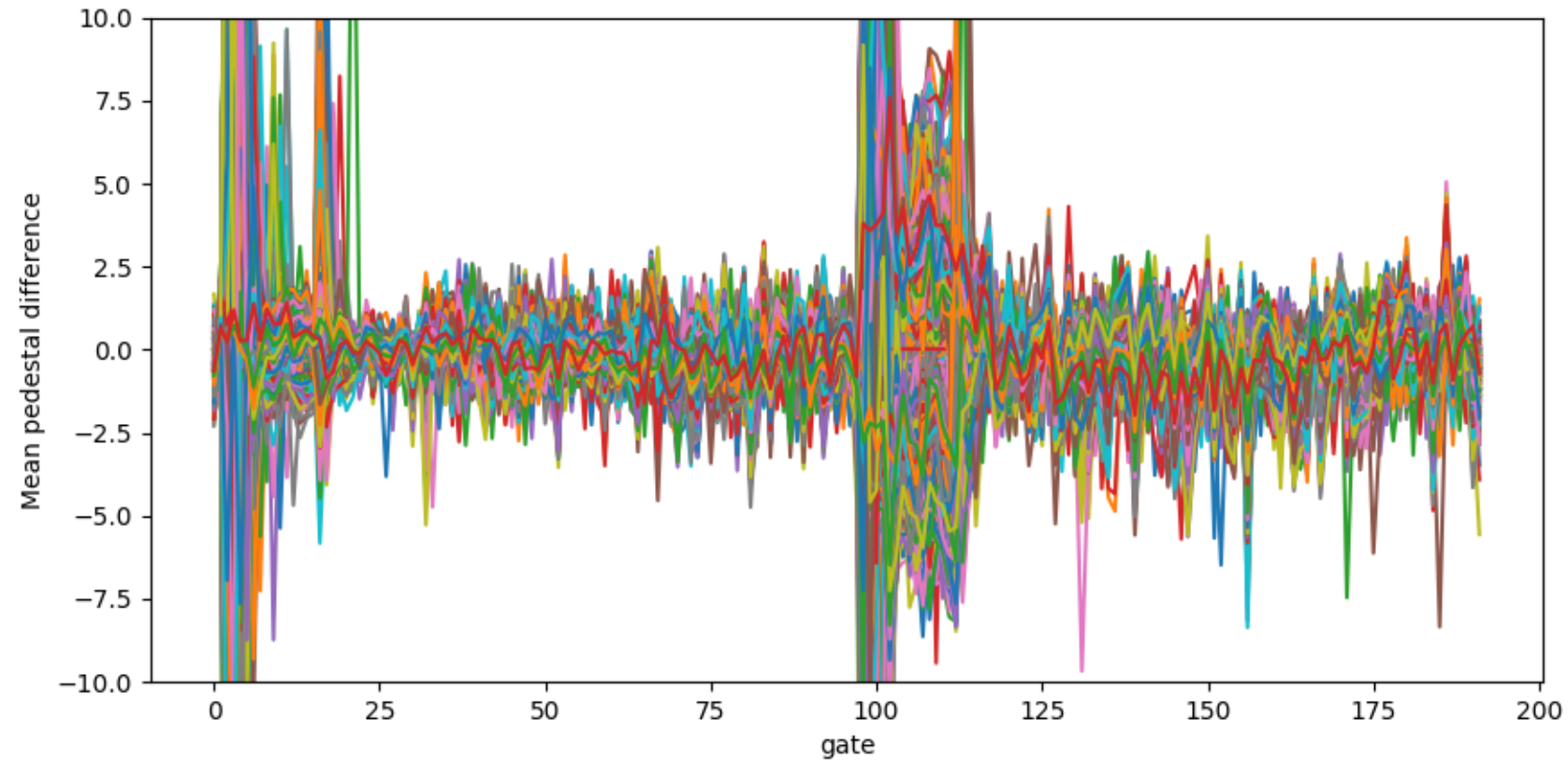
Stability Test.

After 8 hour

Change of mean pedestals H1011 run 0 vs 6, clear on = 15000 mV
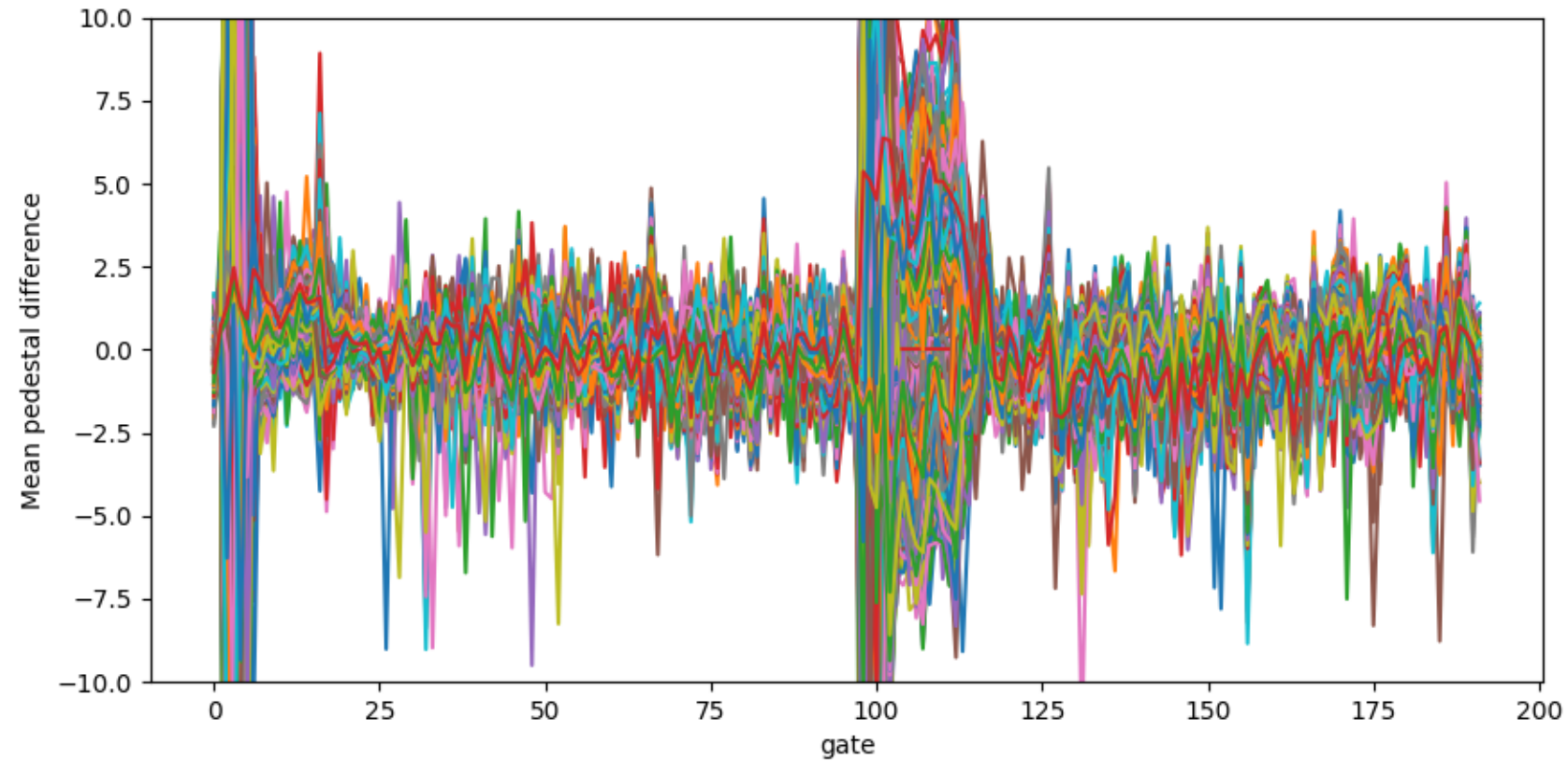
Stability Test.

No correction

Change of mean pedestals H1011, clear on = 15000 mV
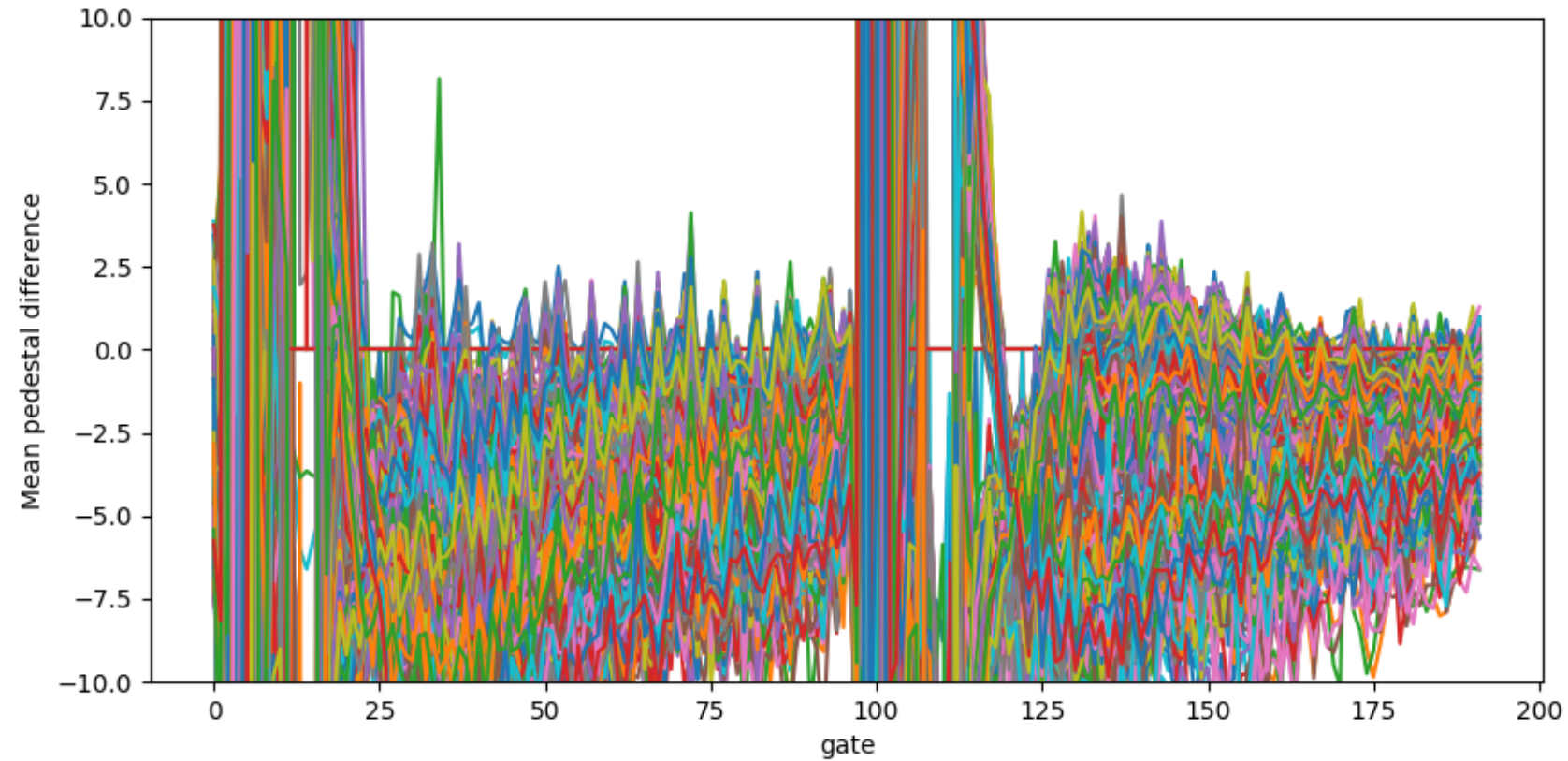
Stability Test.

- GM was off between two measurements

- Pedestal shifts observed even for the reference measurements w/o GM

- Redo the measurement with GM active all the time

- No final conclusion yet but I still have hope that a correction of the pedestal shifts is possible

Further possible/necessary Studies.

- Deeper analysis if the oscillation is a pixel dependent effect (See Robert's talk)

- Describe overall damping behavior for correction (See Robert's talk)

- Determine impact of GM on data analysis due to pedestal fluctuation
    - Wrong pixel charge
        - Hit resolution
    - Additional fake hits
        - Effect on clustering (Hit resolution)
        - Track efficiencies
    - Missing hits
        - Hit efficiency
        - Hit resolution

Necessary Steps for KEK Operation.

- Parameters for GM sequence

- GM Offset:
  - Time between arrival of injection signal and actual arrival of noisy bunches
  - We tried to do a first measurement at the end of phase 3 but did not succeed
  - We need to redo the measurement
    - Change offset during a run and measure occupancies

- GM Length:
  - At least 6 gates and long enough that occupancy is no problem
  - Change offset and length during a run and measure occupancies

- Repetition length:
  - Depends on the damping time of the noisy bunches
  - Reduce as much as possible such that occupancy is no problem
  - Can be determined from a run without GM

Summary.

- Quite some experience with operating with GM

- We see a lot of different effects and ACMC often adds addition structures on top

    – Need to understand these effects and their influence on possible corrections procedures

- Need to redo several measurements (also w/o ACMC) for a final conclusions

- Discuss, prepare and organize the necessary measurements at KEK