# NP04 PDS characterization – Datataking status and plans

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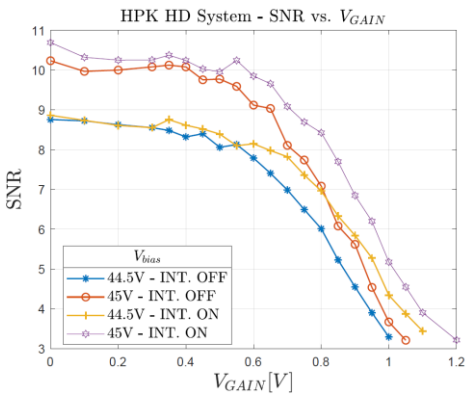
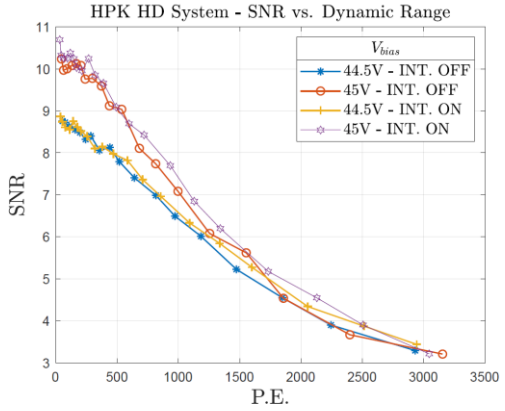
October 17th , 2024

# Datataking plan

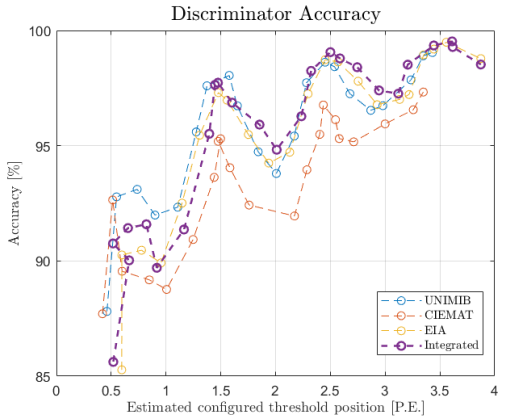
## VGAIN sweep

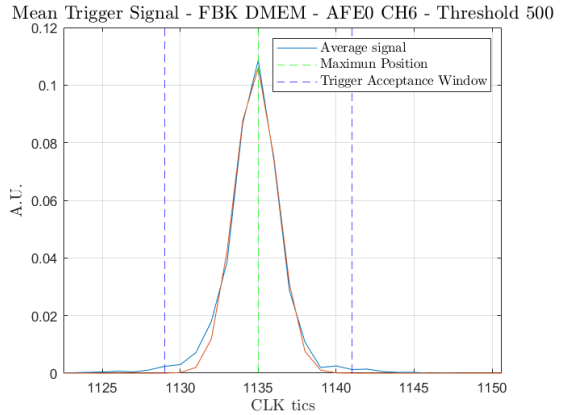



- A VGAIN sweep of the entire detector will allow us to fully characterize SNR (Signal-to-Noise ratio) and Dynamic range versus the VGAIN parameter.

## Selftrigger threshold sweep



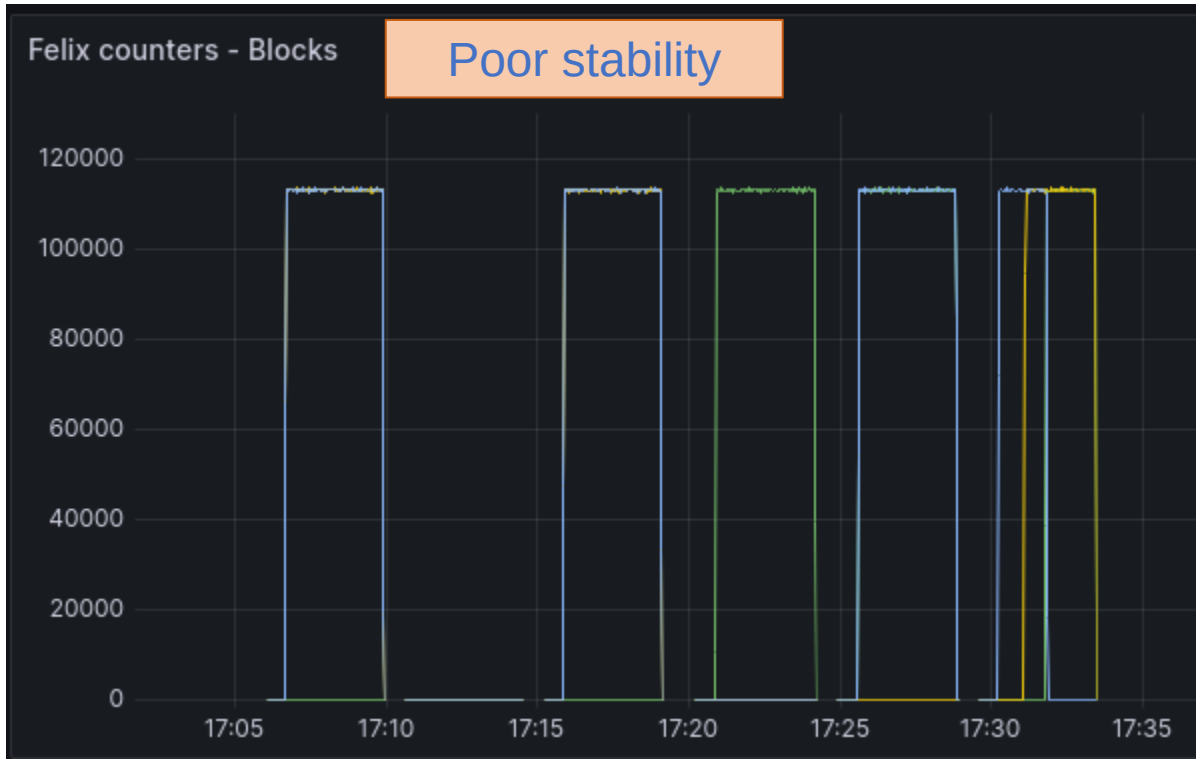




- The selftrigger threshold sweep will fully characterize the discriminator accuracy in NP04 under real conditions
- Also, we will be able to calculate the detector timing resolution in each ARAPUCA channel. Also, calculate any delay associated with cabling in order to understand how to fine tune the selftrigger timing system.

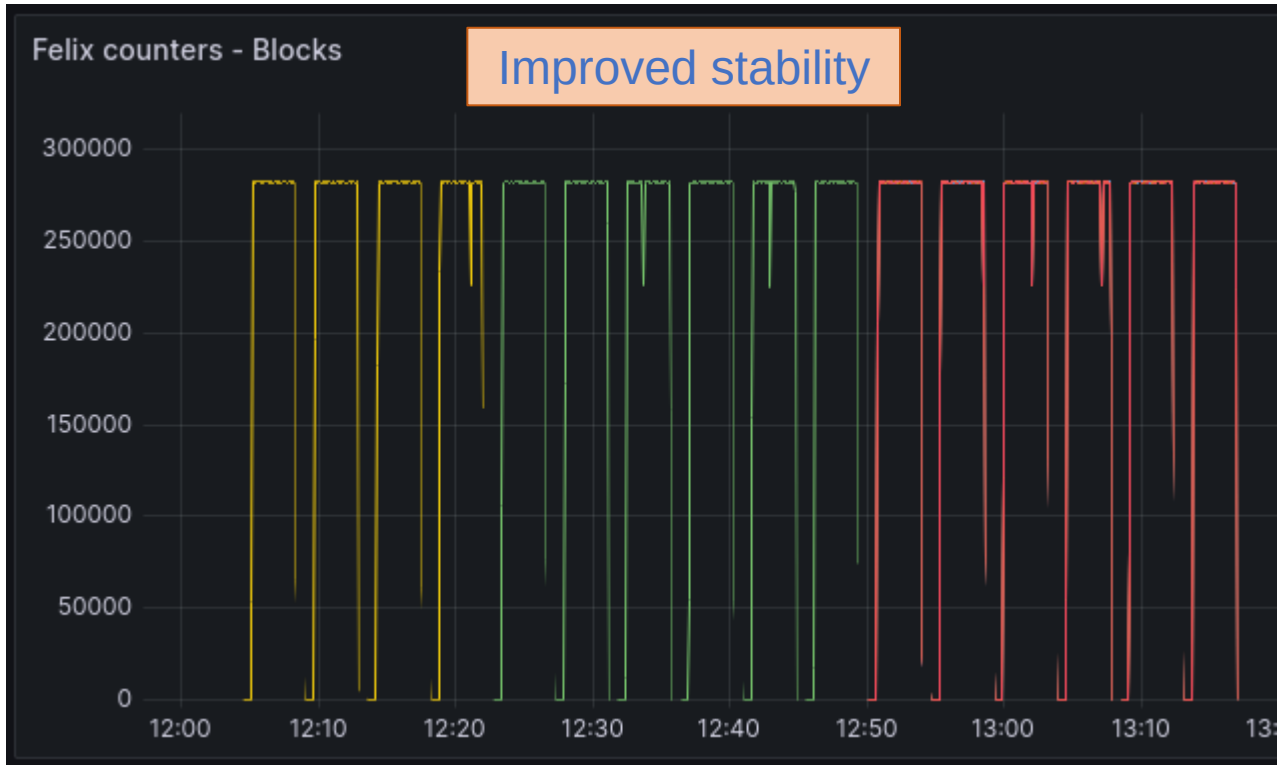
# System improvements

- Longterm stability
- Increased data throughput
- Improved configuration speeds

# Longterm stability improvements

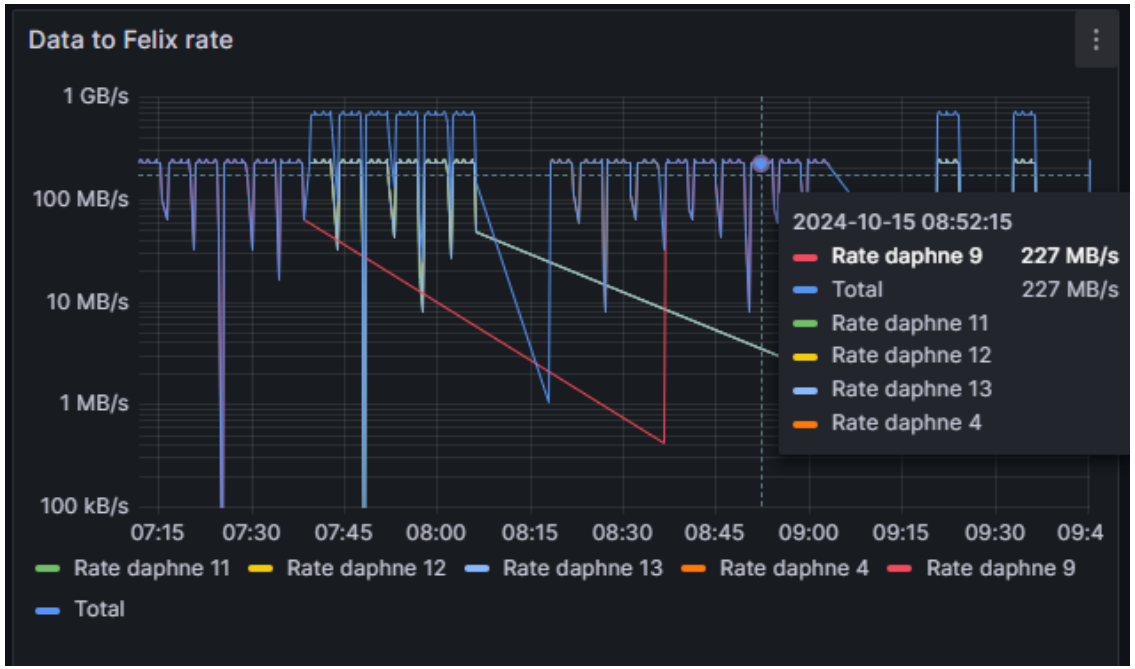



- Although firmware 97823e7 is stable, the selftrigger and VGAIN sweep dedicated firmwares behaved erratically.
- The boards randomly stopped sending data from run to run.




- This issue was solved and stable behaviour was verified for long duration runs.
- The fix consisted in improving the reset scheme of the core module in DAPHNE.
- Valuable information for V3 firmware.

# Increased data throughput





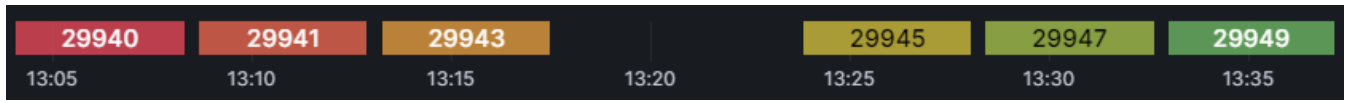
- To increase the data throughput, we increased the LED frequency from around 3200 Hz to 5500 Hz.
- The bandwidth increased from 227MB/s to 427 MB/s, to the limit to avoid overflow of the self-trigger FIFOs.

- To reduce run time and given that we almost doubled the trigger frequency, we reduced run times from 180 seconds to 90 seconds.
- The number of waveforms per run decreases from around 15000 to 13000.

# Improved configuration speed

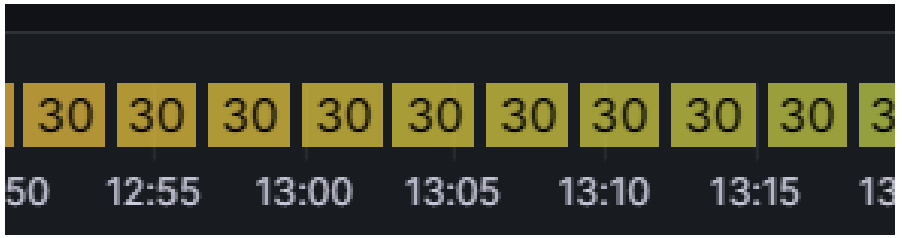
- To improve configuration speeds, we overrided a nested process that saves all previous configurations, and replaced it with a simple log file that saves the current configuration.

## Slow configuration




- Configuration could take up to 15 minutes in some ocassions.

## Fast configuration




- Configuration time is now stable and takes between 2 to 3 minutes per run.

# Volume of data and status of RUNs

## VGAIN sweep

| VCNTL [V] | VGAIN [mV] | |
|---|---|---|
| 1,2 | 3192 | APA 34 |
| 1,1 | 2926 | APA 34 |
| 1,05 | 2793 | ALL APAs |
| 1 | 2660 | ALL APAs |
| 0,95 | 2527 | ALL APAs |
| 0,9 | 2394 | ALL APAs |
| 0,85 | 2261 | ALL APAs |
| 0,8 | 2128 | ALL APAs |
| 0,75 | 1995 | ALL APAs |
| 0,7 | 1862 | ALL APAs |
| 0,65 | 1729 | ALL APAs |
| 0,6 | 1596 | ALL APAs |
| 0,55 | 1463 | ALL APAs |
| 0,5 | 1330 | ALL APAs |
| 0,45 | 1197 | ALL APAs |
| 0,4 | 1064 | ALL APAs |
| 0,35 | 931 | ALL APAs |
| 0,3 | 798 | NA |
| 0,2 | 532 | NA |
| 0,1 | 266 | NA |
| 0 | 0 | NA |
| LNA GAIN: 12dB | | |
| PGA GAIN: 24dB | | |
| Tiempo de toma de datos: | | 1,8472 hours per VGAIN |

- LED:
  - APA 12: [1400,1800,2200,2800,3400,4000]
  - APA 34: [1400,1500,1600,1800,2000,2200]
- OV : [40, 45, 50] %
- Total number of runs: 672
- Status: almost completed (some runs needs to be repeated)

## Selftrigger threshold sweep

| | SELFTRIGGER Test | | | |
|---|---|---|---|---|
| | Threshold | Config[hex] | SIDE A | SIDE B |
| 1 | 50 | 0x20010000032 | APA 34 | |
| 2 | 100 | 0x20010000064 | APA 34 | |
| 3 | 150 | 0x20010000096 | | |
| 4 | 200 | 0x200100000c8 | | |
| 5 | 250 | 0x200100000fa | | |
| 6 | 300 | 0x2001000012c | | |
| 7 | 350 | 0x2001000015e | | |
| 8 | 400 | 0x20010000190 | | |
| 9 | 450 | 0x200100001c2 | | |
| 10 | 500 | 0x200100001f4 | APA 34 | |
| 11 | 550 | 0x20010000226 | | |
| 12 | 600 | 0x20010000258 | | |
| 13 | 650 | 0x2001000028a | | |
| 14 | 700 | 0x200100002bc | | |
| 15 | 750 | 0x200100002ee | | |
| 16 | 800 | 0x20010000320 | | |
| 17 | 850 | 0x20010000352 | | |
| 18 | 900 | 0x20010000384 | | |
| 19 | 950 | 0x200100003b6 | | |
| 20 | 1000 | 0x200100003e8 | | |
| 21 | 1050 | 0x2001000041a | | |
| 22 | 1100 | 0x2001000044c | | |
| 23 | 1150 | 0x2001000047e | | |
| 24 | 1200 | 0x200100004b0 | | |
| 25 | 1250 | 0x200100004e2 | | |
| | Tiempo de toma de datos: | | 0,61573 hours per Thr | |

- LED:
  - APA 12: [1400,1800,2200,2800,3400,4000]
  - APA 34: [1400,1500,1600,1800,2000,2200]
- OV : [45] %
- VGAIN: According to table
- Total number of runs: 600
- Status: Not yet started

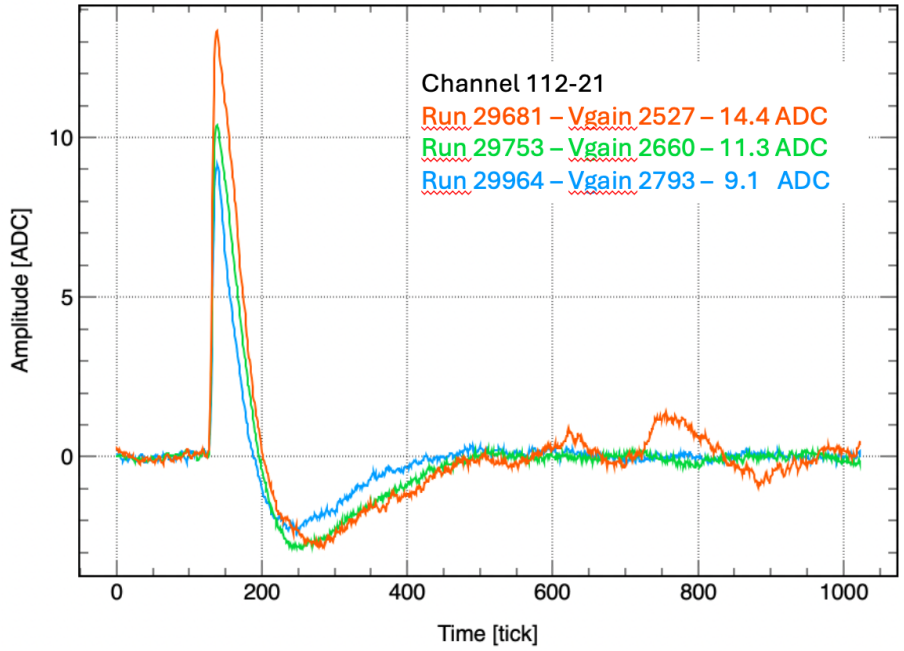
- Here, side A and side B refers to runs where the waveform signal and trigger signal are swapped.
- Because we need to have both signal and trigger, we divide 20/20 among the 40 channels. Then to have the full detector characterized, we need to scan this table twice.

# Monitoring the data


- We monitor the debug registers to make sure the data in the FIFOs coincides with the number of selftriggered events.
- If these do not coincide, we mark the run to be repeated.

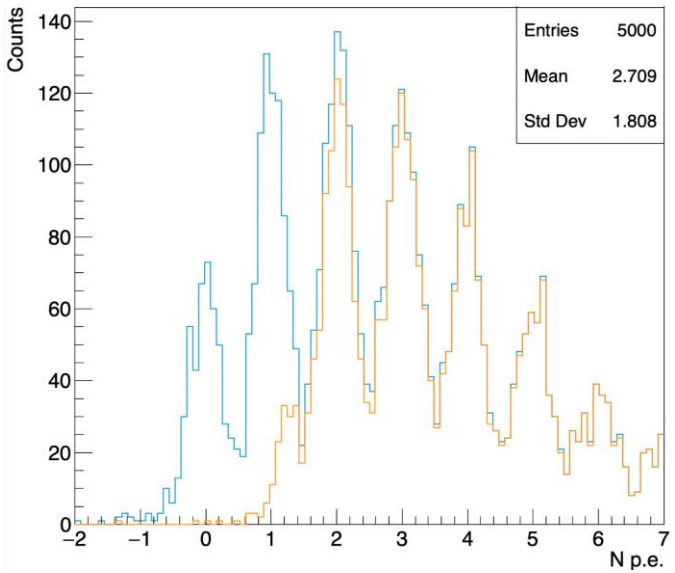
# Examples of runs

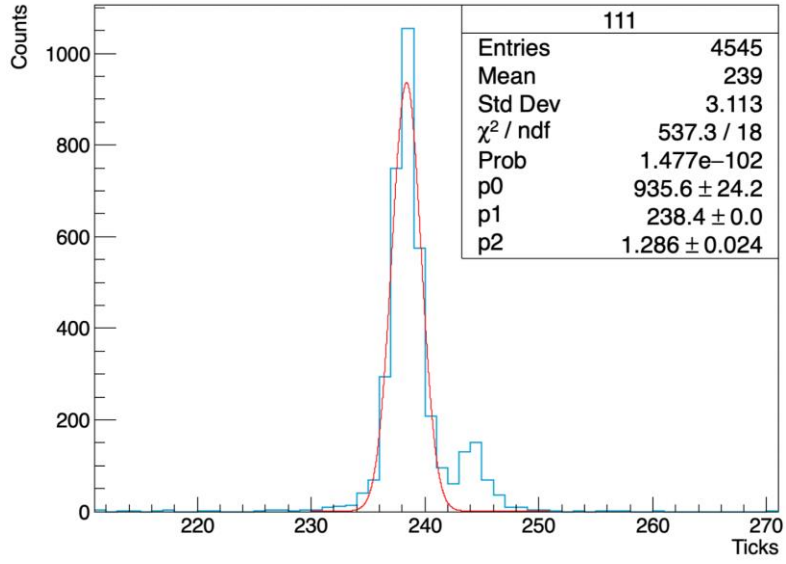
## VGAIN sweep




- Channel 112-21 with different single P.E. amplitudes.
- The system is indeed sweeping the VGAIN parameter.

## Selftrigger threshold sweep




- SiPM signals and associated trigger are correctly aligned by timestamp in complete 40 channels groups.
- Aligning timestamps is done efficiently (2min vs previous 40min)
- Threshold value is configured correctly manually (DAQ configs still needs to be confirmed).
- The trigger jitter is compatible with laboratory measurements.

# Conclusions

- We have until November 1st to finish these runs. We will probably finish the VGAIN scan today, and we are left with the self-trigger scan.
- We have stable firmware and software capable of operating automatically for long period of times (until proven otherwise).
- The self-trigger scan will take ~30 hours of runs. We have allocated 5 days of detector time.
- More than 1200 runs will be taken in total. The amount of data to analyze will require us to move all our analysis code to waffles.
- We also need to developed automatic analysis methods to analyze all runs and produce the results presented in slide 2.