Coldbox: HD and VD electronics

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Dictionary

Definition of terms you find throughout the presentation

- SNR := G / σ_0, with G = distance between peaks
- Rise time := time interval between 10 % -> 90 % of waveform's amplitude. Computed on an average waveform. No fit was performed.
- Fall time := 90 % -> 10 %
- Dynamic range (DR) := amplitude of the saturating wfs divided by the single p.e. amplitude (Saturation obtained with LED light)
- CX := Cross-talk probability

SETUP

- CAEN DT5730SB operated at 500 MHz (2 ns/tick)
- LED: 365 nm and 275 nm
- SiPM: FBK TT
- VD Coldbox @ Neutrino Platform

Data taken

HD – VD comparison

Data we took with the digitizer

- Scan in LED intensity -> Linearity and saturation
- Calibrations with LED -> SNR, SPE amplitude, Noise FFT, D.R., stability
- Scan in V Bias -> V Breakdown
- Long waveforms -> Dark count, light leak

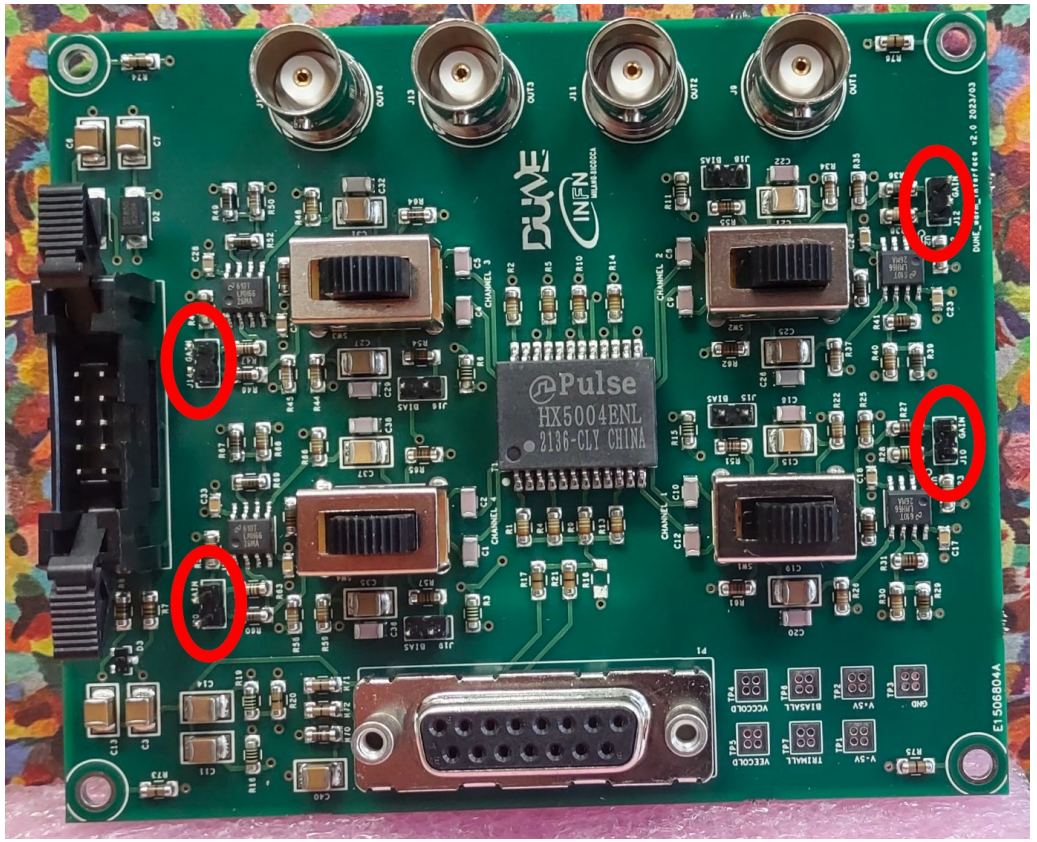
- Data taking repeated with two different LED drivers 365nm and 275 nm
  - The 275 nm one makes the analysis more reliable

M2 – HD Electronic

Gain and Transformer configuration

We can configure the second stage to have a x10 (low) or a x75 (high) gain putting jumpers on pins in red circles.

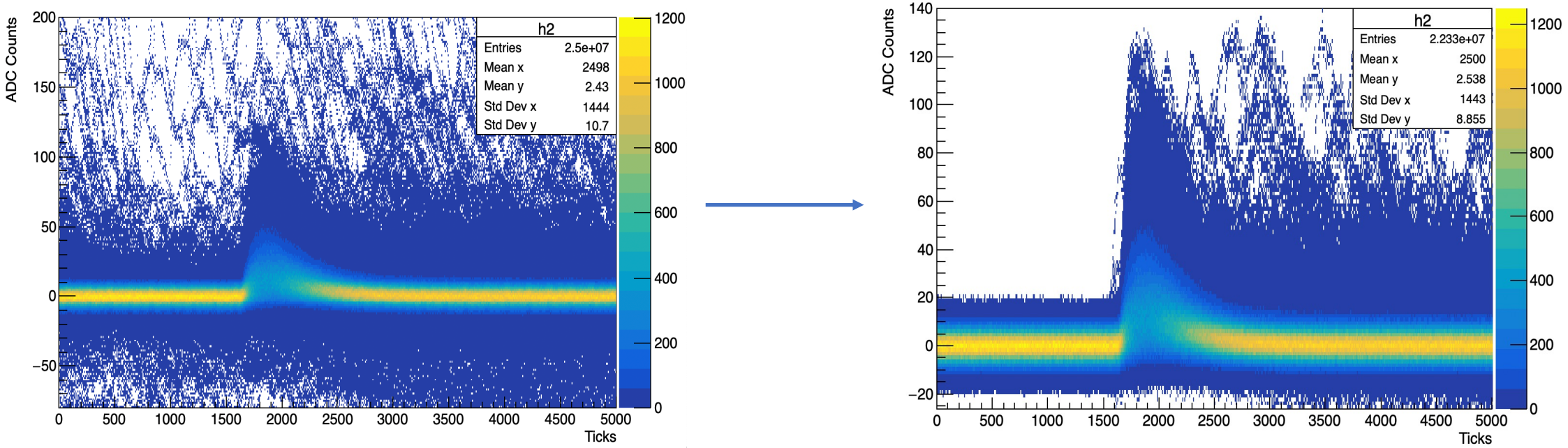
Also, we can bypass or not the transformer thaks to the switchers on the board.



Waveform selection

LED data analysis

I select waveforms with no light in the pre-trigger and with amplitude of a fistful of photo-electrons.



M1 – VD Electronic

SiPM FBK TT – Bias 32.5 V – 365 nm LED

RUN	Rise time [ns]	Fall time [ns]	Int win [ticks]	SNR	SPE Ampl [ADC]	DR
1	272	1680	1650-3000	4.2	5	2960
2	272	1700	„	4.2	5	2960
3	274	1670	“	4.2	5	2930
4	272	1710	“	4.4	5	2940

M2 – HD Electronic

SiPM FBK TT – Bias 32.5 V – 365 nm LED

RUN	Rise time [ns]	Fall time [ns]	Int win [ticks]	SNR	SPE Ampl [ADC]	DR
Low Gain No Transf	280	1740	1650-3000	6.0	6.8	2110
Low Gain Transf	256	944	1650-2600	5.4	6.2	2320
High Gain No Transf	274	1690	1650-3000	7.2	48	305
High Gain Transf	250	1650	1650-3000	6.6	41	349

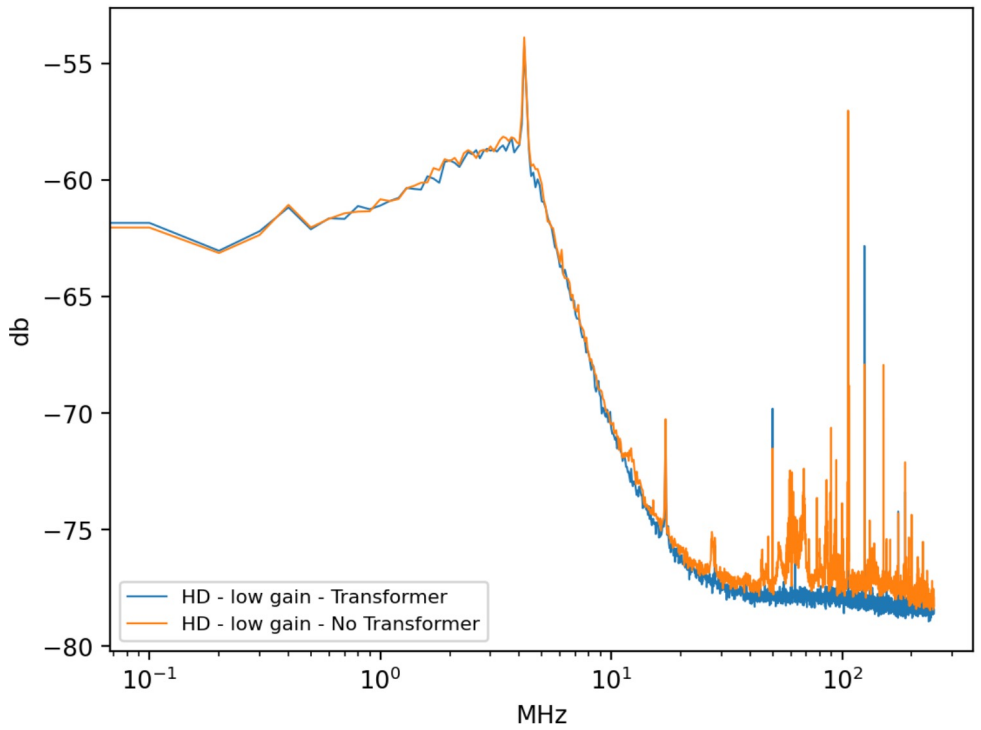
LED 275 nm

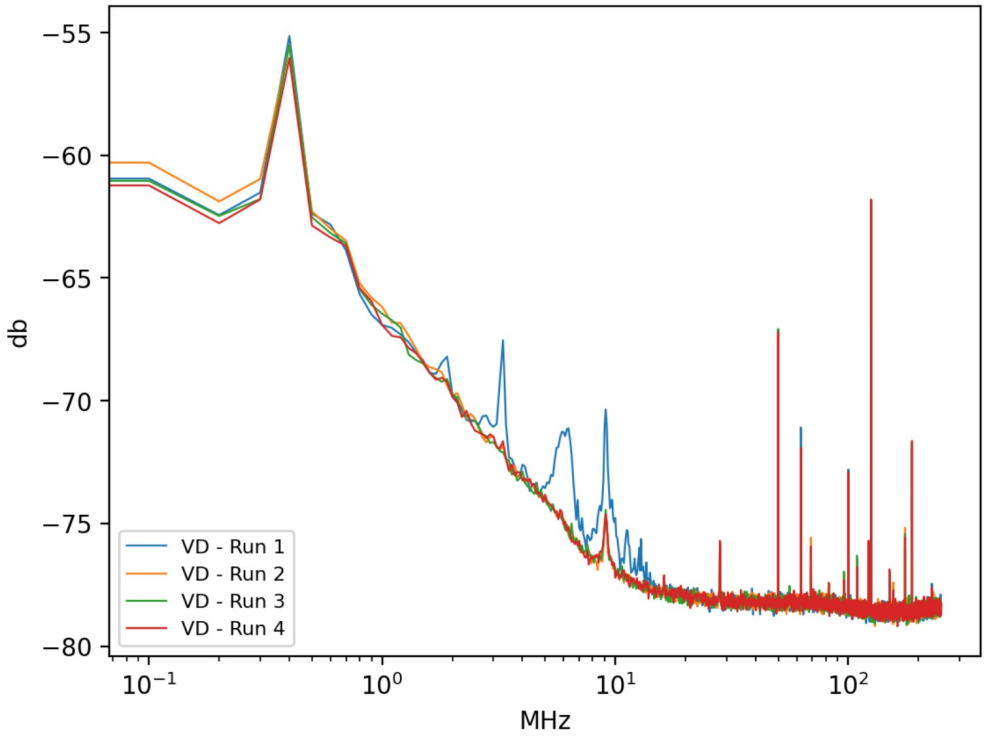
SiPM FBK TT – Bias 32.5 V – HD & VD

RUN	Rise time [ns]	Fall time [ns]	Int win [ticks]	SNR	SPE Ampl [ADC]	DR
HD	142	1480	4150-5500	5.2	8.8	1630
VD	140	1420	4150-5500	4.0	6.9	2144
HD	142	1480	4150-5000	7.3	8.8	1630
VD	140	1420	4150-5000	4.9	6.9	2144

FFTs

HD and VD



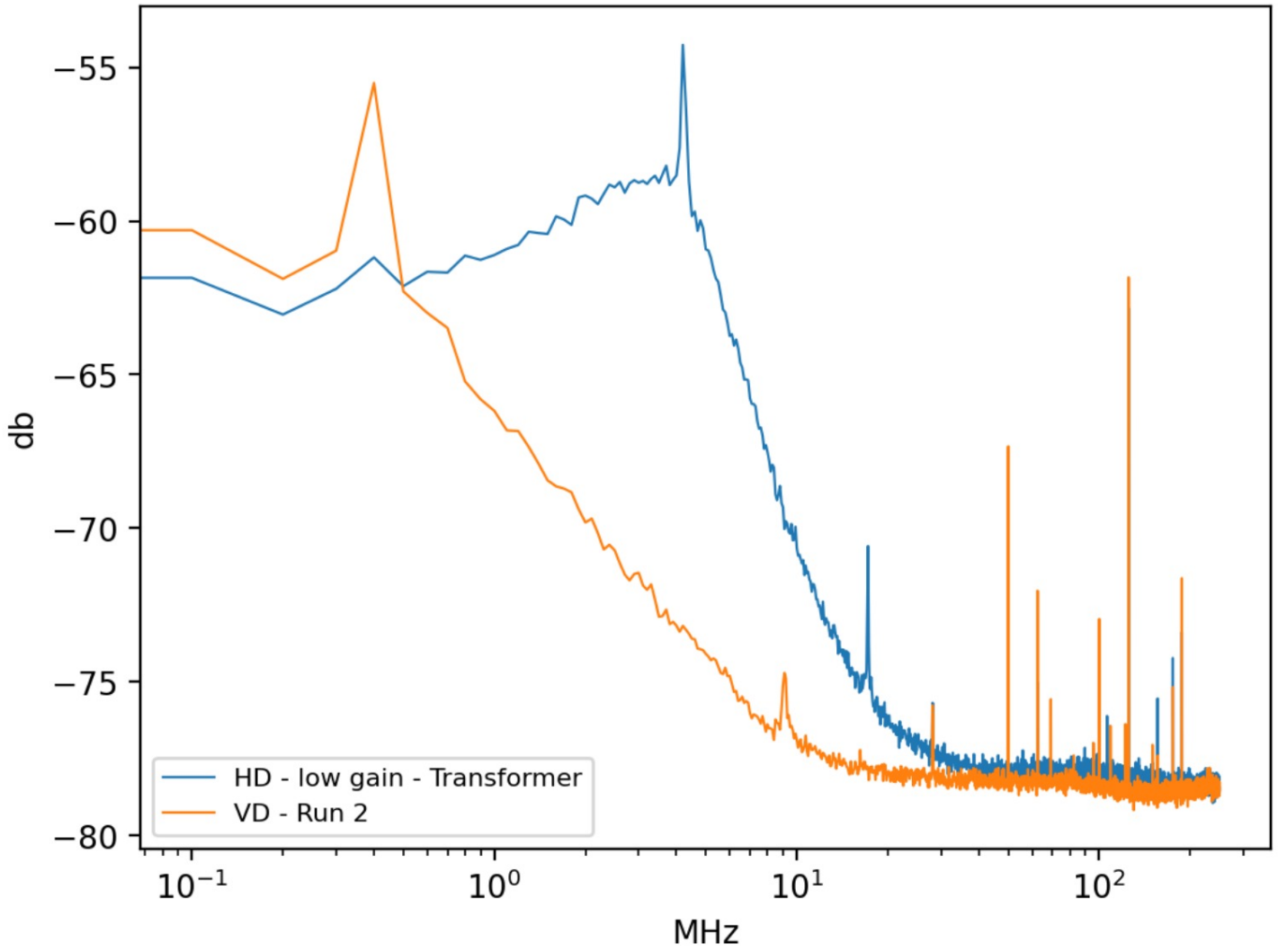


FFTs

HD and VD comparison

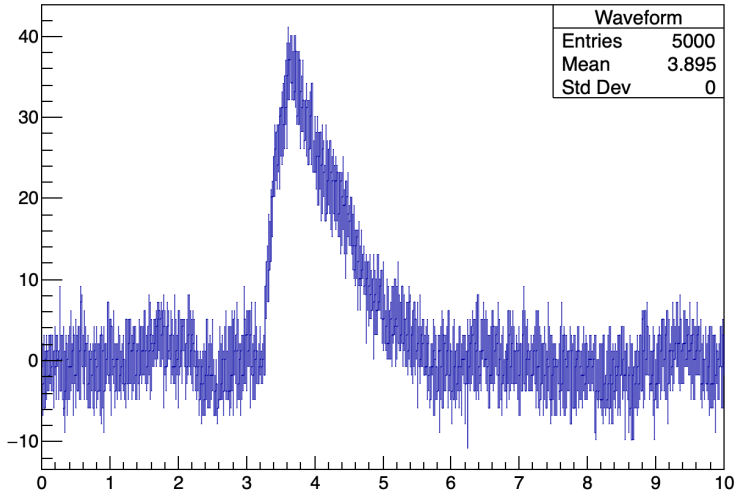
HD: baseline RMS = 4.8

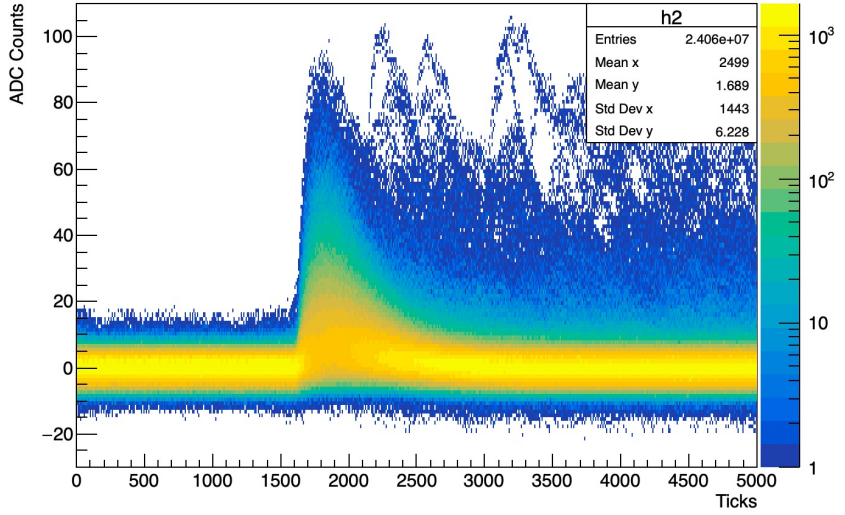
VD: baseline RMS = 3.0

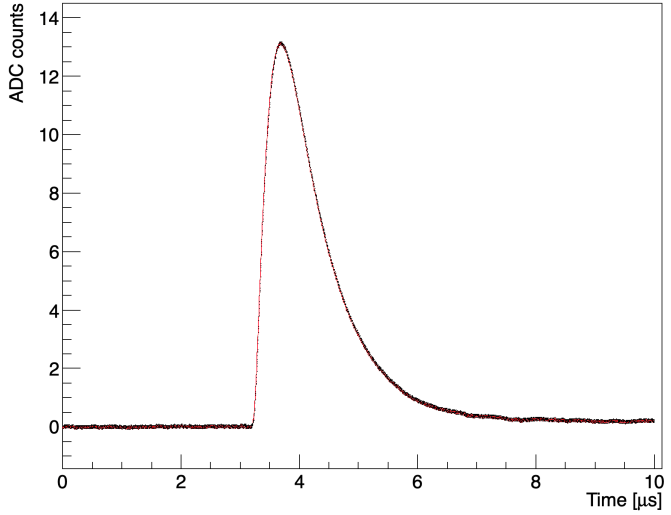


VD waveforms

LED 365 nm

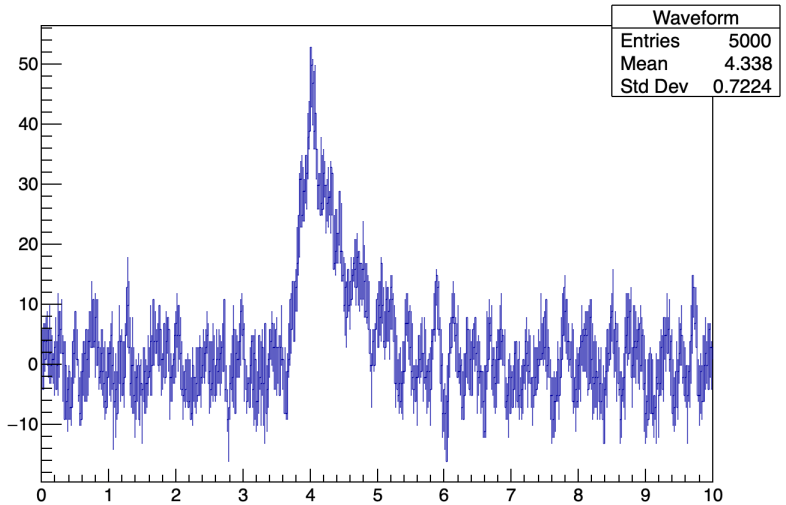


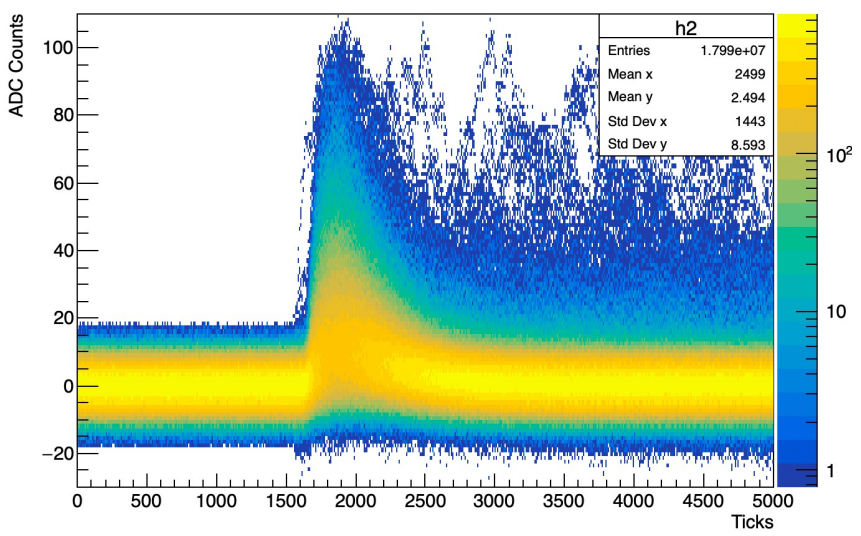


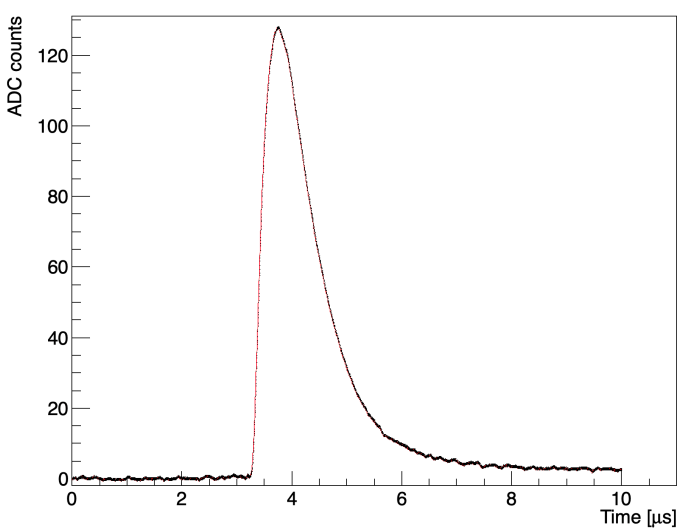


HD waveforms

LED 365 nm



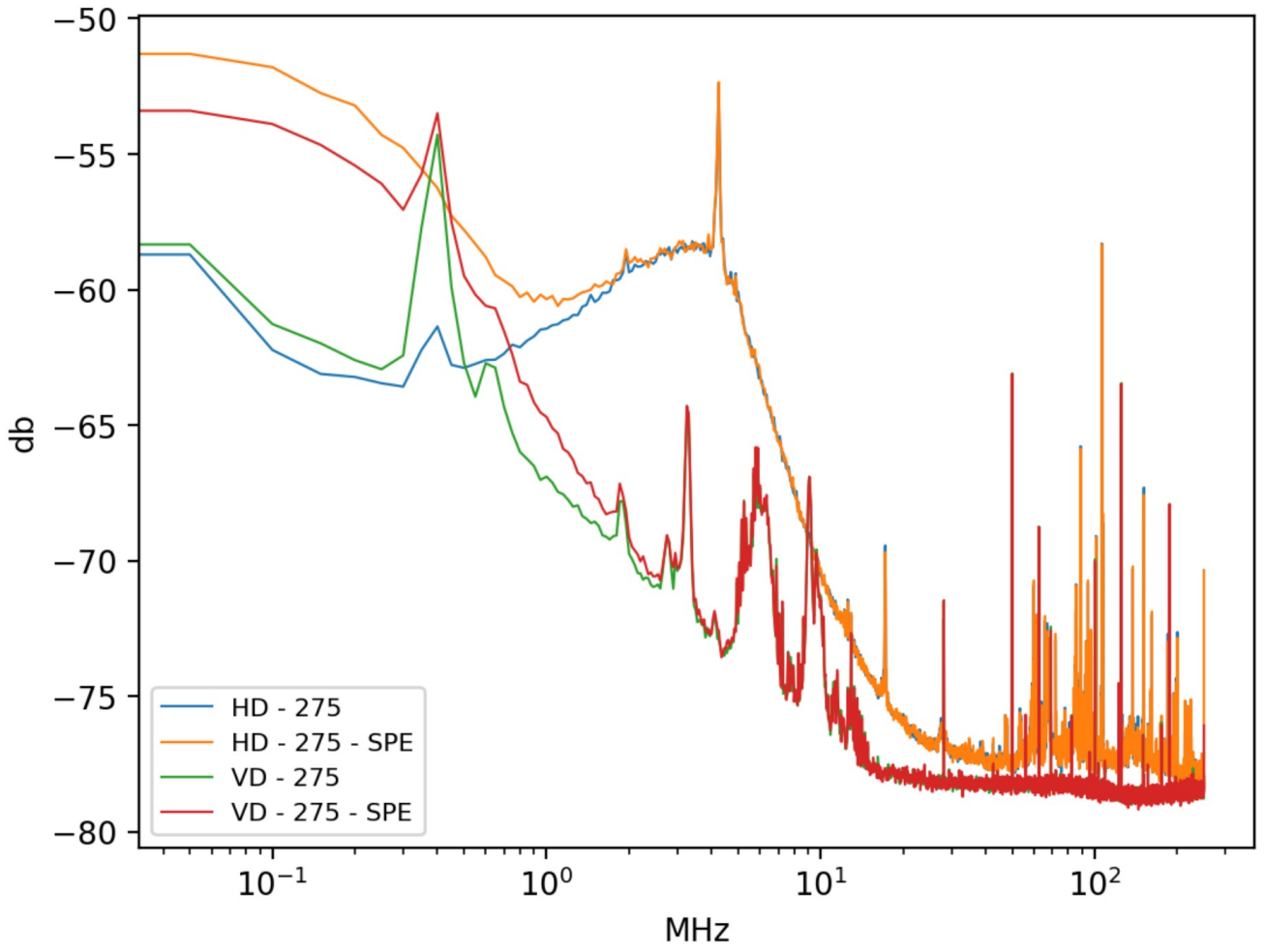




FFTs

HD and VD comparison

SPE = selection of single photo-electron waveforms



CONCLUSIONS

- We observe better SNRs with HD electronic for two reason:
  - Higher gain
  - Slightly lower noise in the low frequency range
- As consequence, the dynamic range is a bit lower but still >> 1’000 p.e.s
- The 365nm LED is not a source of noise but it affects the analysis because it flashes photons in a larger time window. In particular, this drives to underestimate the SPE amplitude (-> dynamic range overestimation) and overestimate the rise and fall time
- The rise time we observed with 275 nm LED is within the expectations
- To do: linearity andbreaksown voltage studies + comparison with deware data