

First measurements of FBK SiPM

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First measurements

Test of two $4 \times 4 \text{ mm}^2$ *ASD-NUV4S-P* SiPM at room temperature and $T=77 \text{ K}$

- **DC characterization I-V**
 - Forward \rightarrow Quenching Resistance
 - Reverse \rightarrow Breakdown
- **Spectrum acquisition**
- **Dark Count Rate with preamplifier**

Experimental setup

Cooling

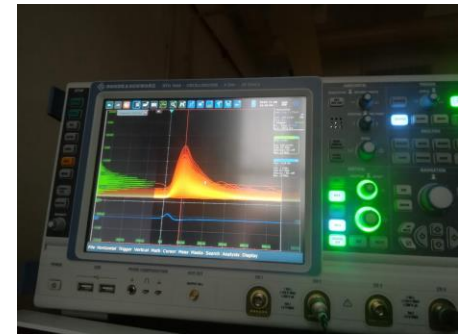
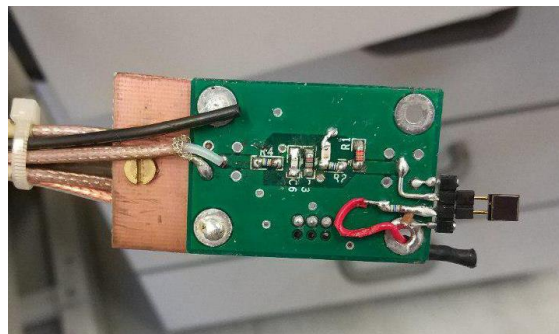
- Dewar with liquid Nitrogen
- Cold finger with optical fiber connected to a laser ($\lambda = 405 \text{ nm}$)

First I-V curves

- DC supply for bias
- Resistance load for current measurement

DCR

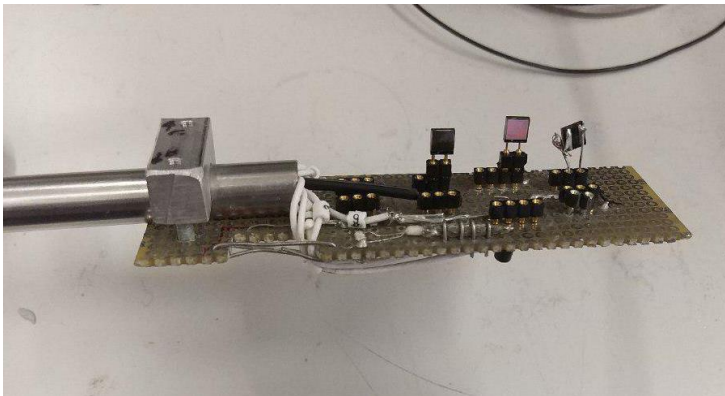
- SiPM biased with DC supply
- Preamplifier installed on cold finger
- Waveforms acquired with R&S 1044 Oscilloscope (with filtering)



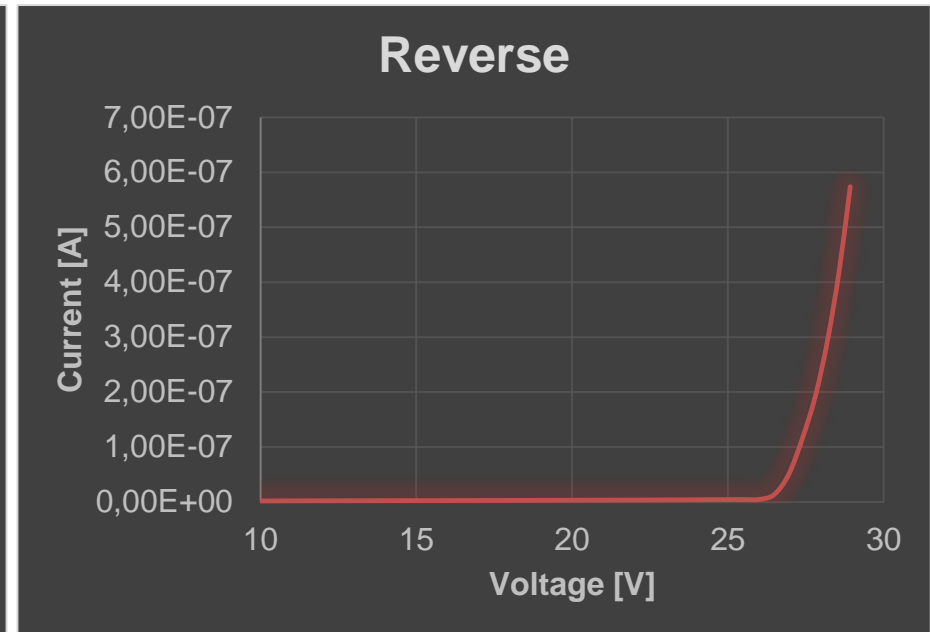
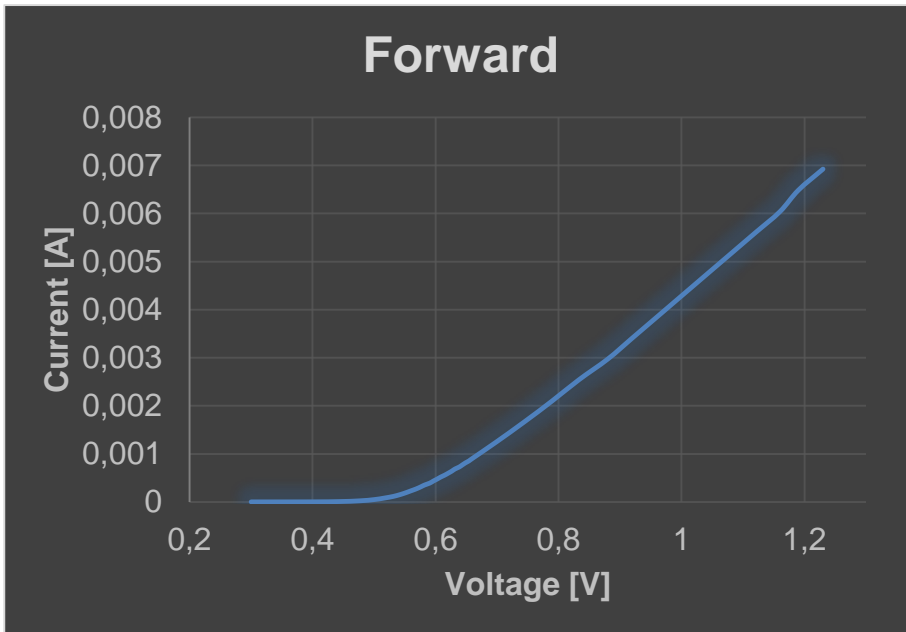
Experimental setup

I-V with semiconductor analyzer

- New cold finger with triaxial connectors and temperature sensor (PT100)
- No preamplifier
- Three devices tested each time
- Measurements performed with Keithley 4200A with a current sensitivity of 100 fA



I-V @ Room Temperature

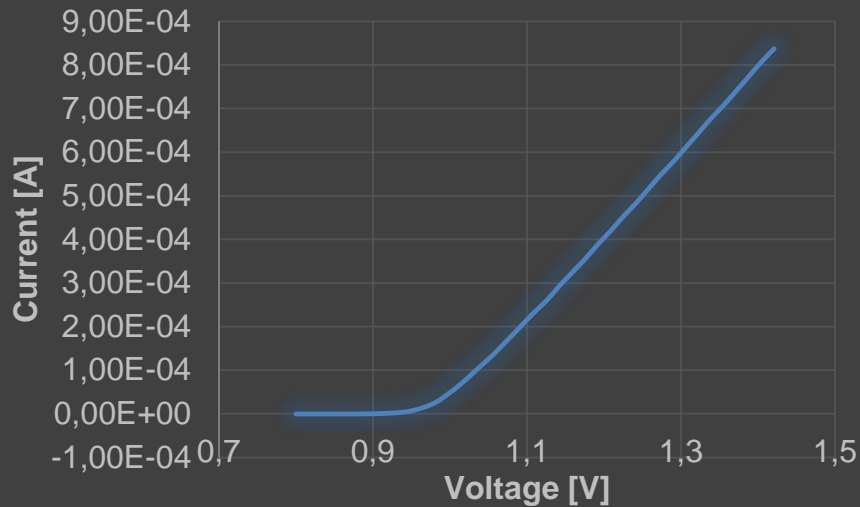


$$R_q \approx 873 \text{ k}\Omega$$

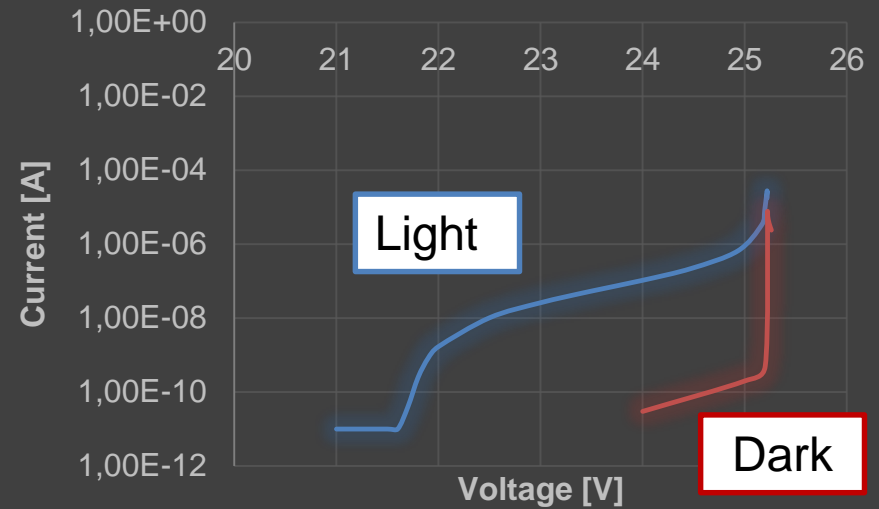
$$V_b \approx 26.5 \text{ V}$$

I-V @ T = 77 K

Forward



Reverse

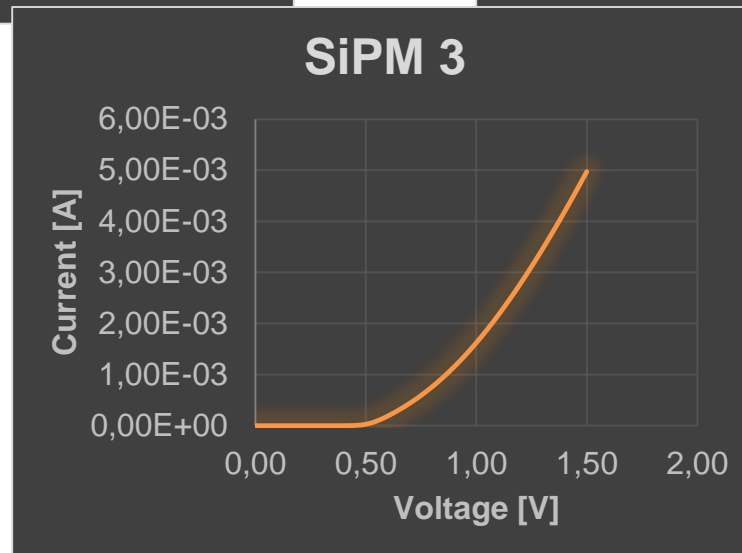
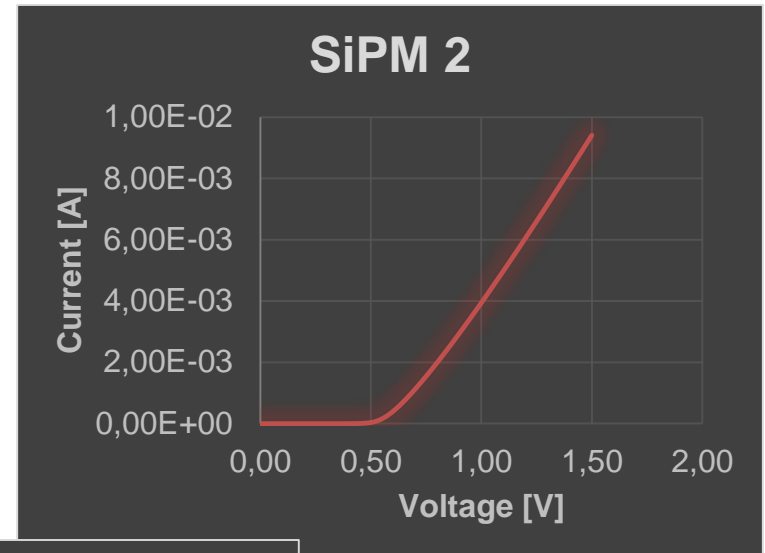
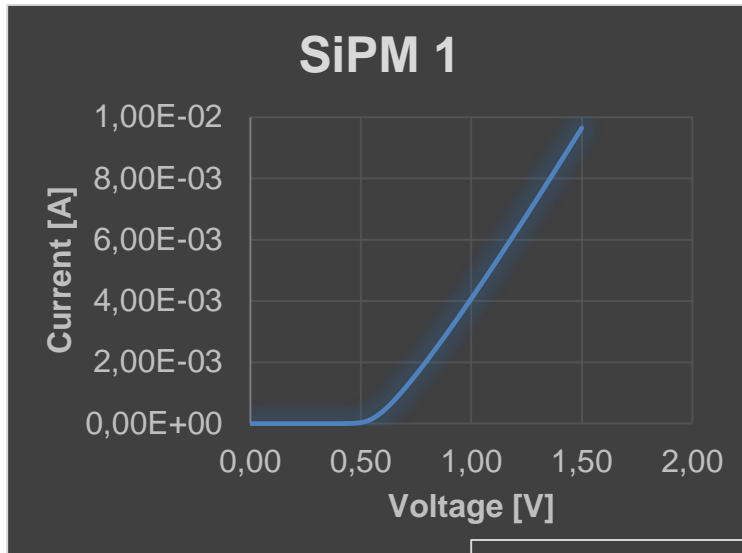


$$R_q \approx 4.75 \text{ M}\Omega$$

$$V'_{bd} \approx 21.7 \text{ V}$$

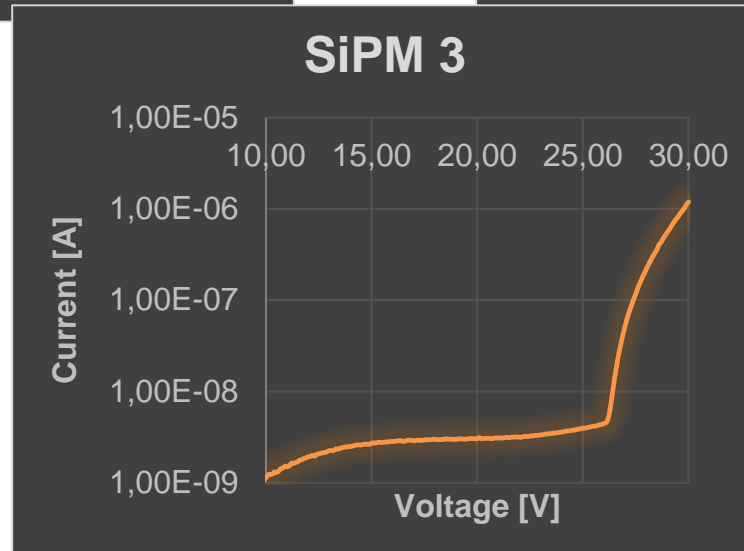
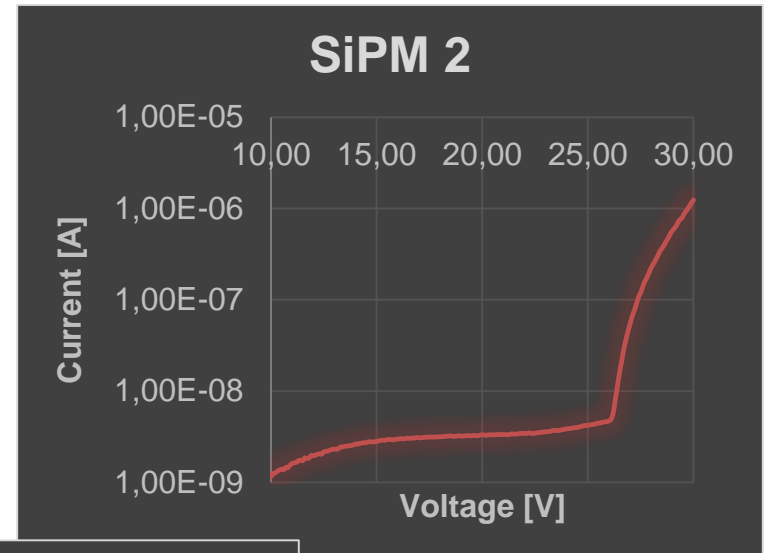
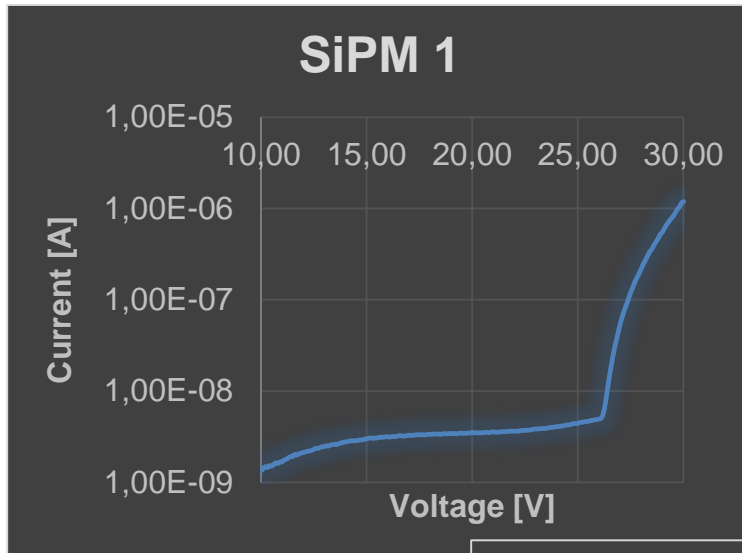
$$V''_{bd} \approx 24.9 \text{ V}$$

I-V @ Room Temperature



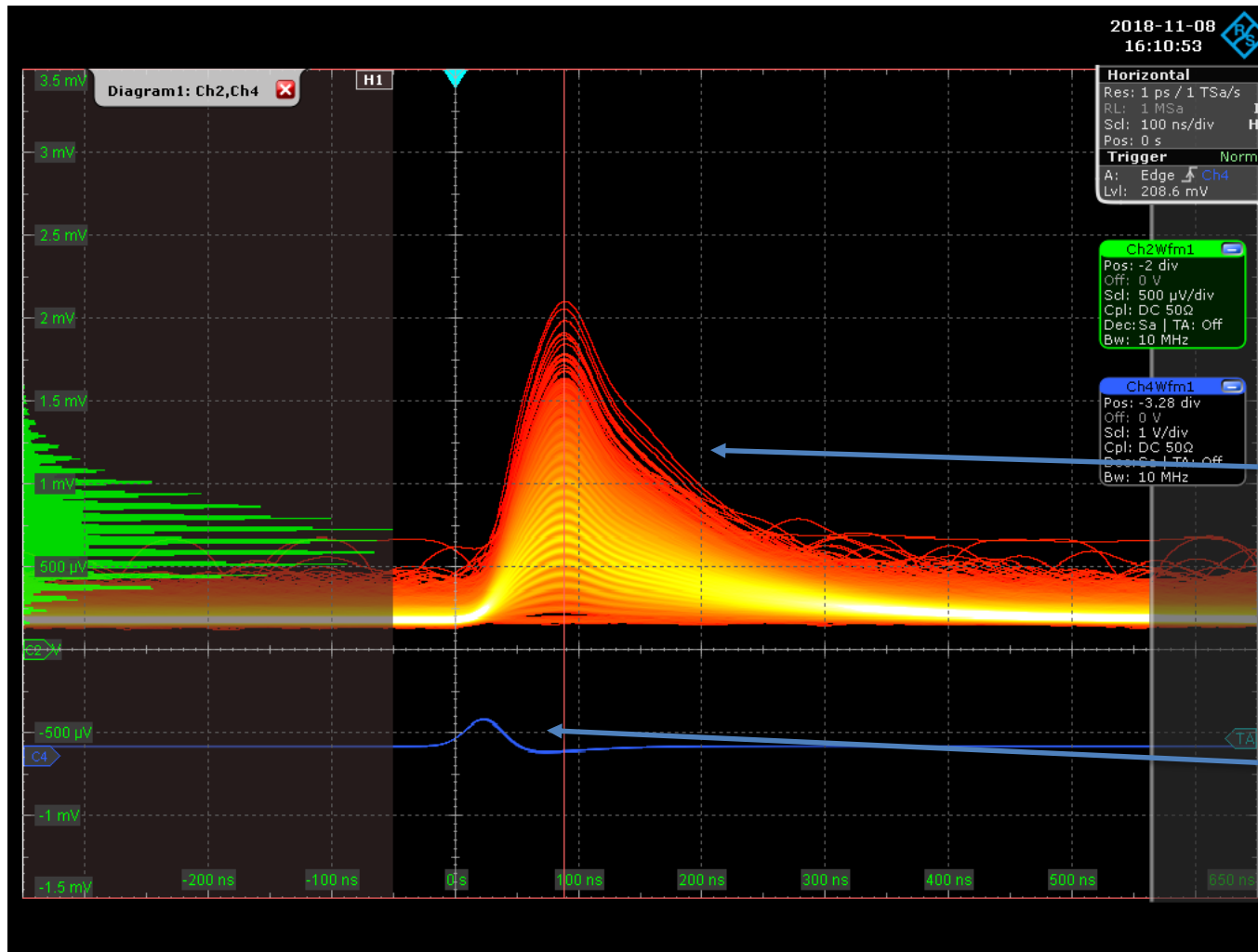
Preliminary

I-V @ Room Temperature



Preliminary

PE spectrum

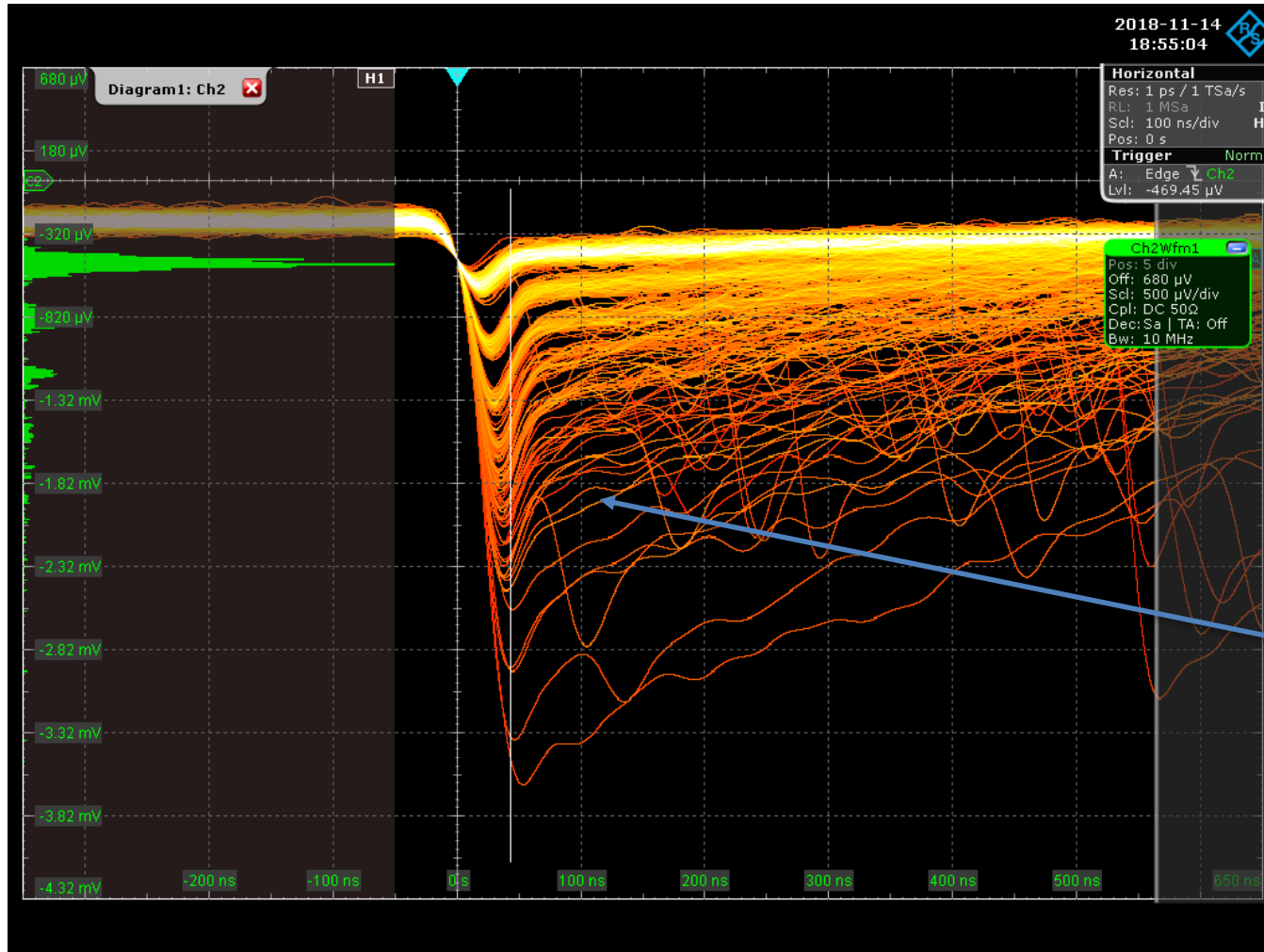


T	293 K
Light	yes
OV	3 V

No amplifier

Light

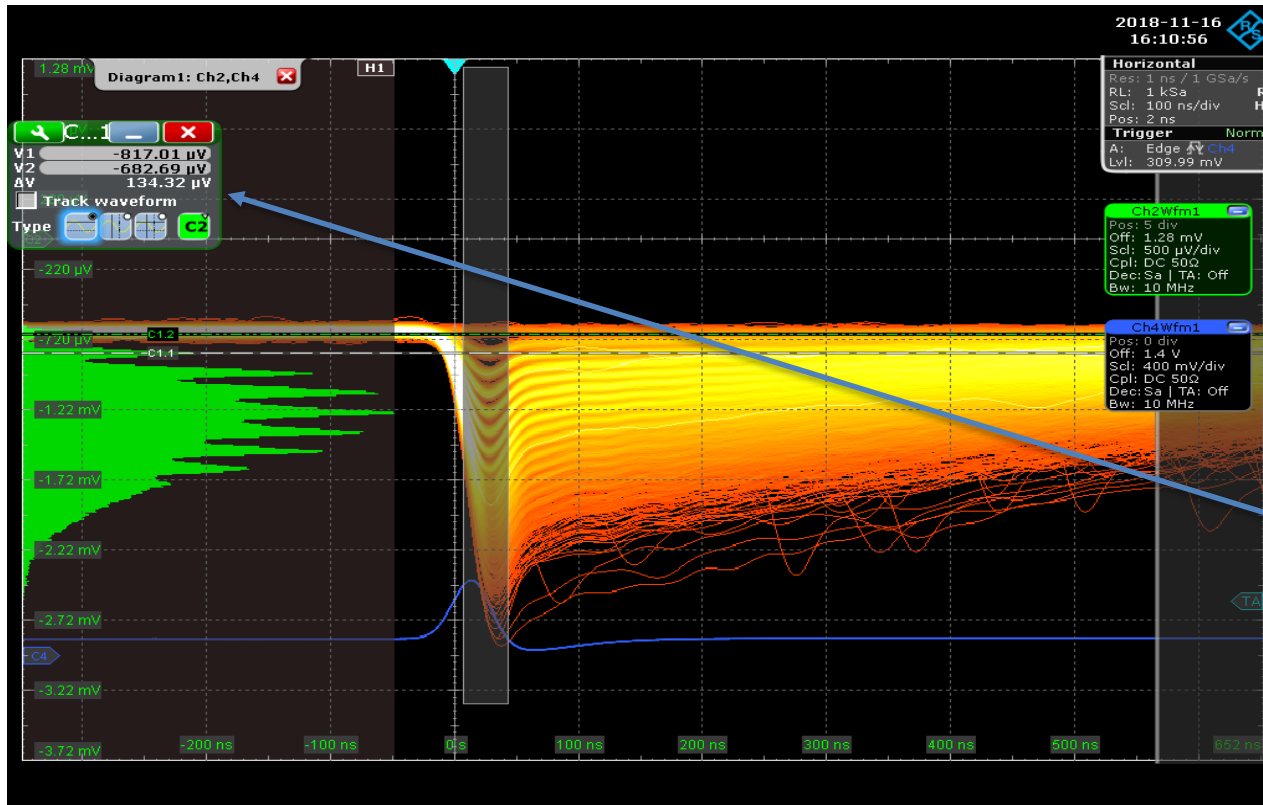
PE spectrum



T	293 K
Light	no
OV	3 V

Amplifier

DCR @ 77K



T	77 K
Light	yes
OV	2.5 V

Baseline
&
1st PE peak

Threshold	DCR [Hz mm^{-2}]
0.5 PE	0.15
0.75 PE	0.14

Conclusions

- **First DC tests accomplished measuring quenching resistance and breakdown voltage.**
 - R increases at low temperature as expected for PolySi (4.75 M Ω).
 - The breakdown voltage decreases down to 21.7 V at 77 K and a second breakdown appears at about +3 V overvoltage.
- **The DCR results are quite encouraging even if these SiPMs are without deep trenches (previous generation before HD-VUV):**
 - Required rate for DUNE: 0.06 Hz/mm²
 - Measured Rate: 0.15 Hz/mm²

Further developments

- Systematic DC characterization on many devices
- Study of after pulse and crosstalk probability
- Study of parameters as a function of temperature