

Status of CACTUS facility and metal-in-trench in Bologna

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Overview:

The massive test of the SiPMs, each SiPM board is tested using the CACTUS facility (Cryogenic apparatus for continues test upon SiPM) developed by INFN and universities of Ferrara and Bologna in 2021-22.

The system comprises:

- Mechanical stage: 60 cm long motorized.
- LN2 Dewar: 55-liters .
- Warm electronic: 4 motherboards with front-end cards.
- Cold electronics:4 cold boards hosting 5 SiPM boards each (120 SiPM)
- Automatic Refilling system.



Slide from C.M. in Santa Marta
Maritza Delgado



Overview:

*The setup is driven by a PC through a Labview programme includes a data analysis module for data storage and population of the hardware database.

*Performed tests:

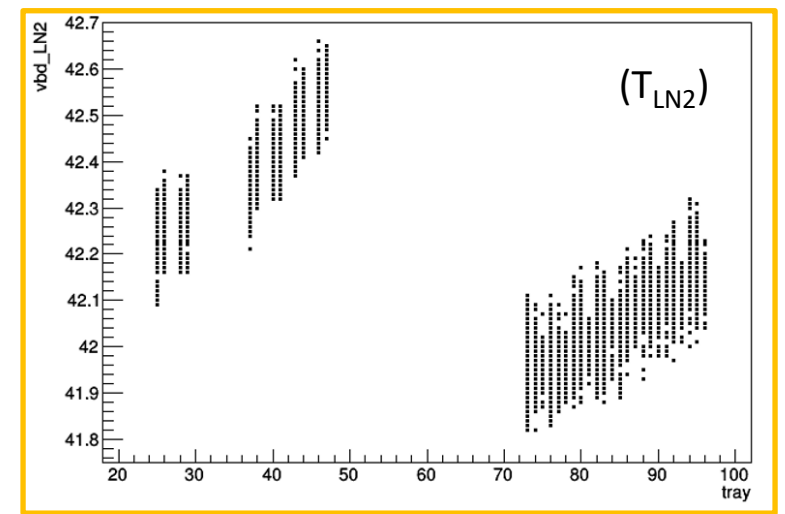
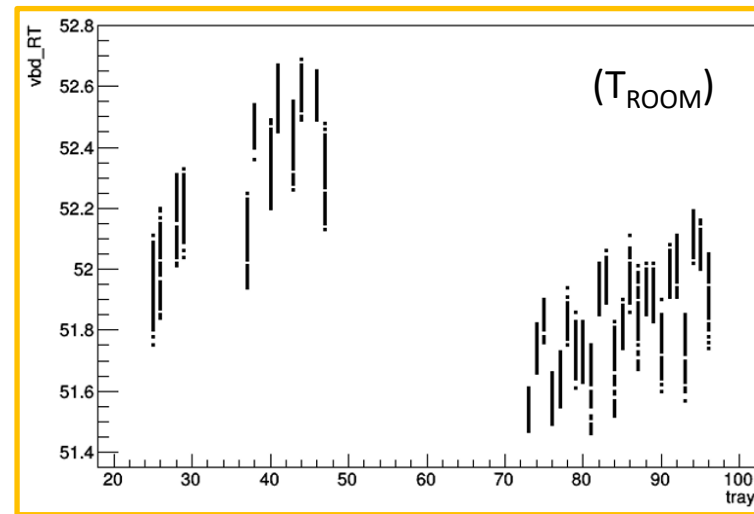
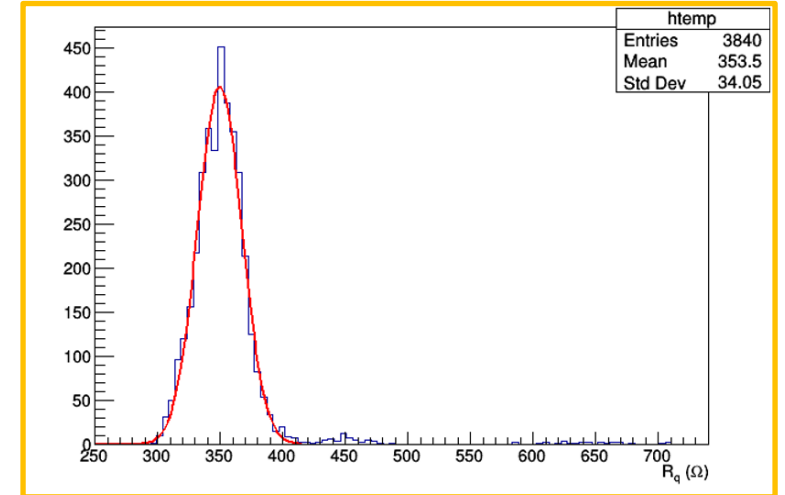
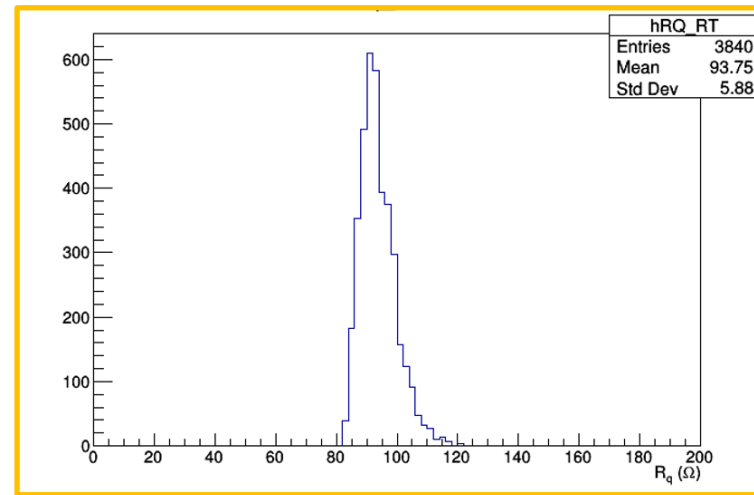
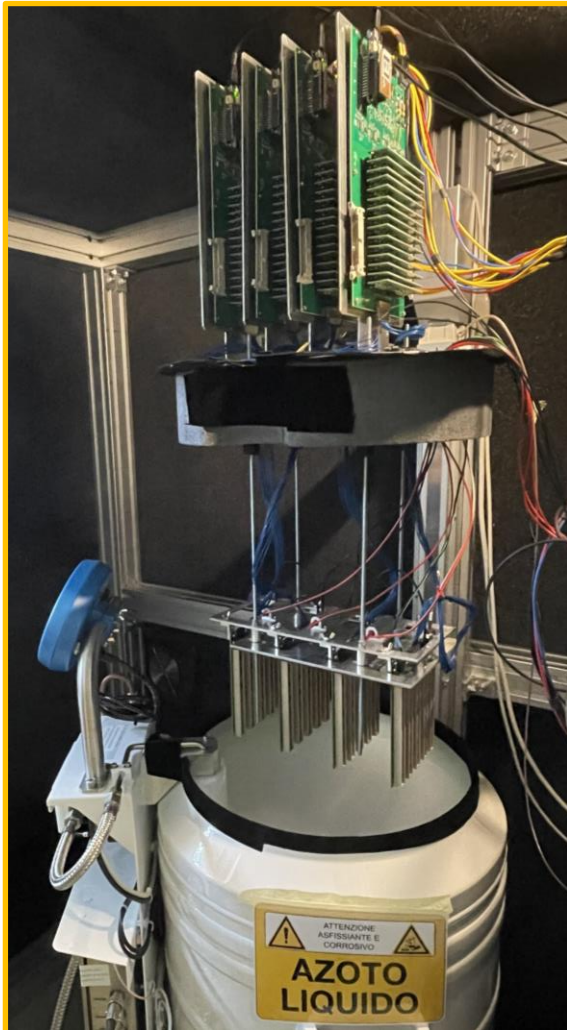
- R_q (quenching resistance) in the forward I-V curve, before and after the thermal cycles.
- V_{bk} (breakdown voltage) in the reverse I-V curve, before and after the thermal cycles.
- The DCR threshold in a defined time window (120 s).

*Cactus has been installed in 4 of the 5 laboratories: Bologna, Ferrara, Granada, Milano Bicocca and Prague (in the coming days).

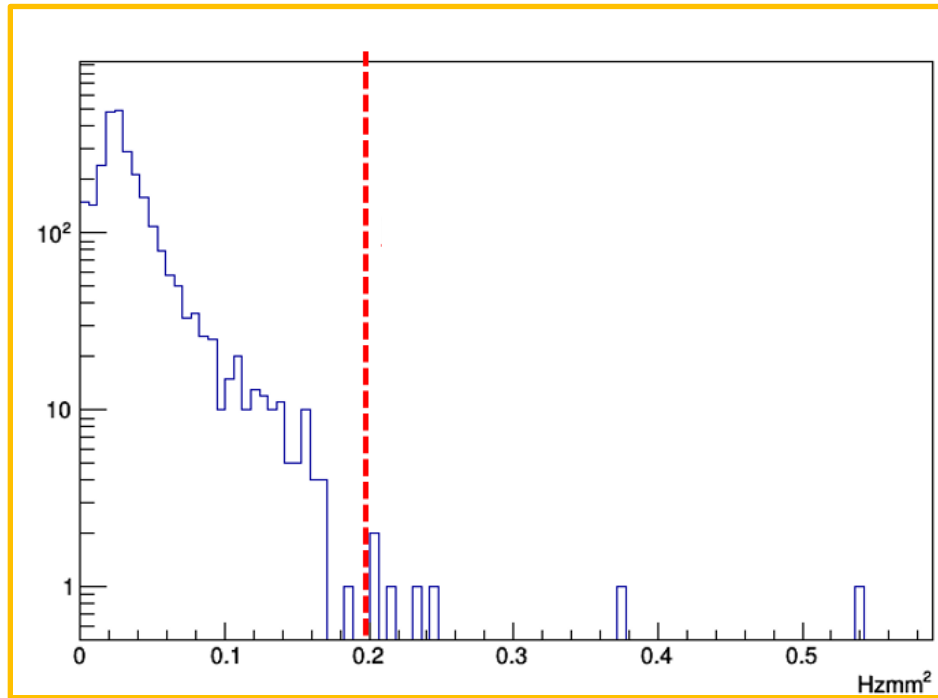
*5% of the boards are being sent to Valencia to perform pre-production sample measurements and control production quality including parameters not tested in CACTUS (cross-talk, after-pulse, gain, high precision DCR) .

**Slide from C.M. in Santa Marta
Maritza Delgado**

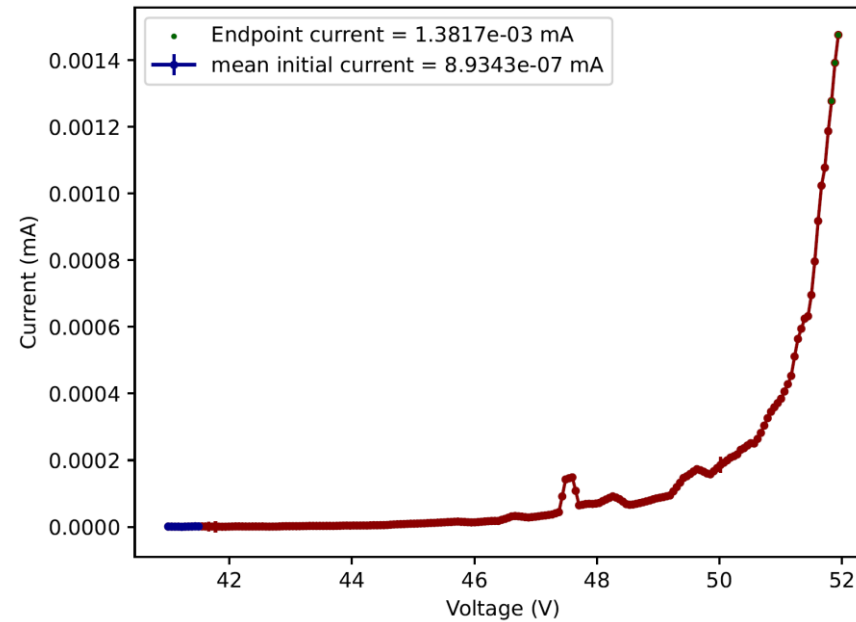
Received 7 boxes: 3 tested, 1 in progress



DCR and extended IV



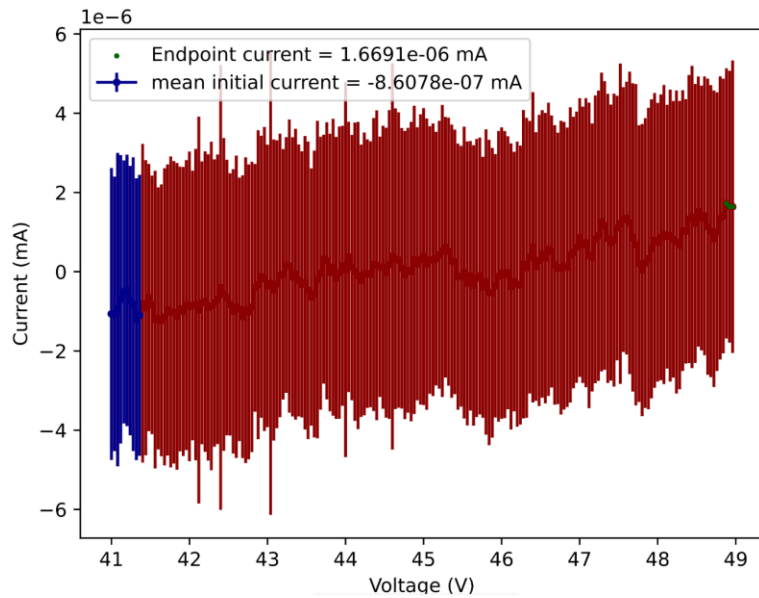
Extended IV curve of ARDUINO 1, SiPM 25



Tray	ID strip	Counts	DCR (mHz/mm ²)
062	000004023	1600221	370421.53

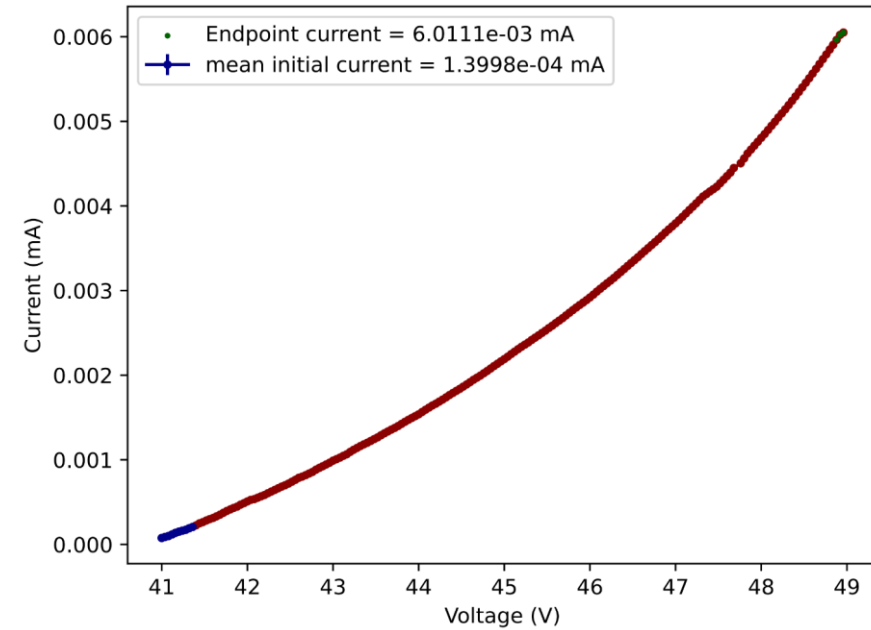
DCR and extended IV

Extended IV curve of ARDUINO 3, SiPM 7



SiPM in specs

Extended IV curve of ARDUINO 3, SiPM 3



Tray	ID strip	Counts	DCR (mHz/mm ²)
077	001566	1640903	379838.66

Metal-in-Trench

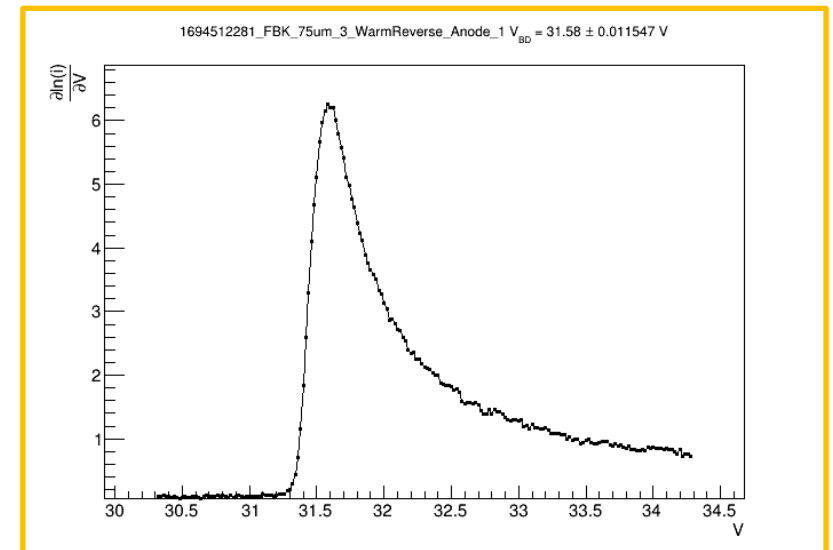
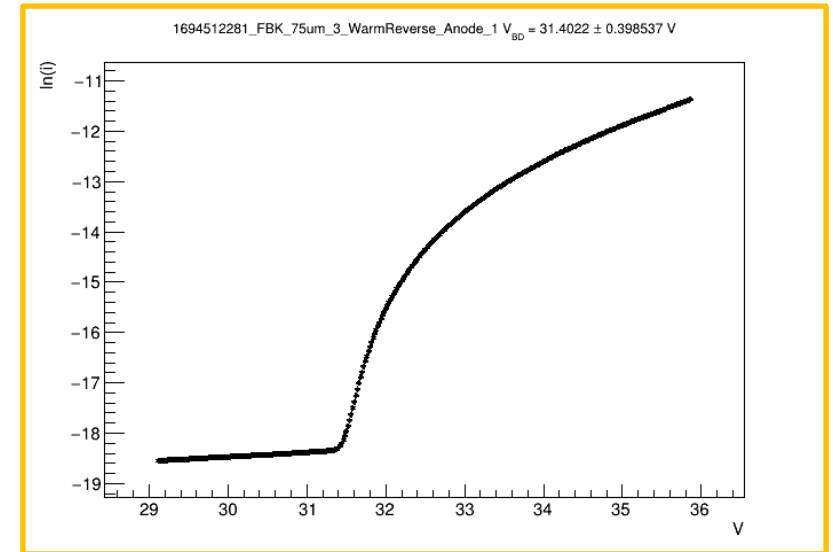
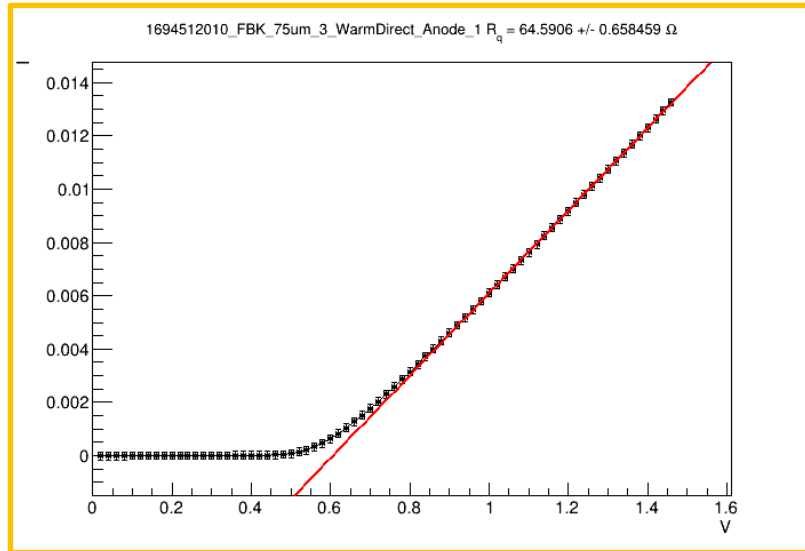
Received 12 samples:

- 3 Samples – cell pitch 75 μm
- 3 Samples – cell pitch 60 μm
- 3 Samples – cell pitch 40 μm
- 3 Samples – cell pitch 3x μm

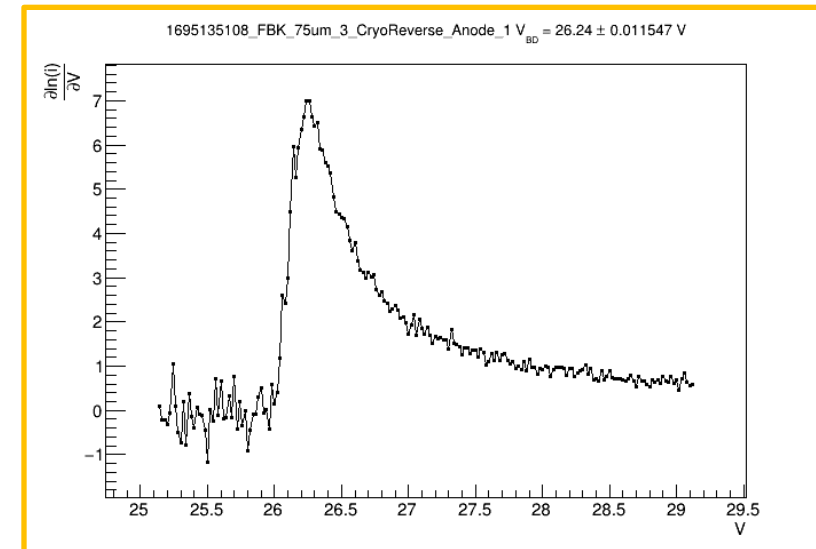
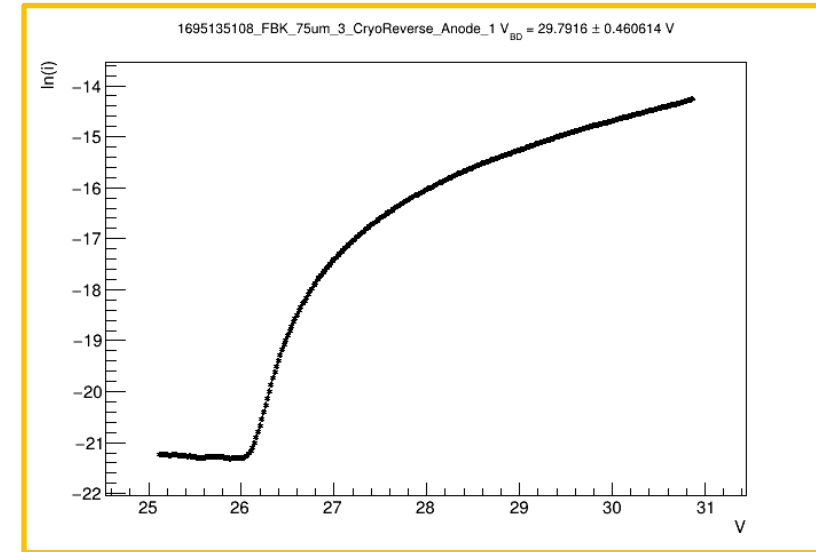
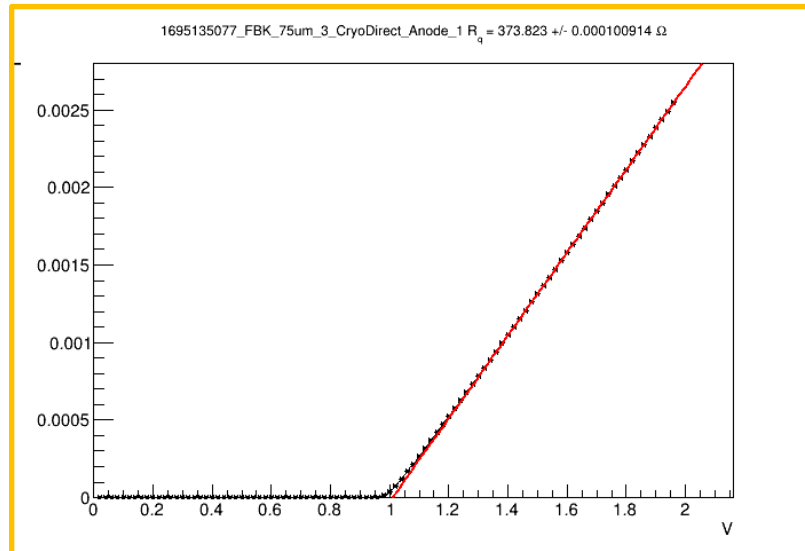
Test procedure:

- IV @ T_{ROOM}
- IV @ T_{LN}
- DCR measurements (+ CT + AP)
- Thermal Cycles

75 μm Sample #3 T_{ROOM}



75 μm Sample #3 T_{LN2}

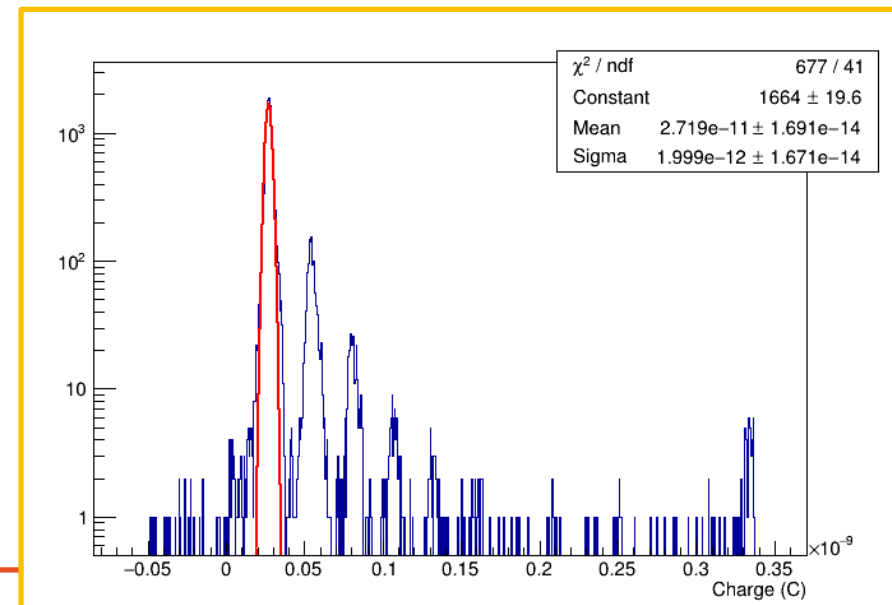
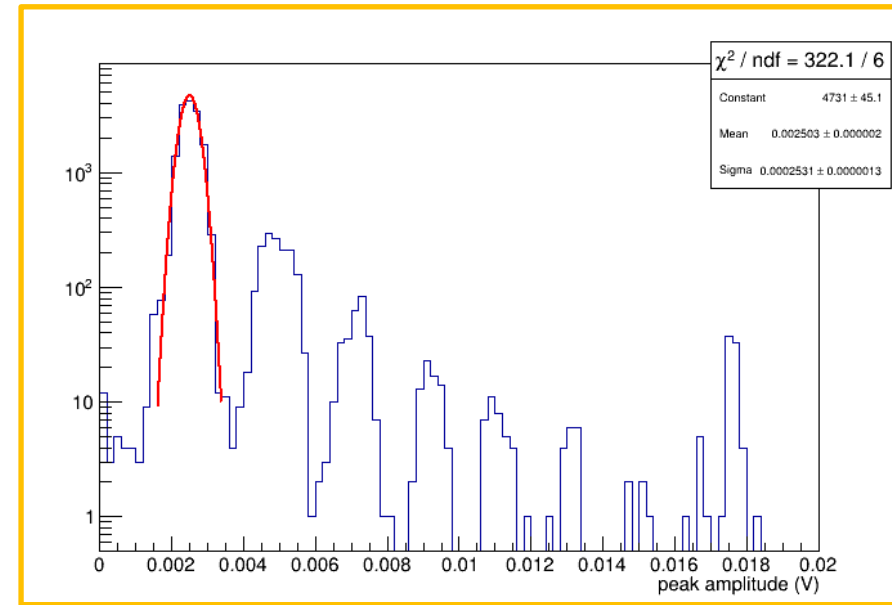
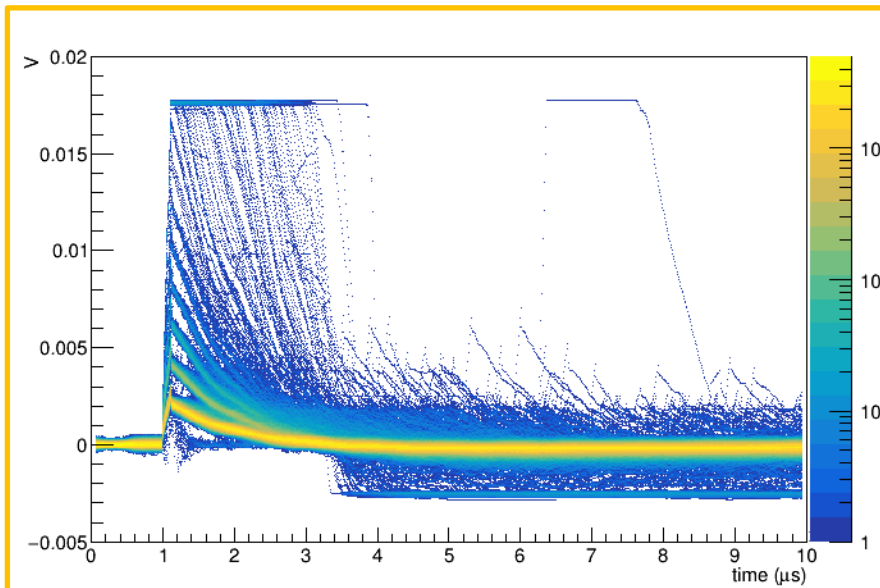


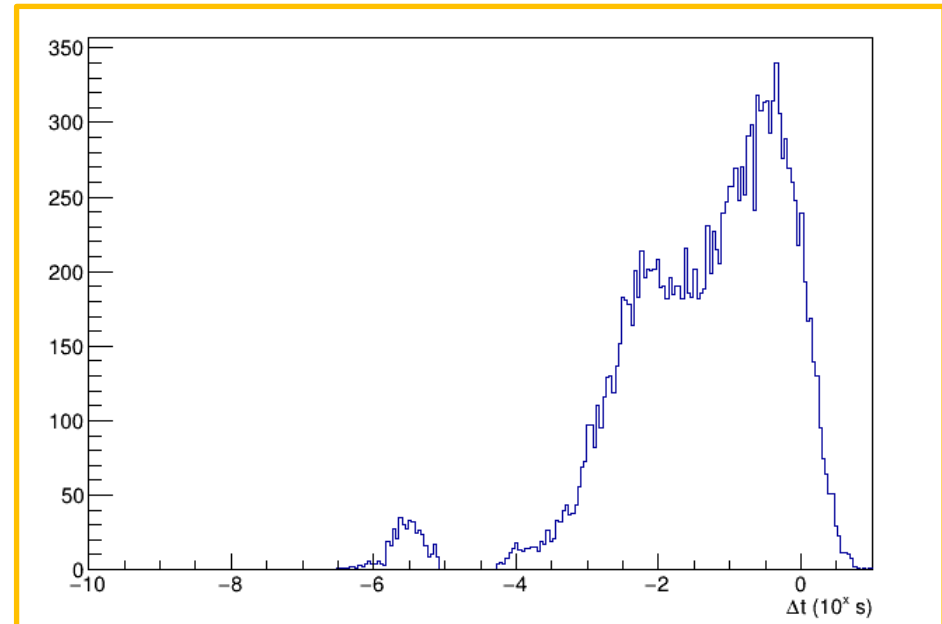
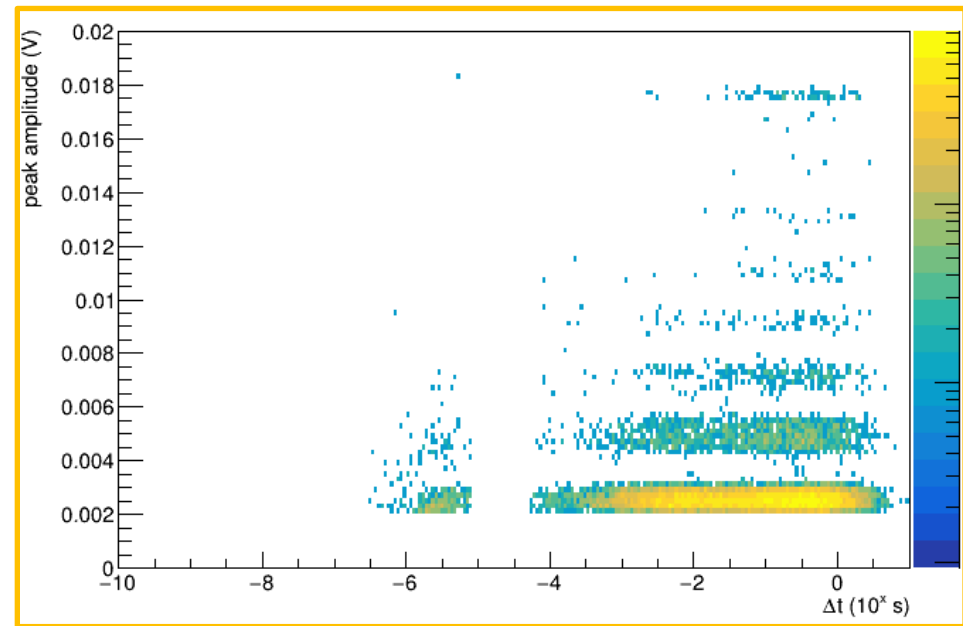
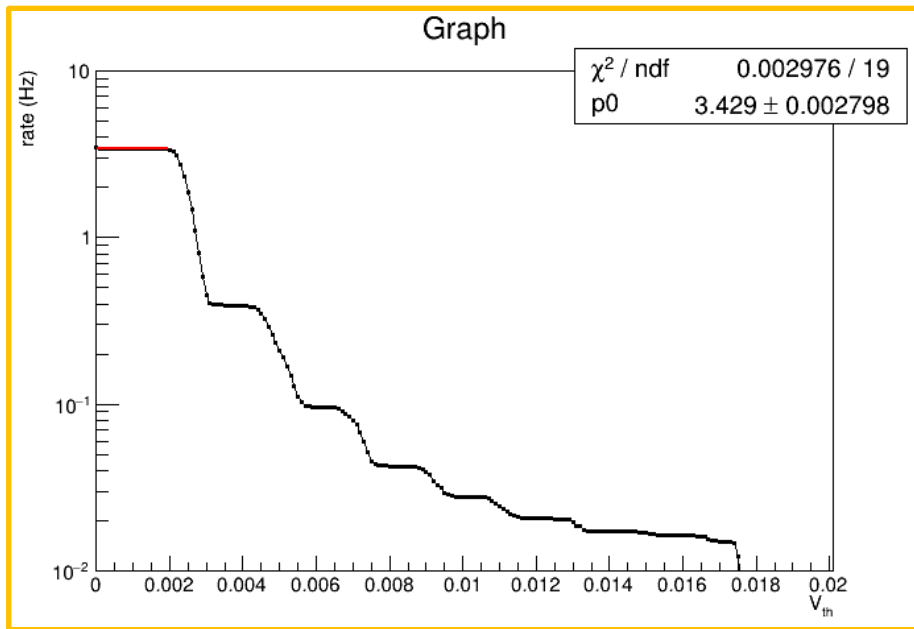
Summary – IV curve

Sample ID (75 μm)	$R_q T_{\text{ROOM}} (\Omega)$	$V_{\text{BD}} T_{\text{ROOM}} (\text{V})$	$R_q T_{\text{LN}} (\Omega)$	$V_{\text{BD}} T_{\text{LN}} (\text{V})$
1	61.4 ± 0.7	31.74 ± 0.01	350.4 ± 0.1	26.52 ± 0.01
2	65.1 ± 0.7	31.60 ± 0.01	378.2 ± 0.1	26.20 ± 0.01
3	64.6 ± 0.7	31.58 ± 0.01	373.8 ± 0.1	26.24 ± 0.01

Sample #3 T_{LN} DCR

nTriggers: 18059
acqTime: 5065.11
Overvoltage: +3 V





Summary table – Work In Progress...

ID	Over voltage	DCR (mHz/mm ²) with bursts	CT (%)	AP (%)
1	3	67	17	7
2	3	75	13	4
	4	67	19	9
3	3	94	11	4
	4			
	5			

Conclusions - WIP

- CACTUS system:
 - Received 7 boxes: 3 tested, 1 in progress
 - SiPMs characterization: 120 SiPM per cycle
 - 2 SiPMs found with DCR out of specs (and “strange” iv curve)
 - Database will soon be usable through the script to transform the output of CACTUS to the database
- Metal-in-trench:
 - Started test on 75 μm cells;
 - Characterization @ T_{ROOM} and T_{LN2}
 - Thermal cycles done
 - quite similar in terms of CT w.r.t Triple Trench
 - Higher Quantum efficiency due to Fill Factor