

miniCACTUS

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Measurement protocol

- 1) **IV curve reverse @ room T** → mean V_{bd} for the strip at room [uniform illumination of the strip];
- 2) **single SIPM connection test @ room T** → current of single sipm at a fixed V [illumination of 1 SiPM while others in absolute dark]
- 3) **IV curve reverse @ LN2 T pre-thermal cycle** → mean V_{bd} for the strip at LN2 [uniform illumination of the strip];
- 4) **IV curve reverse @ LN2 T post-thermal cycle** → mean V_{bd} for the strip at LN2 [uniform illumination of the strip];
- 5) **extended IV @ LN2 T** → current for all SiPM in absolute darkness (noise measurement) [absolute darkness]

System requirements

The system thus needs to:

- Provide voltage & measure current;
- At room T provide a controlled amount of light both to all strip and to single sipm while other in dark;
- At LN2 provide light at all strip + all strip in complete darkness (non only close the dewar flange but a cover close to SIPM to avoid light scintillation on nitrogen
- Motion for the thermal cycles
- SiPMs QR scan

Idea

We are investigating the possibility to partially re-use some electronics developed for CACTUS with some adjustments, in particular:

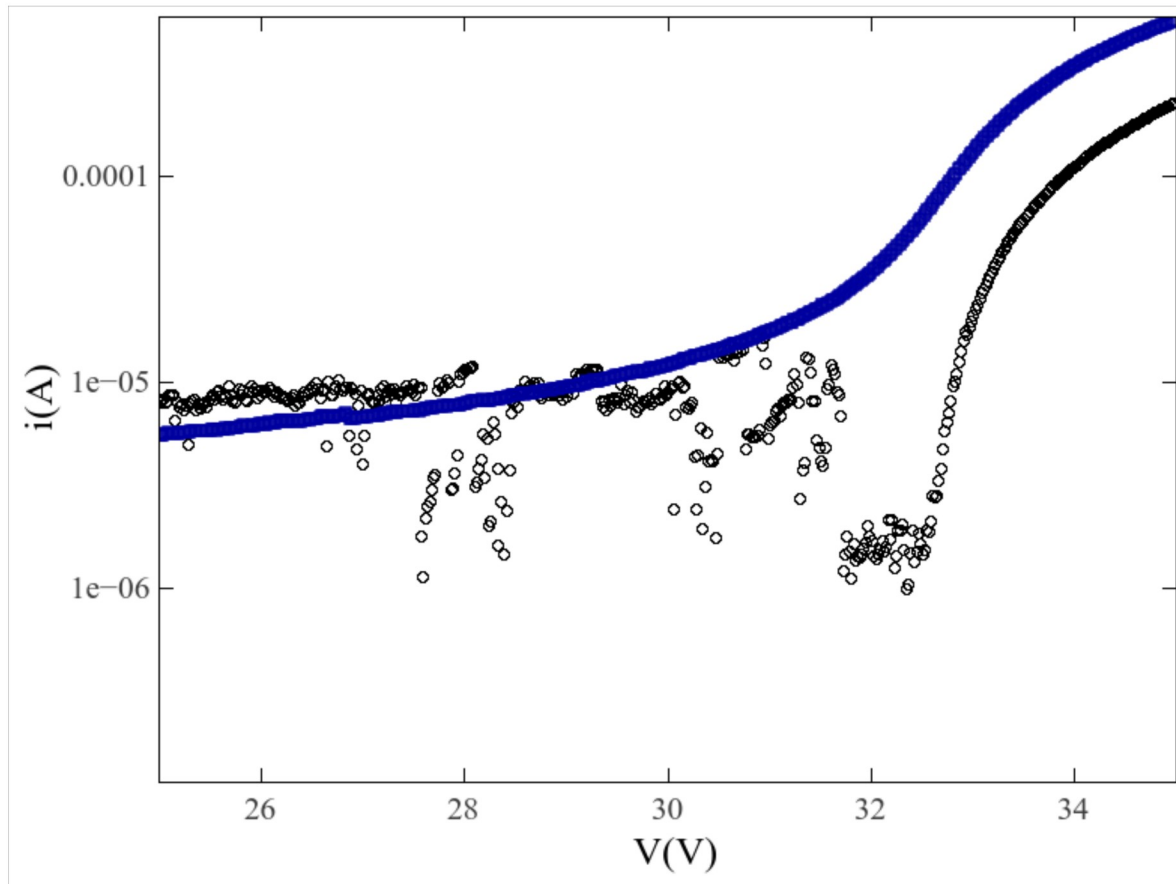
- Motherboards;
- daughter cards;
- some software.

This means that we have to understand if the new current range and the new ganging coupling can handle by only changing some minor components in the electronic boards leaving the layout the same.

NB on the other hand there is the proposal to build a new system using a multiplexer coupled with a commercial SMU

Room T meas: strip

I tested a single flex PCB with (20) FBK sensors using a commercial SMU (keithley 2450) to understand the requirements for the new test system

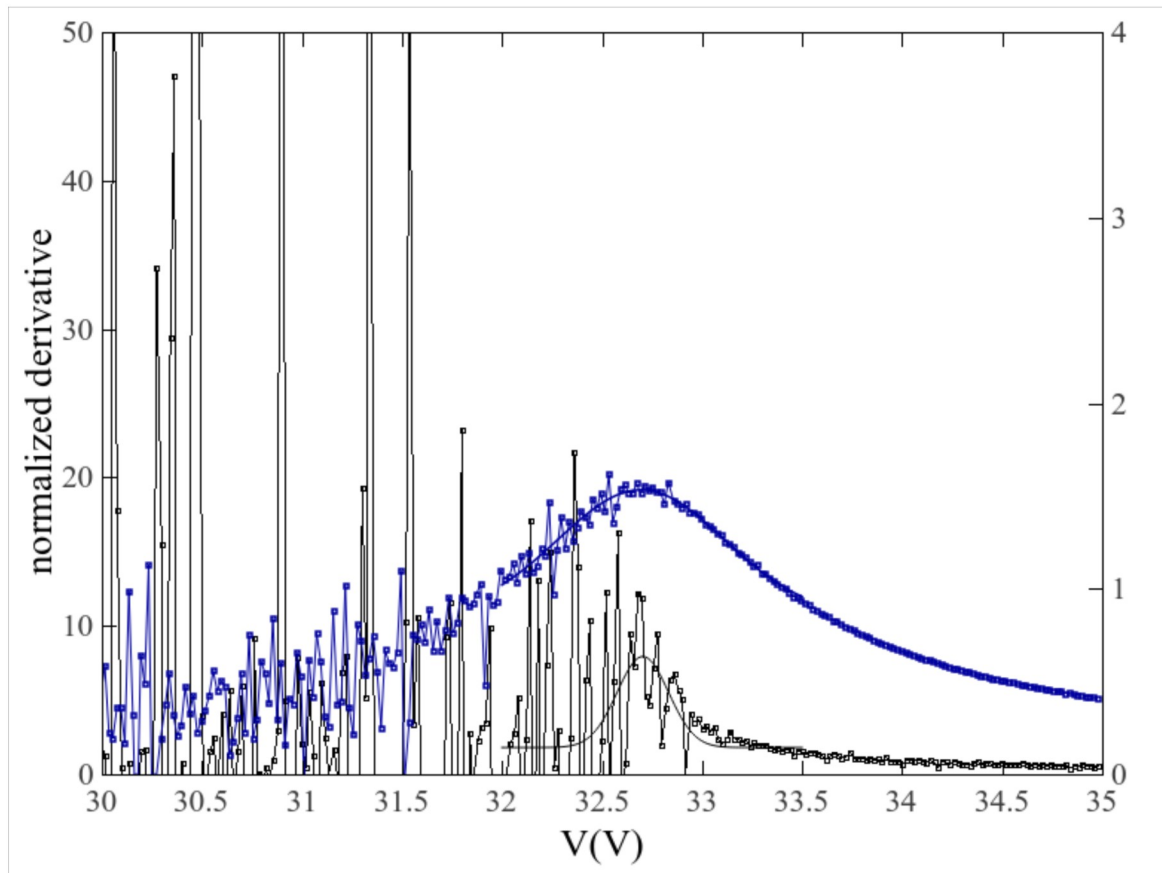


Different light irradiation:
Black curve → low light
Blue curve → high light

High light irradiation:
 $V=30V \rightarrow i=10\mu A$
 $V=35V \rightarrow i=600\mu A$

Room T meas: strip

Standard normalized derivative method to infer the breakdown voltage from the current measurements



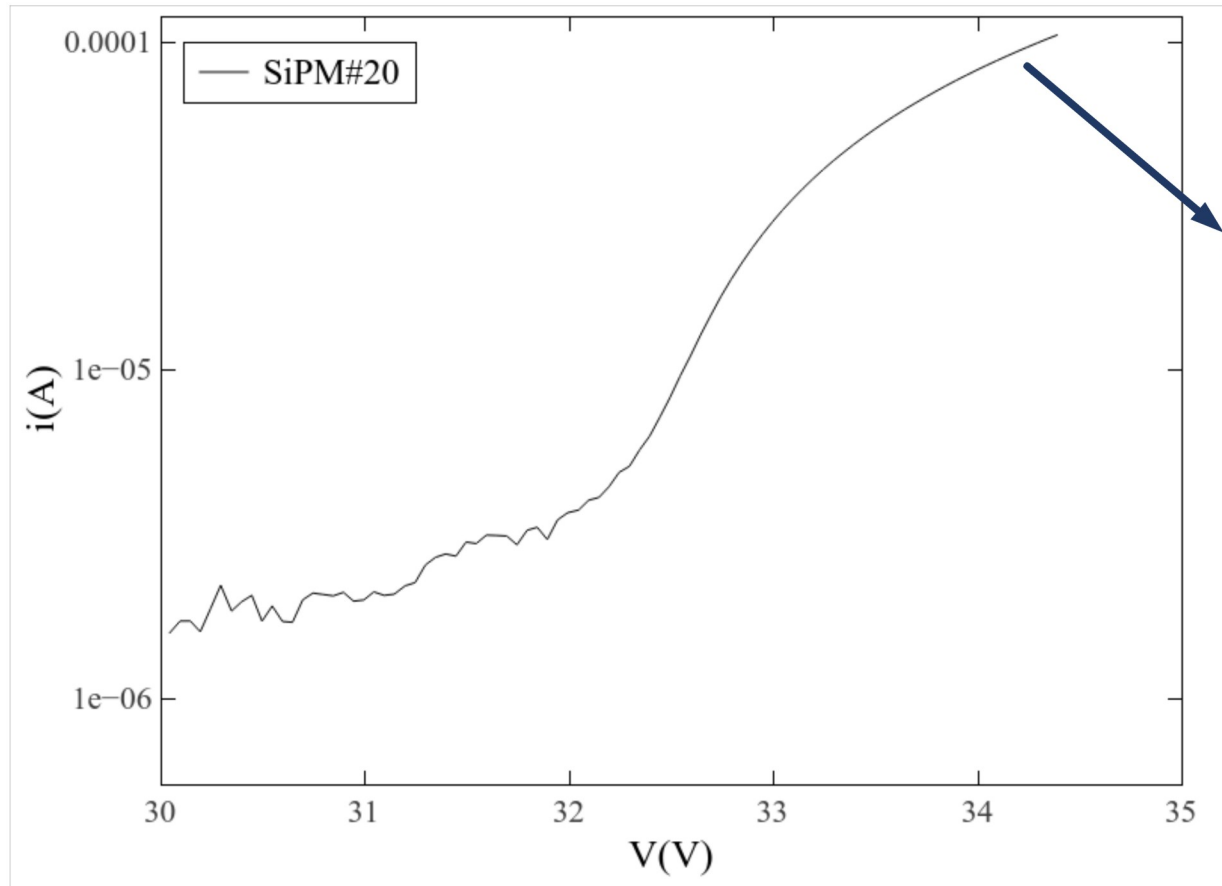
black curve → low light
Blue curve → high light

High light irradiation →
clear curve
($V_{bd}=32.69V$)

Low light irradiation →
noisy curve, difficulty in
 V_{bd} determination

Room T meas: single SiPM

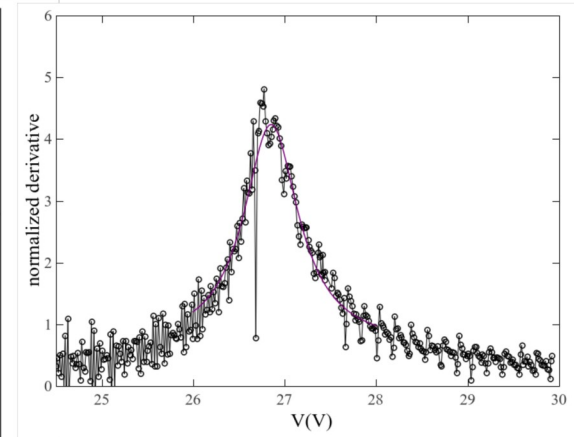
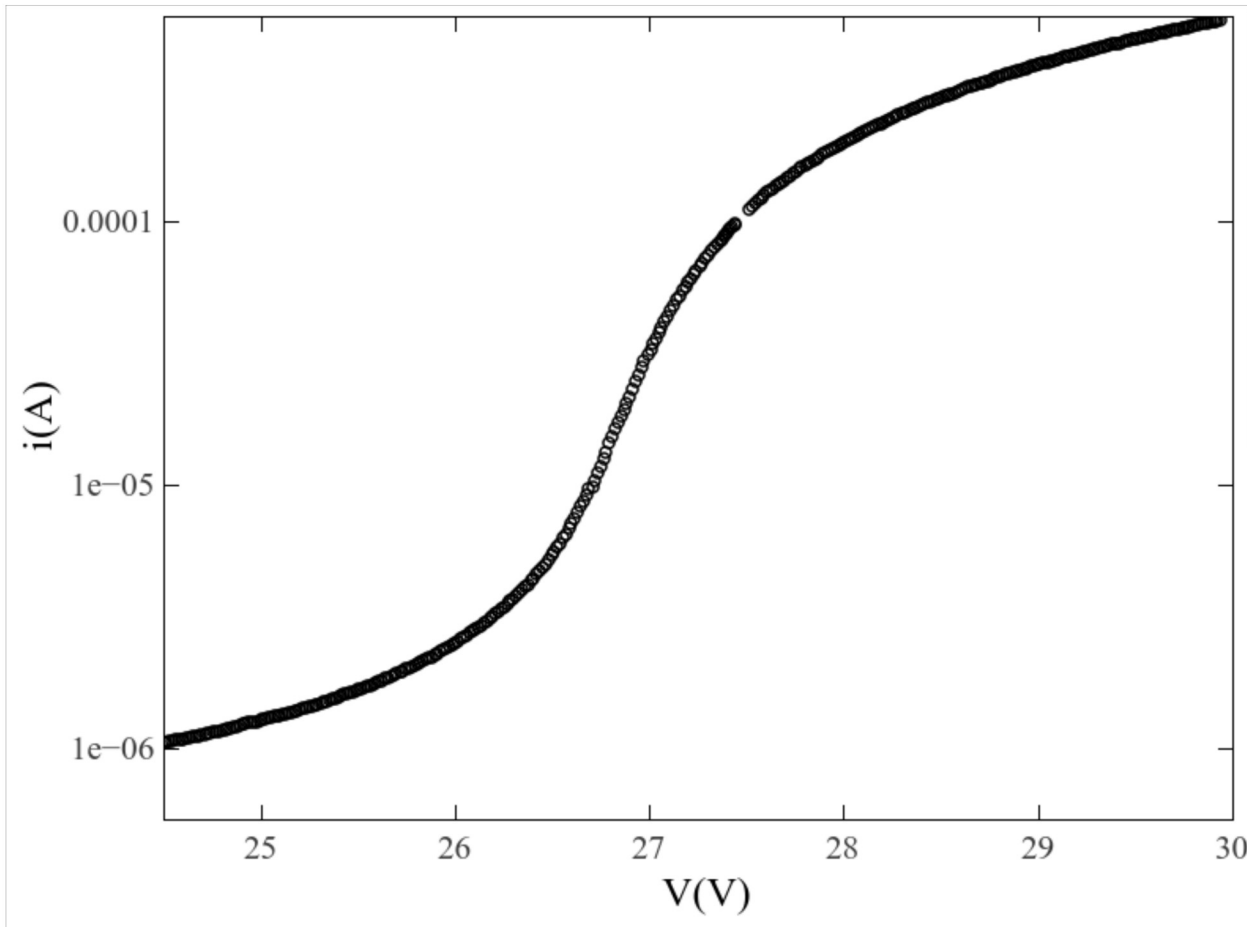
- Light re-optimization only in one sensor. Complete darkness in other SiPM



at +2 OV around 100uA

LN2 T meas: strip

- Light re-optimization



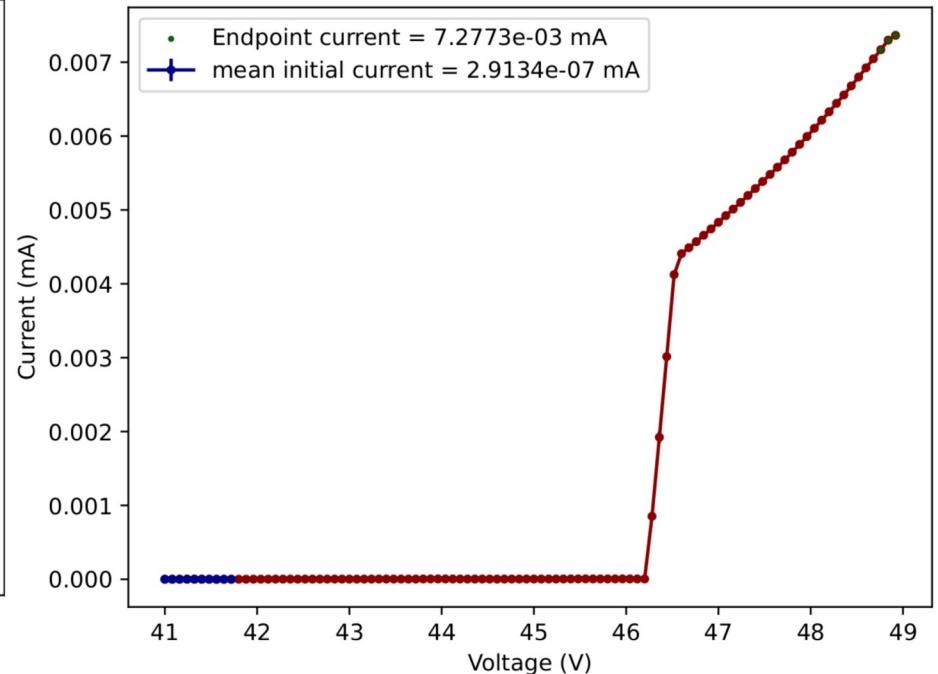
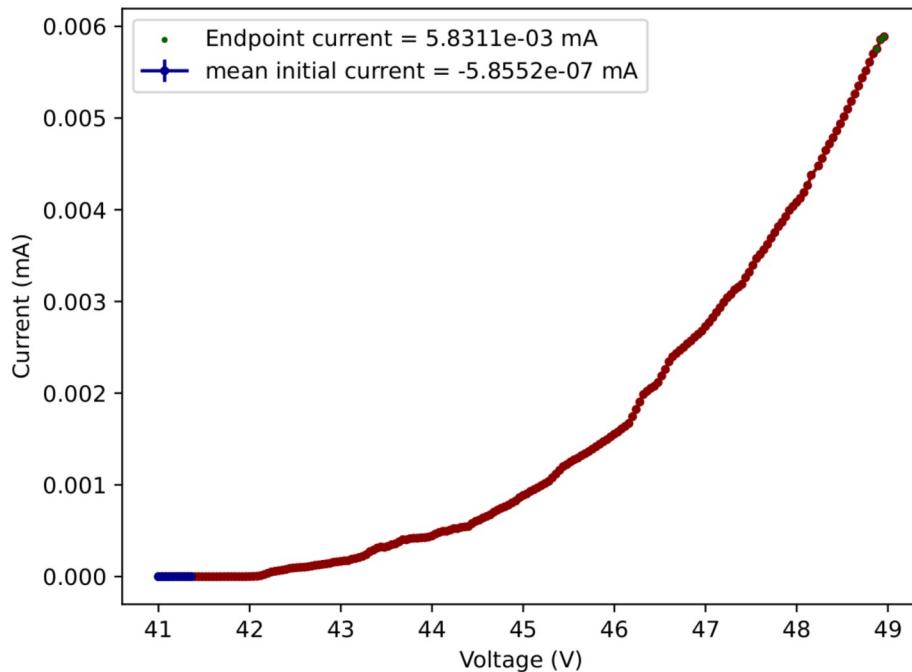
Range:

Min: 1uA

Max: 600uA

LN2 T meas: strip

- SiPM HPK HD with high DCR measured in complete darkness @LN2 : high current at +70V (around 5uA). We can set a threshold of 500nA for “safety”



Conclusion

- Flex PCB for VD: 20 sensors in a common anode/cathode connection.
- Milano Bicocca and Milano Statale are in charge of the new test setup + tests on SiPMs.
- Helps and consulting of Ferrara group to investigate the possibility to partially re-use CACTUS electronic.
- The new miniCACTUS facility will have less requirements of the CACTUS one (only IV reverse + IV extended).
- Different current range because of the large number of SiPMs ganged together (μA range), but high sensitivity in the IV extended in order to identify fail SiPMs (500nA ?).
- Complete new mechanics and light/dark system which will be very important.