Irradiation of SiPMs

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1 Methodology

To grant temperature stability, the SiPMs and the Raspberry Pi are placed in a climate chamber, the temperature is set to $T = 25\,°\mathrm{C}$ for all precision measurements.

This setup is shown in figure 1: The climate chamber by WEISS? contains two aluminum boxes with the SiPM, a temperature sensor, the "HV" distribution board and a paper box with a Raspberry Pi 2. The HV board [1], which is currently under development for the EMC barrel of the PANDA experiment at FAIR (GSI), has been chosen to perform the IV-scanning because of availability and easy programmability. The board is controlled by a Raspberry Pi 2 and too reads out a temperature sensor which is directly connected to the SiPM. To avoid parasitic light and surface leakage, the SiPM is cleaned with ethanol and wrapped in black tape. A Keithley Sourcemeter powers the HV board, a PC controls the Raspberry via Ethernet. The temperature settings can be set by a terminal.

The IV-curves are scanned from $I = 0\,\mathrm{nA}$ to $I \approx 1000\,\mathrm{nA}$ and back to $I = 0\,\mathrm{nA}$. This is looped five times. The step range is given by the digital potentiometer (10bit) at the HV board, a small hysteresis for the current is know (see [1]). For each potentiometer position (voltage), the current is measured 100 times and is then averaged. This results in ten IV-curves per SiPM which should improve precision.

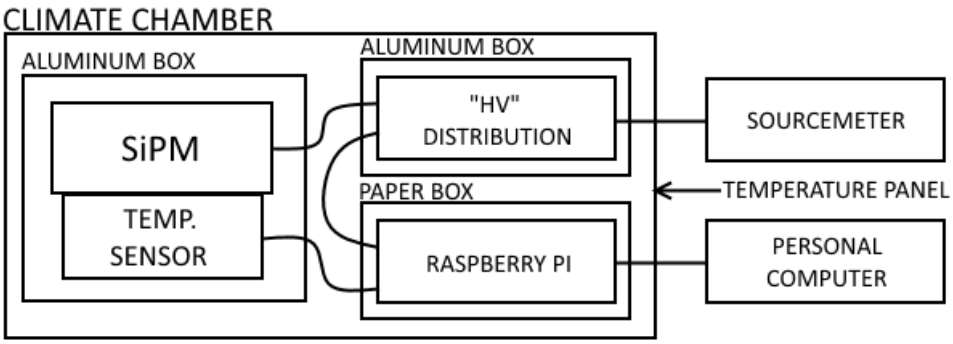

Figure 1: Mesurement setup in Giessen.

2 Measurements

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2.1 Before irradiation

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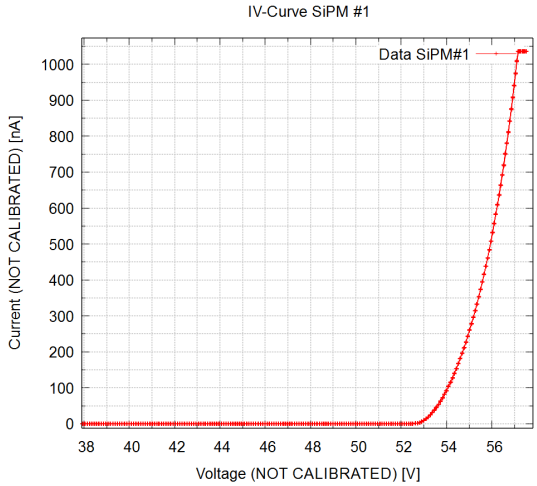
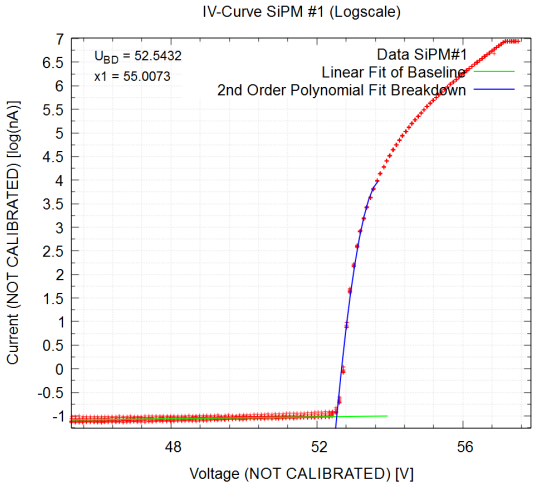
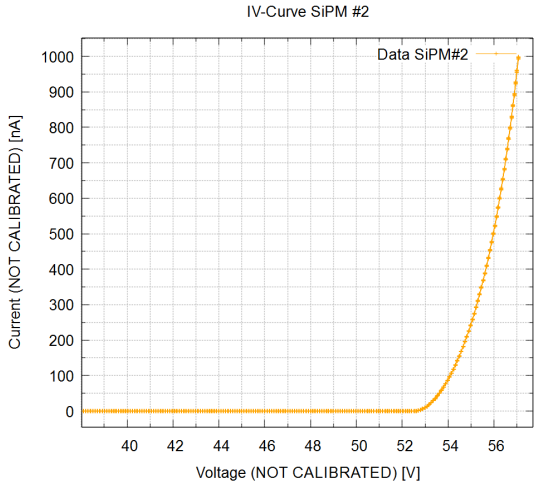


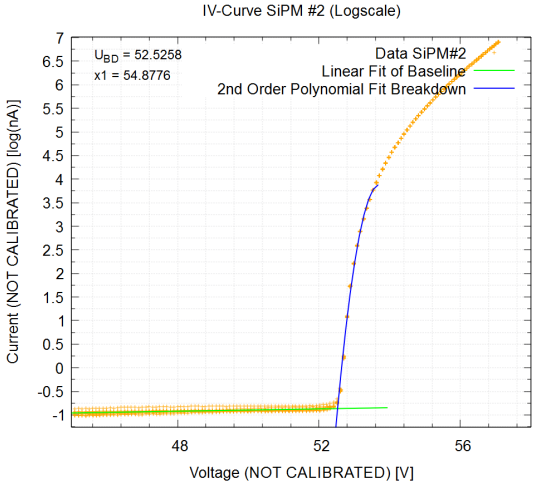
(a) SiPM #1



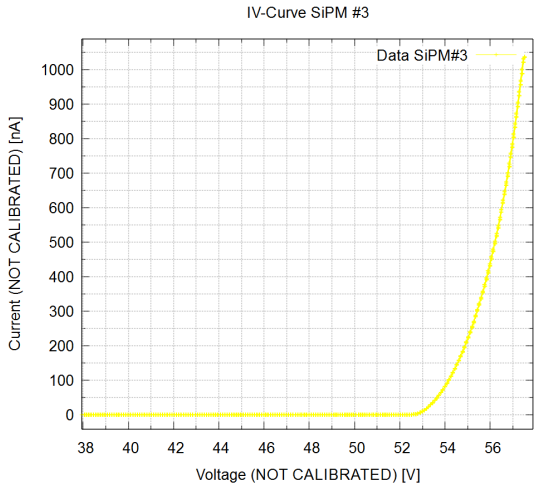
(b) SiPM #1 (log)



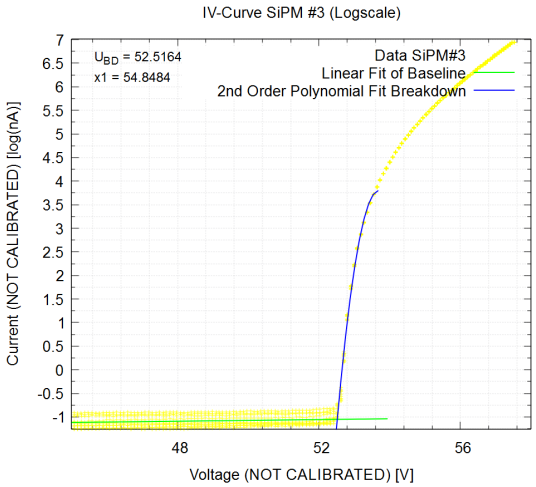
(c) SiPM #2



(d) SiPM #2 (log)

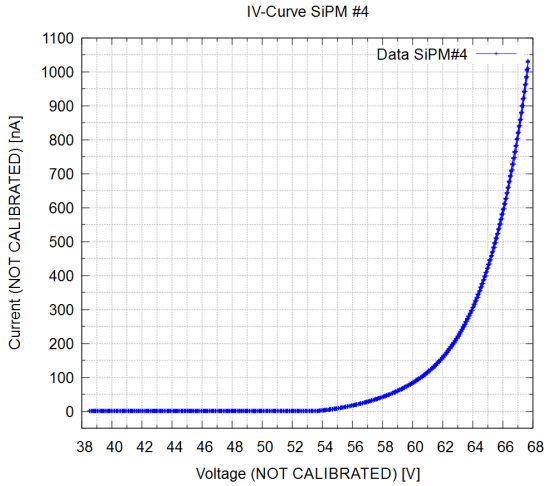


(e) SiPM #3

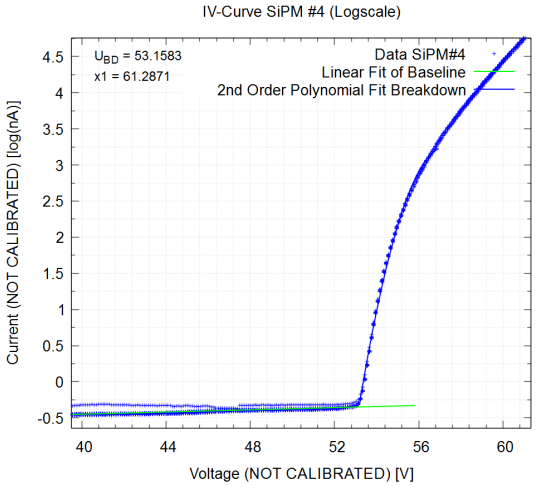


(f) SiPM #3 (log)

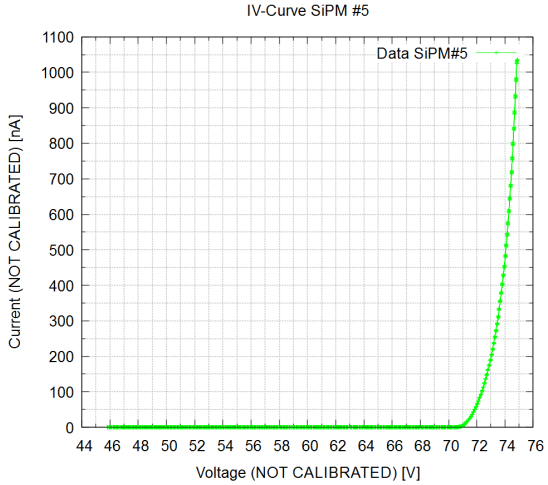
Figure 2: Comparison of different SiPMs.



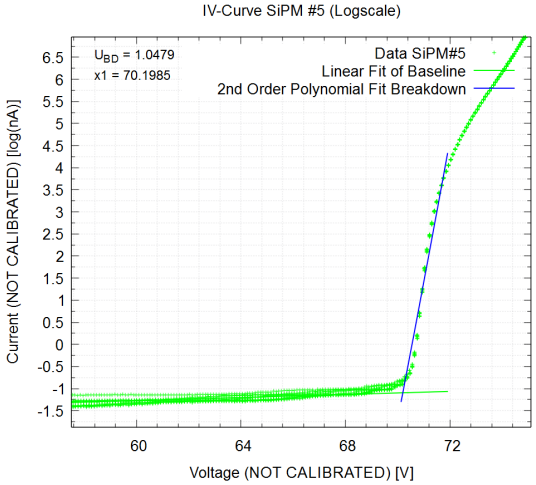
(a) SiPM #4



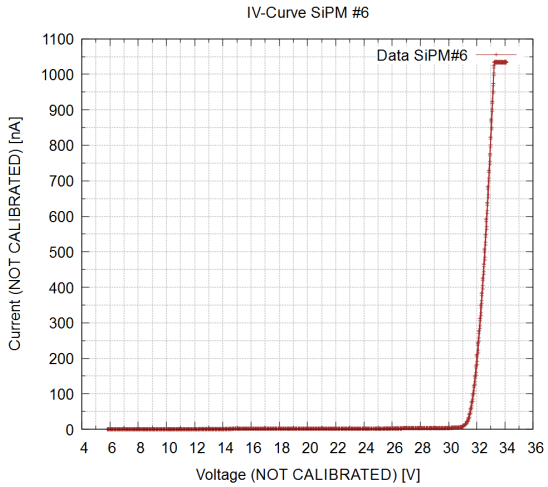
(b) SiPM #4 (log)



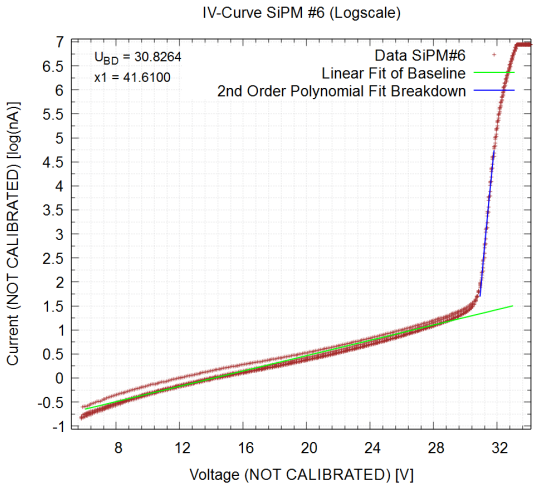
(c) SiPM #5



(d) SiPM #5 (log)

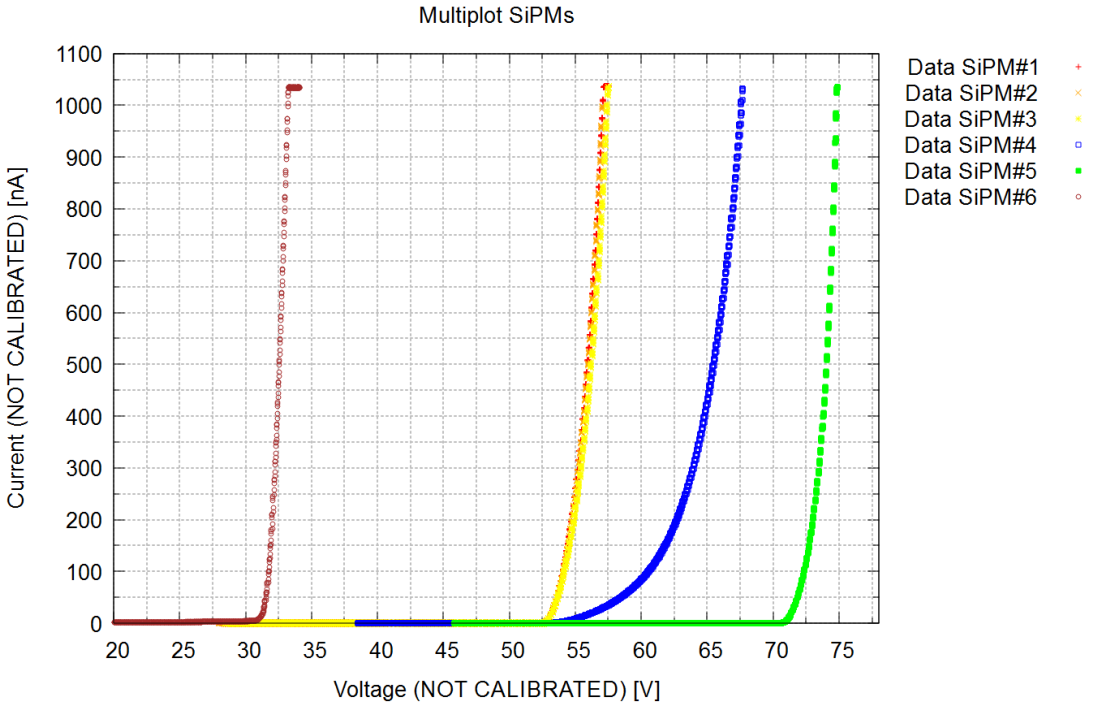


(e) SiPM #6

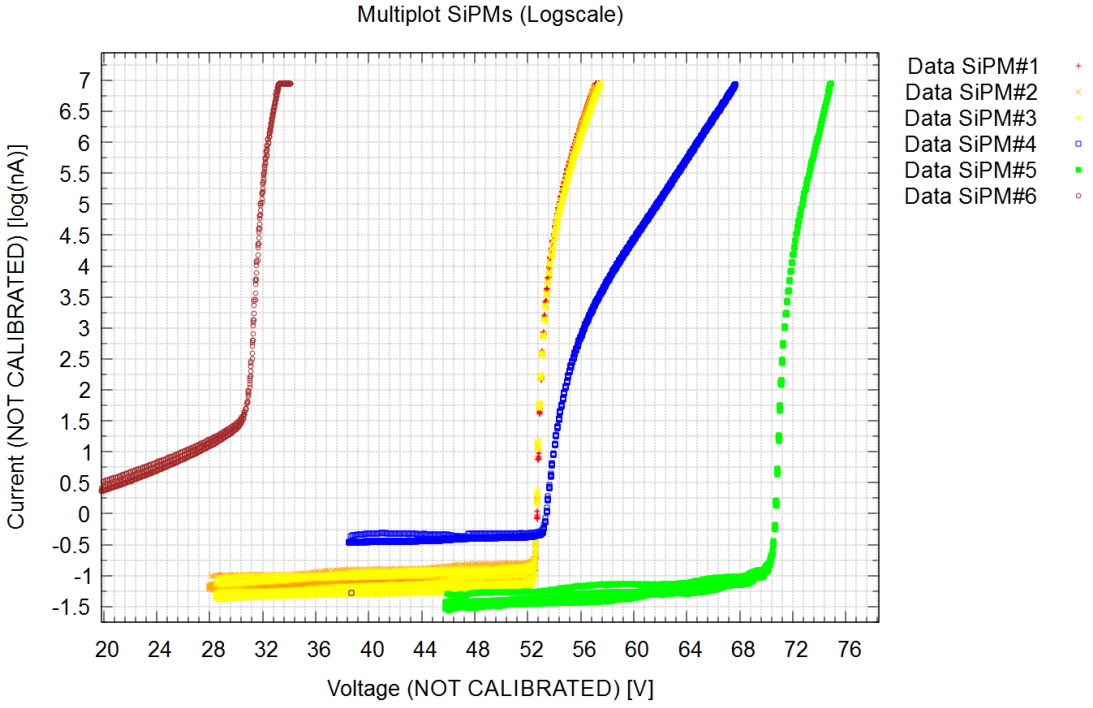


(f) SiPM #6 (log)

Figure 3: Comparison of different SiPMs part 2.



(a) SiPM #4



(b) SiPM #4 (log)

Figure 4: Comparison of different SiPMs part 3.

References

[1] Christopher Hahn. *Measurements on the radiation hardness of the high voltage subdistribution prototype of the Electromagnetic Calorimeter for the PANDA Experiment.* JLU, Mai 2017.