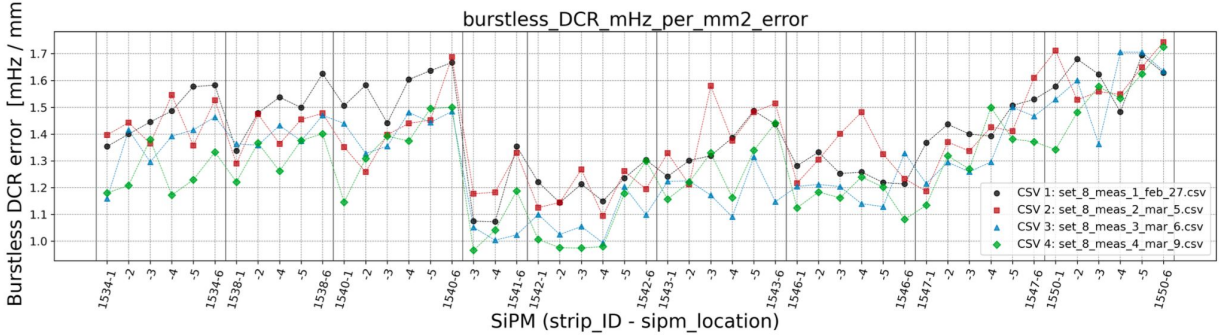
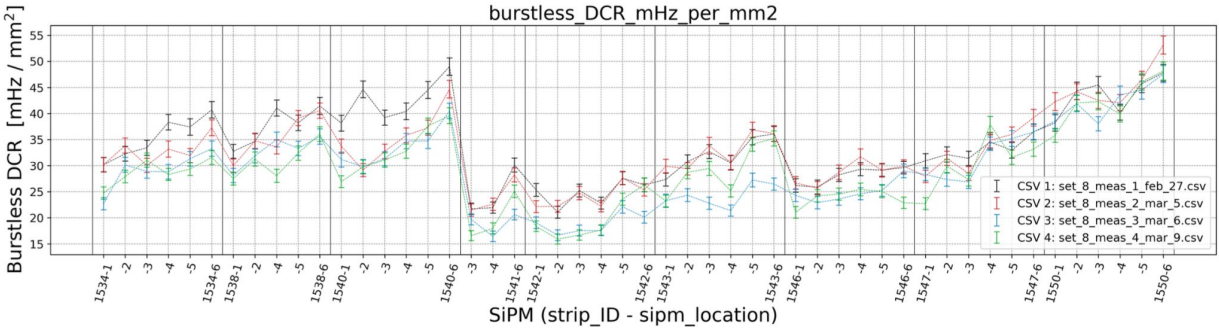


Massibo reproducibility studies and new-measurements plan

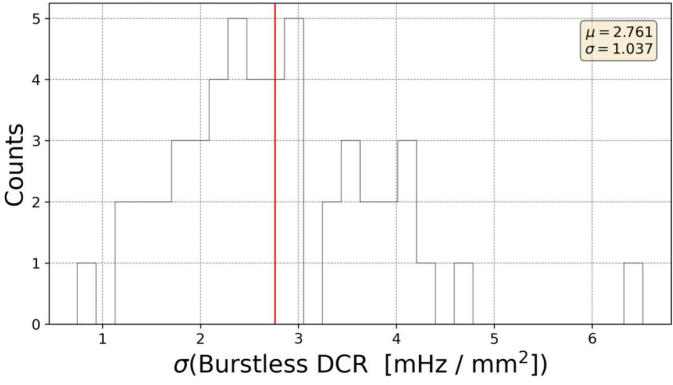
Julio Ureña, Carlos Gaspar Benítez, Anselmo Cervera, Justo Martín-Albo

Group meeting - 25 Mar 2026

Reproducibility studies (no bursts) - dark count rate (DCR)



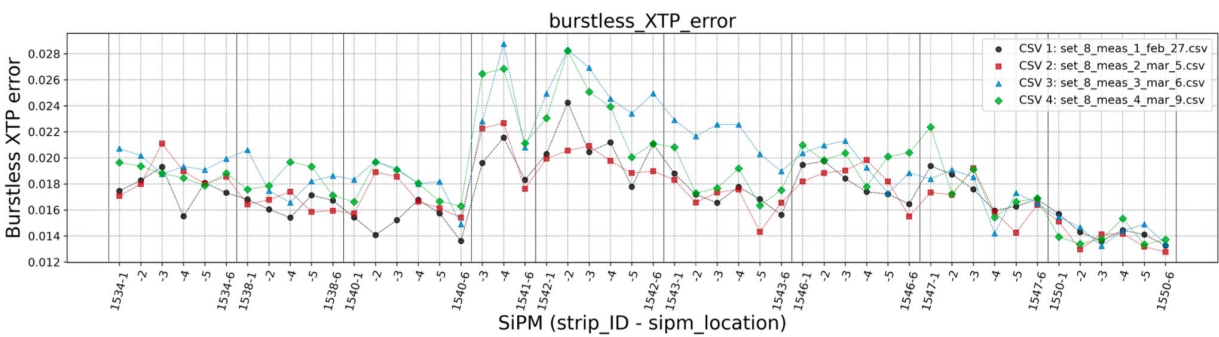
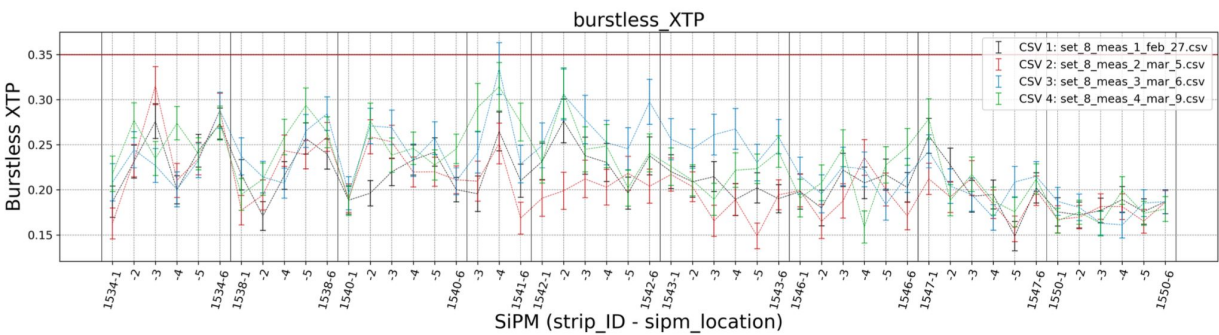
These results follow from 4 measurements Carlos did on the same 9 strips (each strip contains 6 SiPMs) from February 27 to March 9. The goal of these measurements is to understand what is the reproducibility level of massibo measurements.



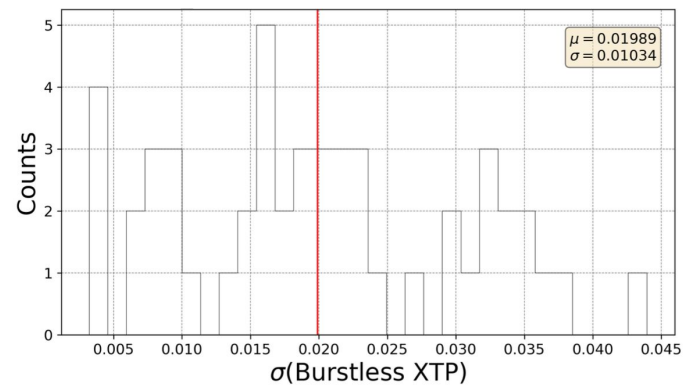
SiPM		Gain		DCR+B (mHz/mm ²)		DCR-B (mHz/mm ²)		Xtalk (%)		Afterpulses (%)	
Model	PDE (%)	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
75_HQR	40	3.93E+06	0.09E+06	58	11	28	10	6.6	0.7	0.9	0.2
	45	4.83E+06	0.09E+06	65	18	26	7	9.0	1.0	1.1	0.4
	50	5.70E+06	0.09E+06	55	17	30	9	11.0	1.0	1.3	0.3

← HPK downselection paper results

Reproducibility studies (no bursts) - cross talk probability (XTP)



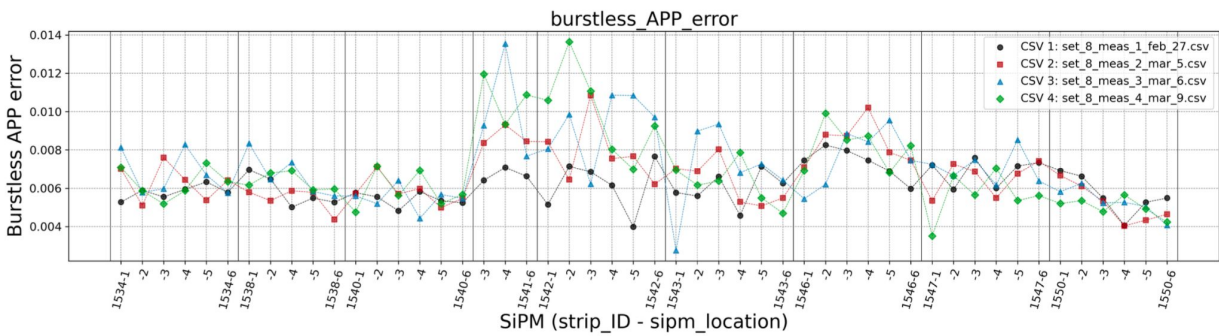
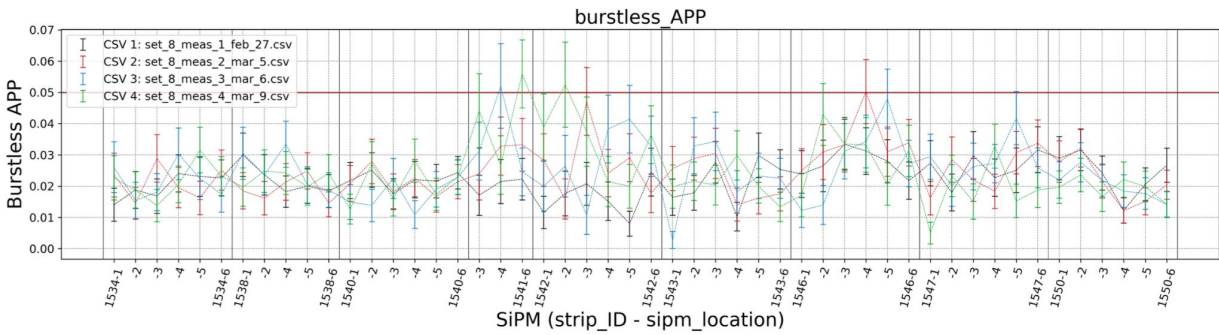
These results follow from 4 measurements Carlos did on the same 9 strips (each strip contains 6 SiPMs) from February 27 to March 9. The goal of these measurements is to understand what is the reproducibility level of massibo measurements.



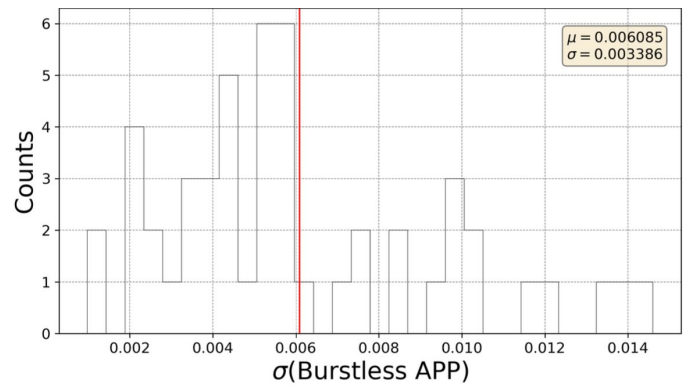
SiPM		Gain		DCR+B (mHz/mm ²)		DCR-B (mHz/mm ²)		Xtalk (%)		Afterpulses (%)	
Model	PDE (%)	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
75_HQR	40	3.93E+06	0.09E+06	58	11	28	10	6.6	0.7	0.9	0.2
	45	4.83E+06	0.09E+06	65	18	26	7	9.0	1.0	1.1	0.4
	50	5.70E+06	0.09E+06	55	17	30	9	11.0	1.0	1.3	0.3

← HPK downselection paper results

Reproducibility studies (no bursts) - after pulsing probability (APP)



These results follow from 4 measurements Carlos did on the same 9 strips (each strip contains 6 SiPMs) from February 27 to March 9. The goal of these measurements is to understand what is the reproducibility level of massibo measurements.



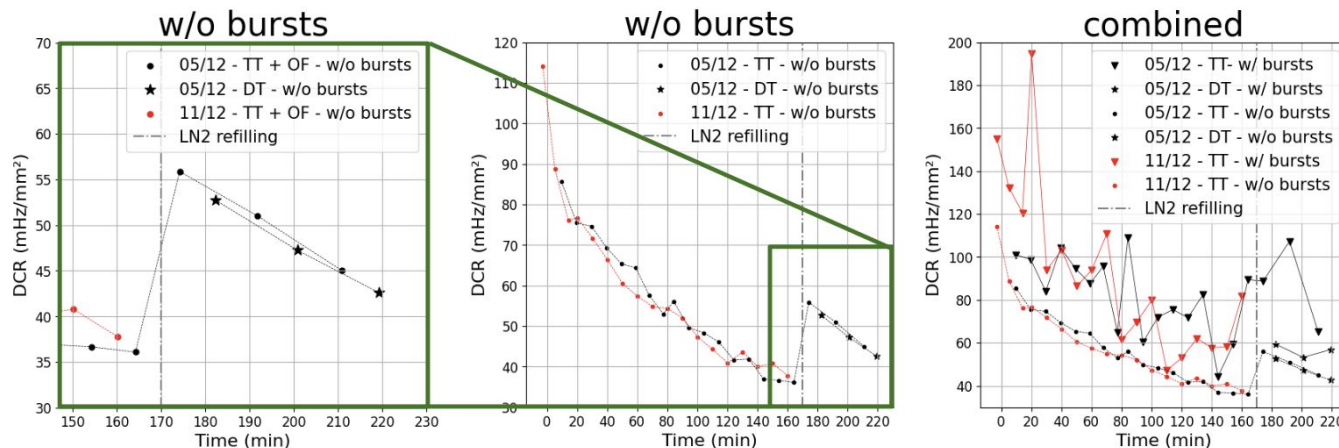
SiPM		Gain		DCR+B (mHz/mm ²)		DCR-B (mHz/mm ²)		Xtalk (%)		Afterpulses (%)	
Model	PDE (%)	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
75_HQR	40	3.93E+06	0.09E+06	58	11	28	10	6.6	0.7	0.9	0.2
	45	4.83E+06	0.09E+06	65	18	26	7	9.0	1.0	1.1	0.4
	50	5.70E+06	0.09E+06	55	17	30	9	11.0	1.0	1.3	0.3

← HPK downselection paper results

From 16 January 2024 (presentation on photosensors WG)

Trigger validation results (DT - Duration trigger, TT - Threshold trigger, OF - Offline filter)

- Dec 5th meas. - first SiPM of the first pre-production board plugged to the first massibo socket
- Dec 11th meas. - first SiPM of the second pre-production board plugged to the second massibo socket



Julio Ureña, Carlos G. Benítez, Jose A. Soto

From 27 February 2024 (presentation on photosensors WG)

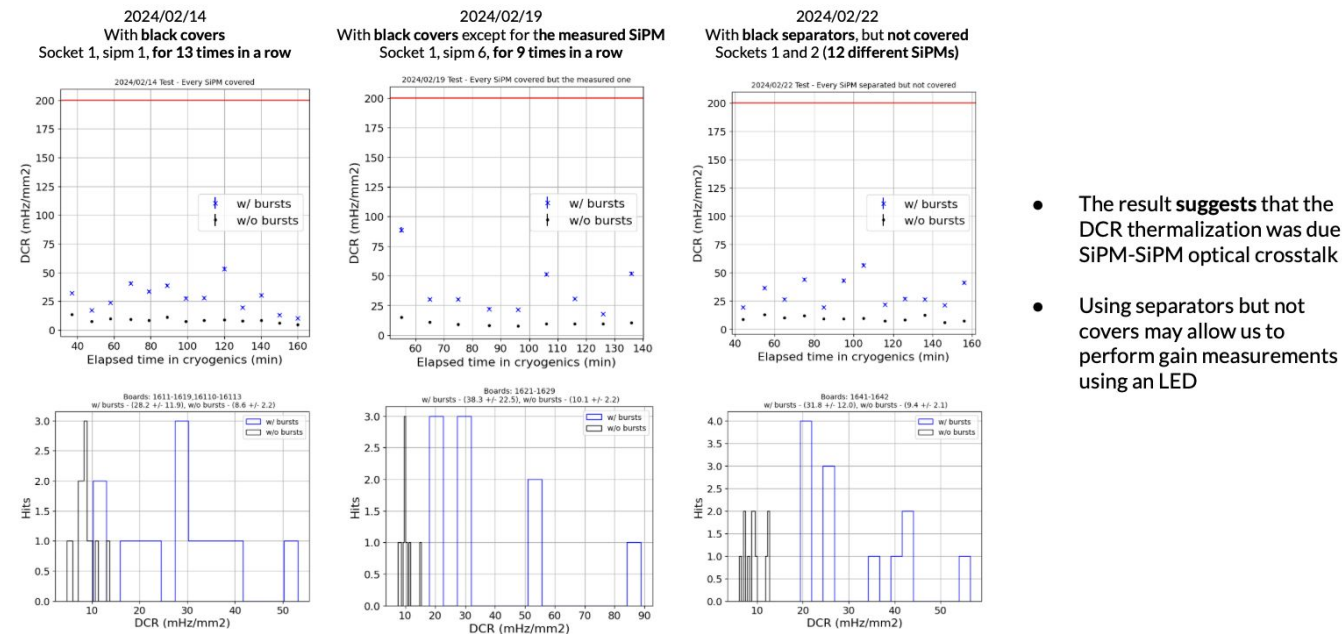
Black covers



Julio Ureña, Carlos G. Benítez, Jose A. Soto - 2024/02/27

From 27 February 2024 (presentation on photosensors WG)

Black covers tests



- The result **suggests** that the DCR thermalization was due SiPM-SiPM optical crosstalk
- Using separators but not covers may allow us to perform gain measurements using an LED

Cross talk between SiPMs

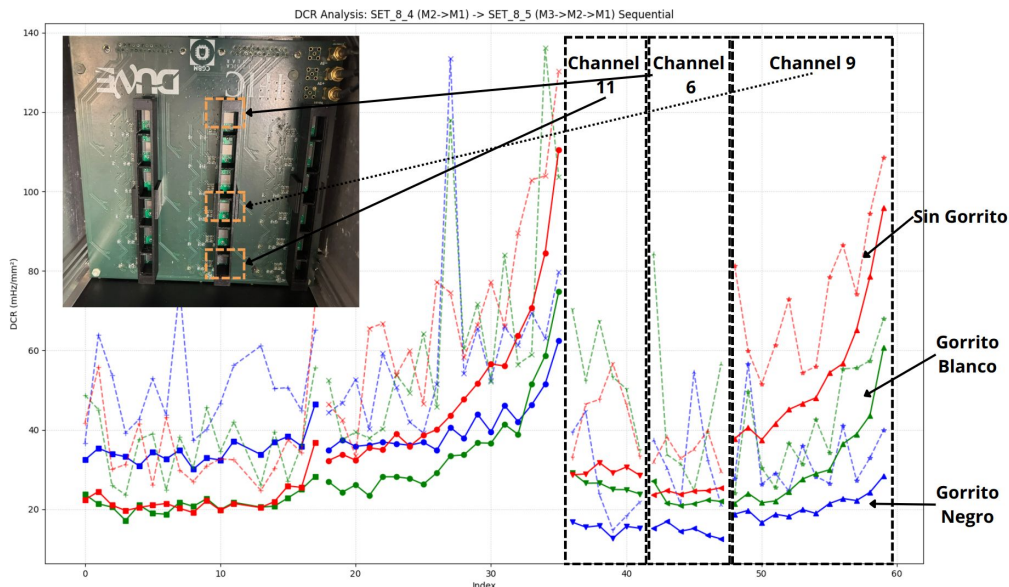
So we assumed that the SiPM separators were a must, and used them by default for every measurement. However, when the measurements re-started with the new massibo version (dewar), new separators were 3d-printed. Assuming that the filament color didn't make a difference, the new separators were printed using white filament. For reference, the ones used for the 2024 measurements were black. The filament color actually made a difference: see Carlos's plot below.

Justo found [this reference](#) where they show that light extinction coefficient in filaments vary not only with the wavelength, but also with the color and the manufacturer

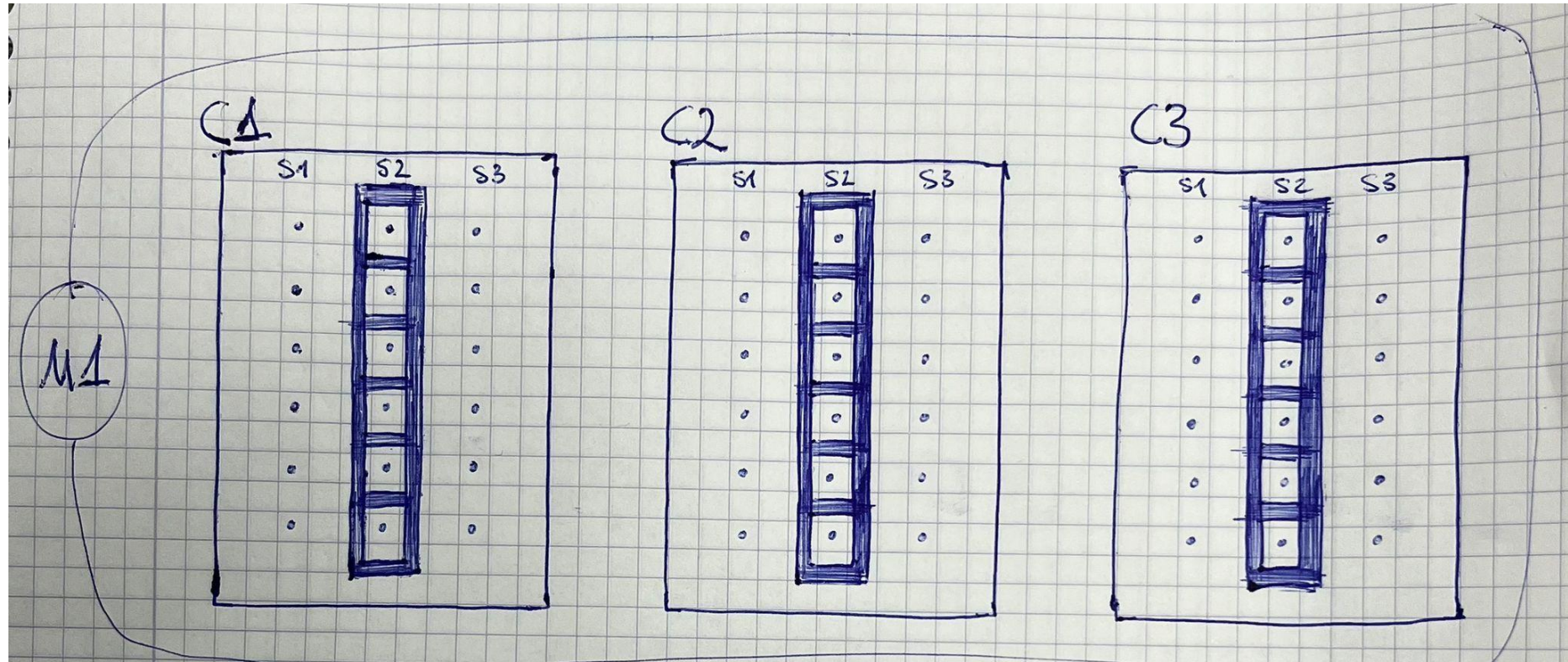
We don't understand (do we?) what is the cause for the time dependence of the DCR, but have strong evidence that it can be sufficiently mitigated using inter-SiPM optical isolation

We plan to take 3 measurements (three cryogenic immersions) with the aim of testing:

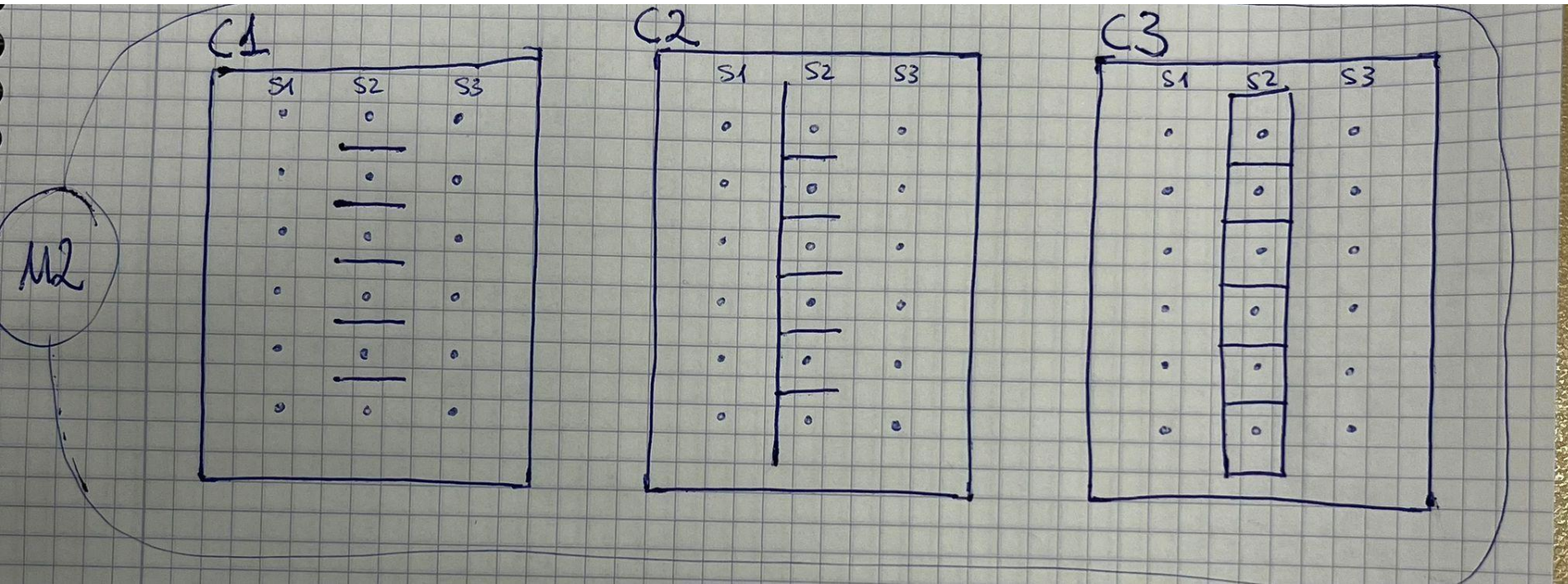
- 1) Influence of the separators thickness on the measured DCR
- 2) Test the hypothesis that the unexpectedly big DCR of the first measurements is due to cross talk between SiPMs (progressively isolate different groups of SiPMs)



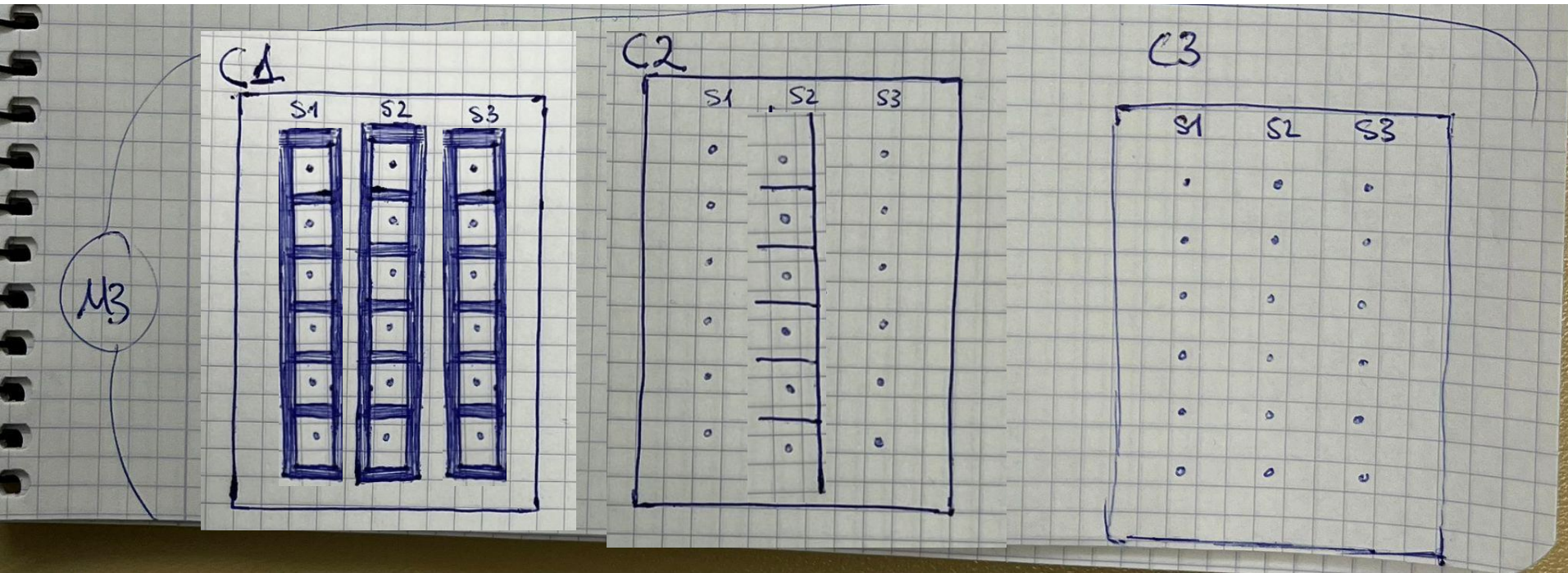
Measurements plan (normalization measurement)



Measurements plan



Measurements plan



Measurements plan

