

Outdoor Systems, performance and upgrade

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MARTA Collaboration, LouMu Collaboration, Lip Detector Laboratory



LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia



Instituto de Ciências da Terra
Institute of Earth Sciences



UNIVERSIDADE
DE ÉVORA



EXPL/FIS-OUT/1185/2021

OE,FCT-Portugal, CERN/FIS-PAR/0012/2021

- **MARTA Eng. Array at Auger Site**

- Astrophysics

- **LouMu**

- A project that combines particle physics and geophysics in order to map large geologic structures, using the Muon Tomography. **Physics results already presented by Raul on Wednesday**

- **Sealed RPC**

- Important approach concerning the limitations using HFCs in the near future

- **Conclusions and future work**

MARTA @ Auger site, prototype station



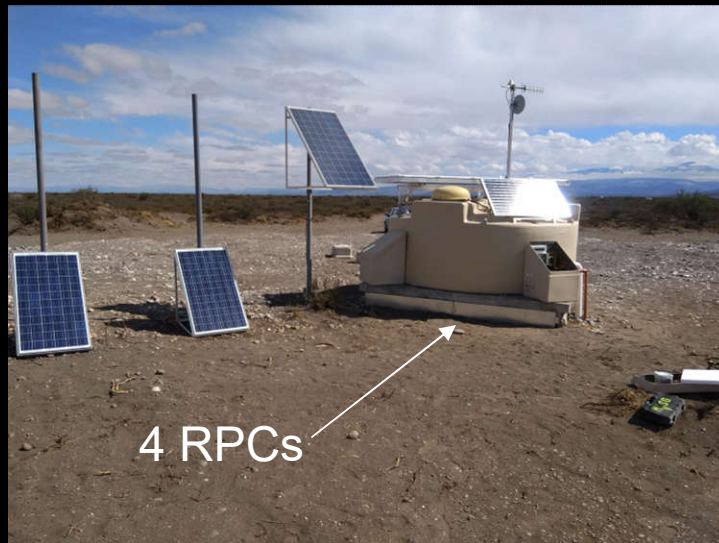
Harsh conditions



MARTA @ Auger site, prototype station



Due to pandemic chambers were off and out of gas from January 2020 until April 2022



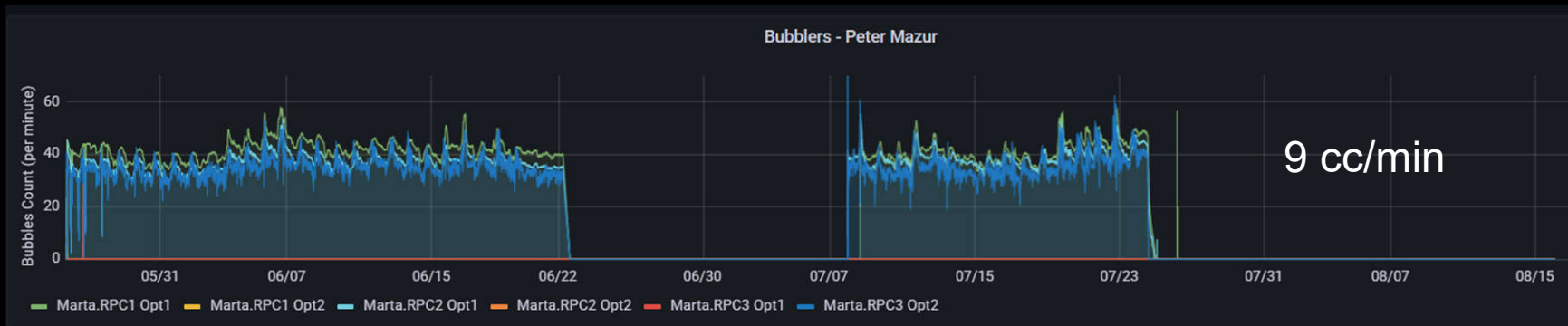
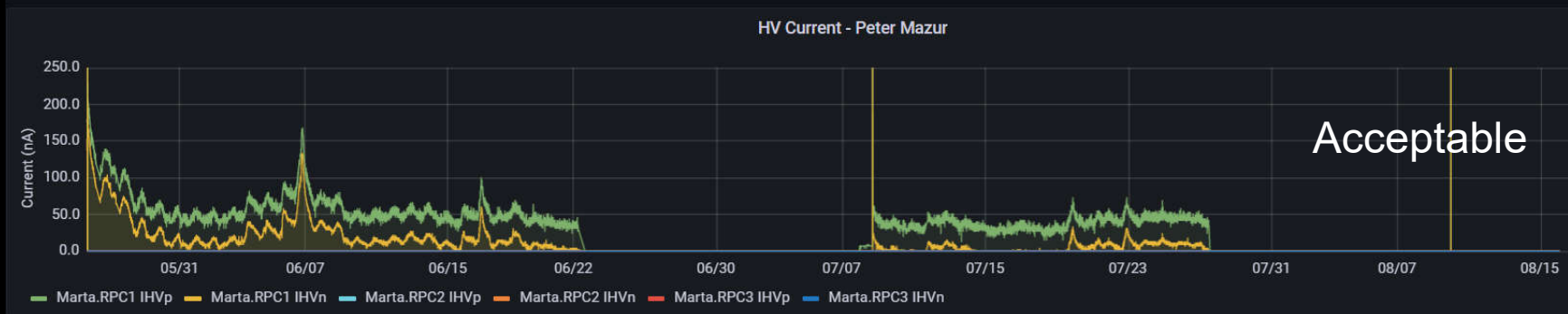
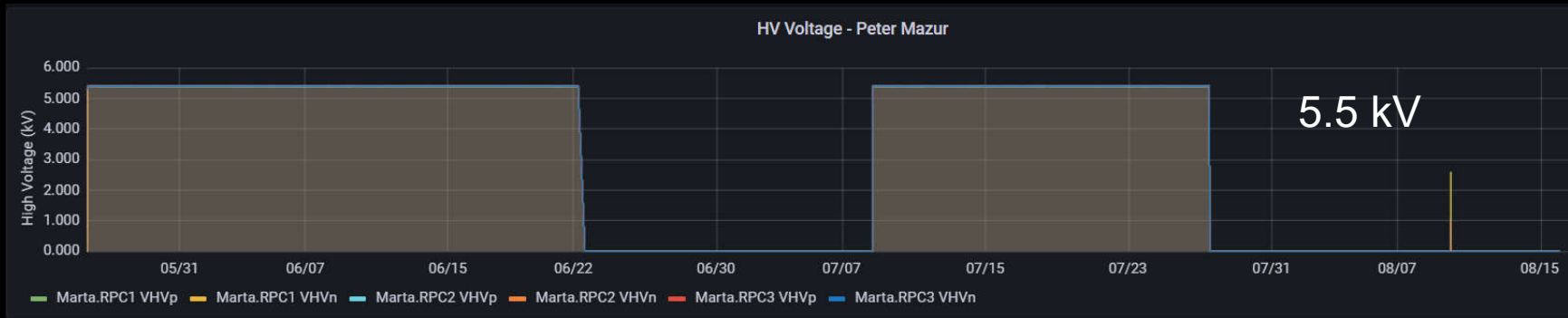
4 RPCs

4 double gap RPCs with $1.2 \times 1.5 \text{ m}^2$ active area underneath the tank. Deployed in November 2019, restarted in April 2022. After gas flowing for some days chambers were turn on.



Gas bottle and distribution under ground to mitigate temperature effects. Probably we need to work on better solution due to condensation and tube material. We found some liquid inside the tubes, not clear what it is!! Most probably water.

MARTA @ Auger site, prototype station



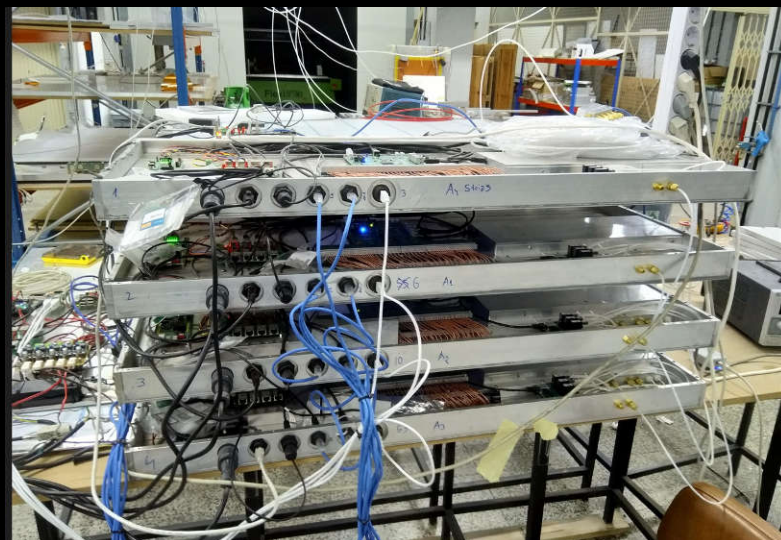
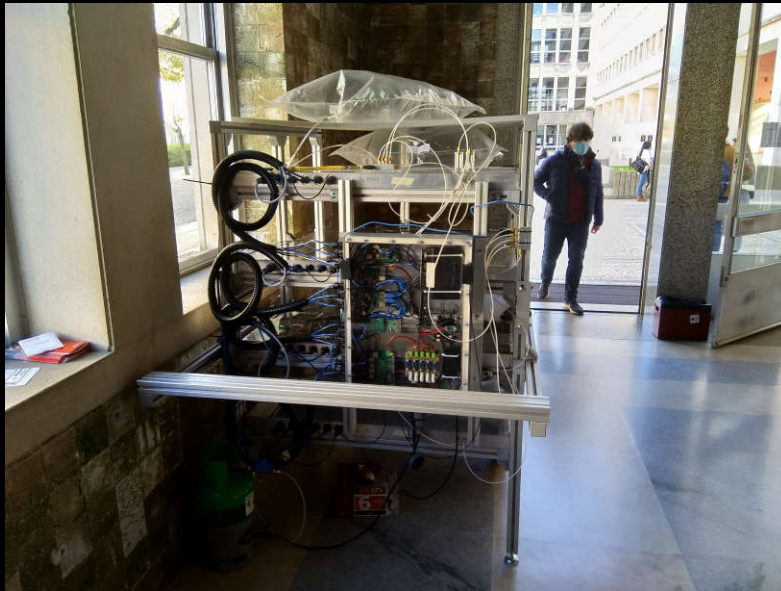
After 2.5 years seems to be all ok. Very high flow, not needed, misconfigured during installation!!

MARTA @ Auger site, prototype station



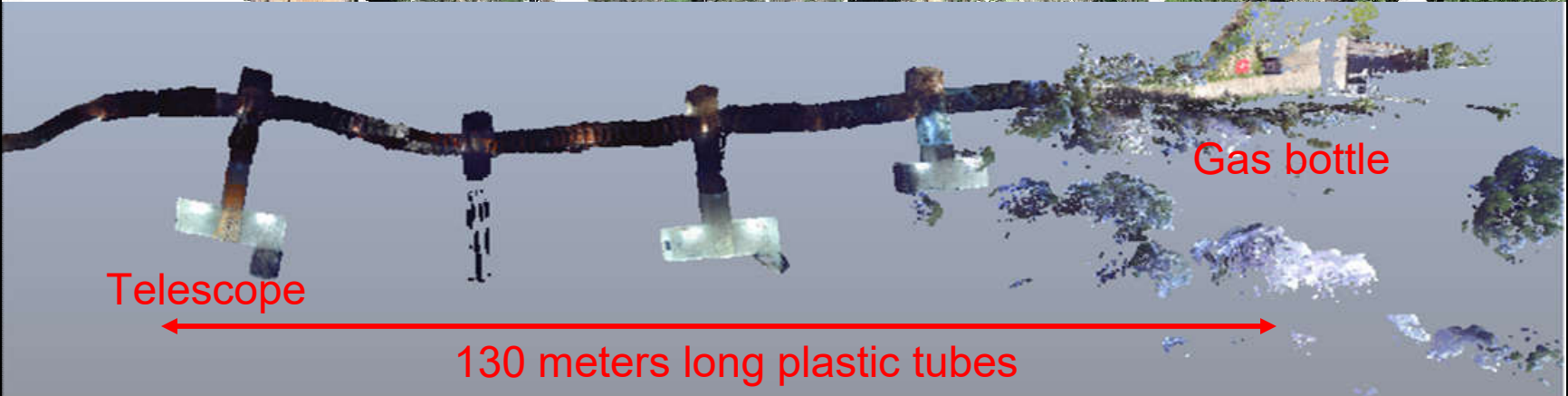
Humidity inside the aluminum boxes is too high... Need some experts @ site to check the reasons.

@ Lip-Coimbra

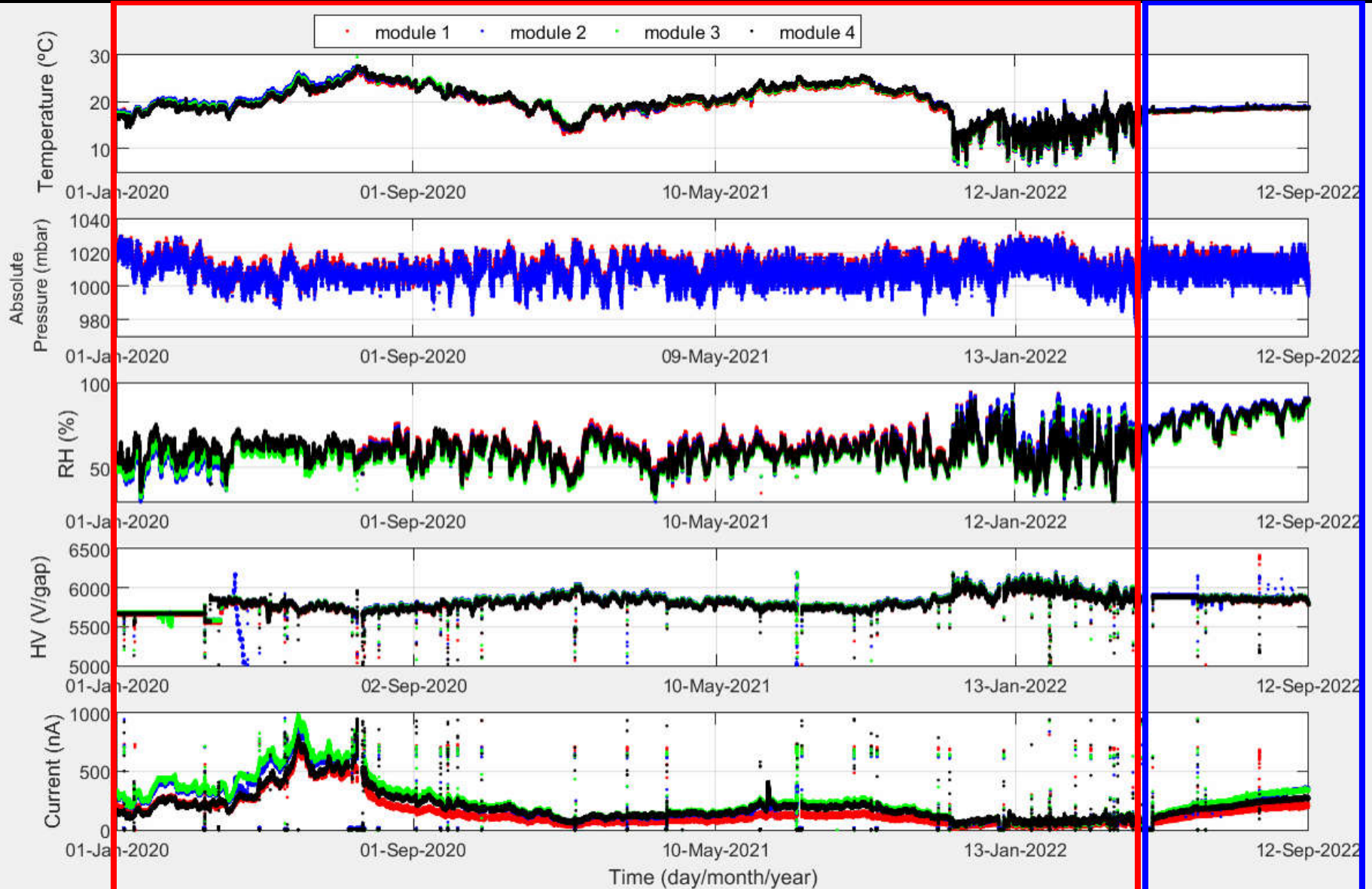


- Four plane telescope
 - double 1 mm gap and 1 m² sensitive area, MARTA like construction.
 - Pure R134a, recover and compressed for recycling.
 - prepared to be easily move to different places
- Around 1 kg gas consumption per week.
- HV automatic adjustment to keep gain and efficiency stable over time
 - constant monitoring of temperature, absolute pressure, RH and gas flow
- Very stable performance over time @ lab
- 64 channels Maroc front end in each chamber
- Central unit, custom made trigger unit based on Xilinx Spartan-6 FPGA

LouMu @ Lousal mine



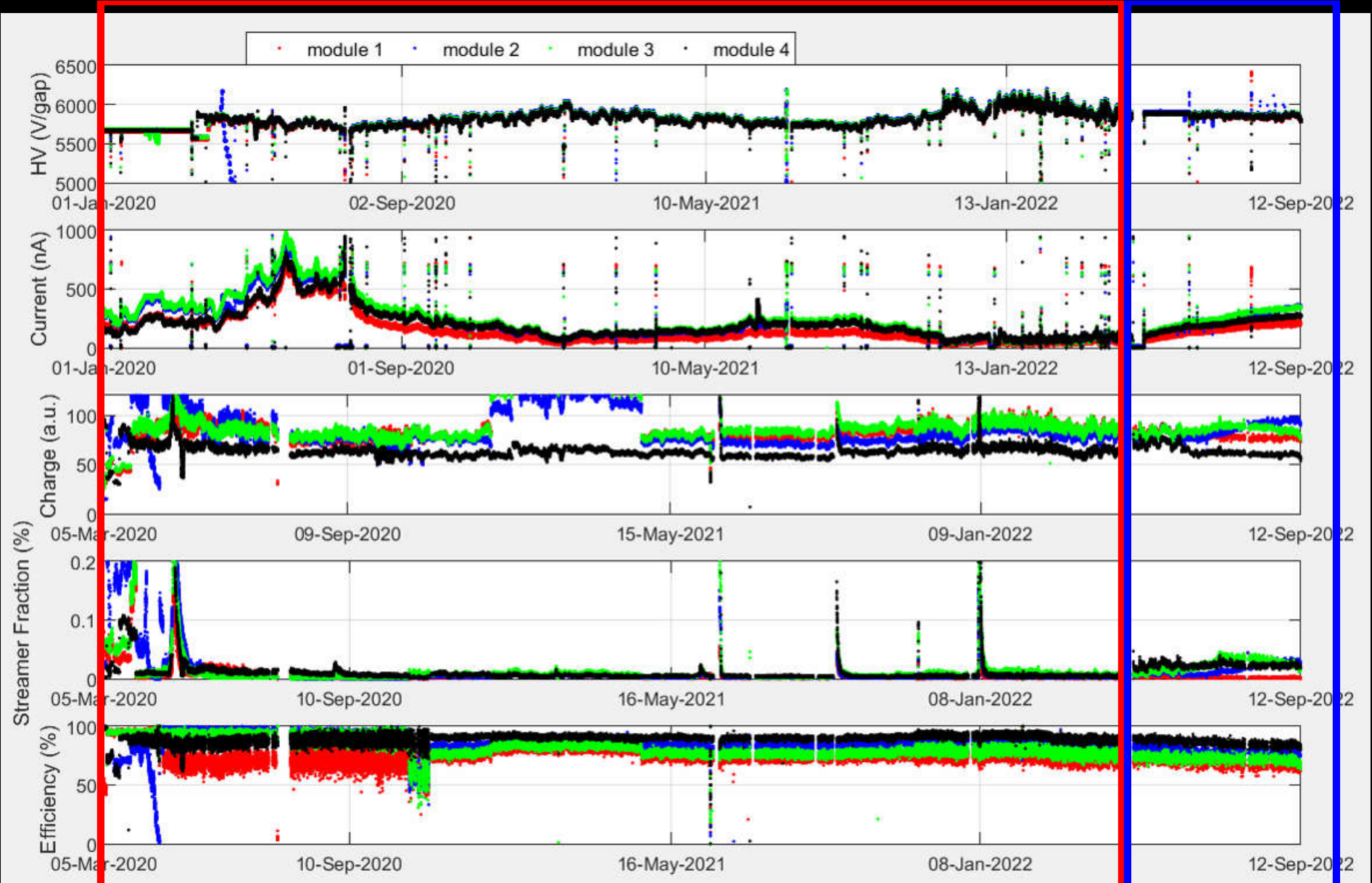
LouMu @ Lousal mine



@ the Lab

@ the Mine

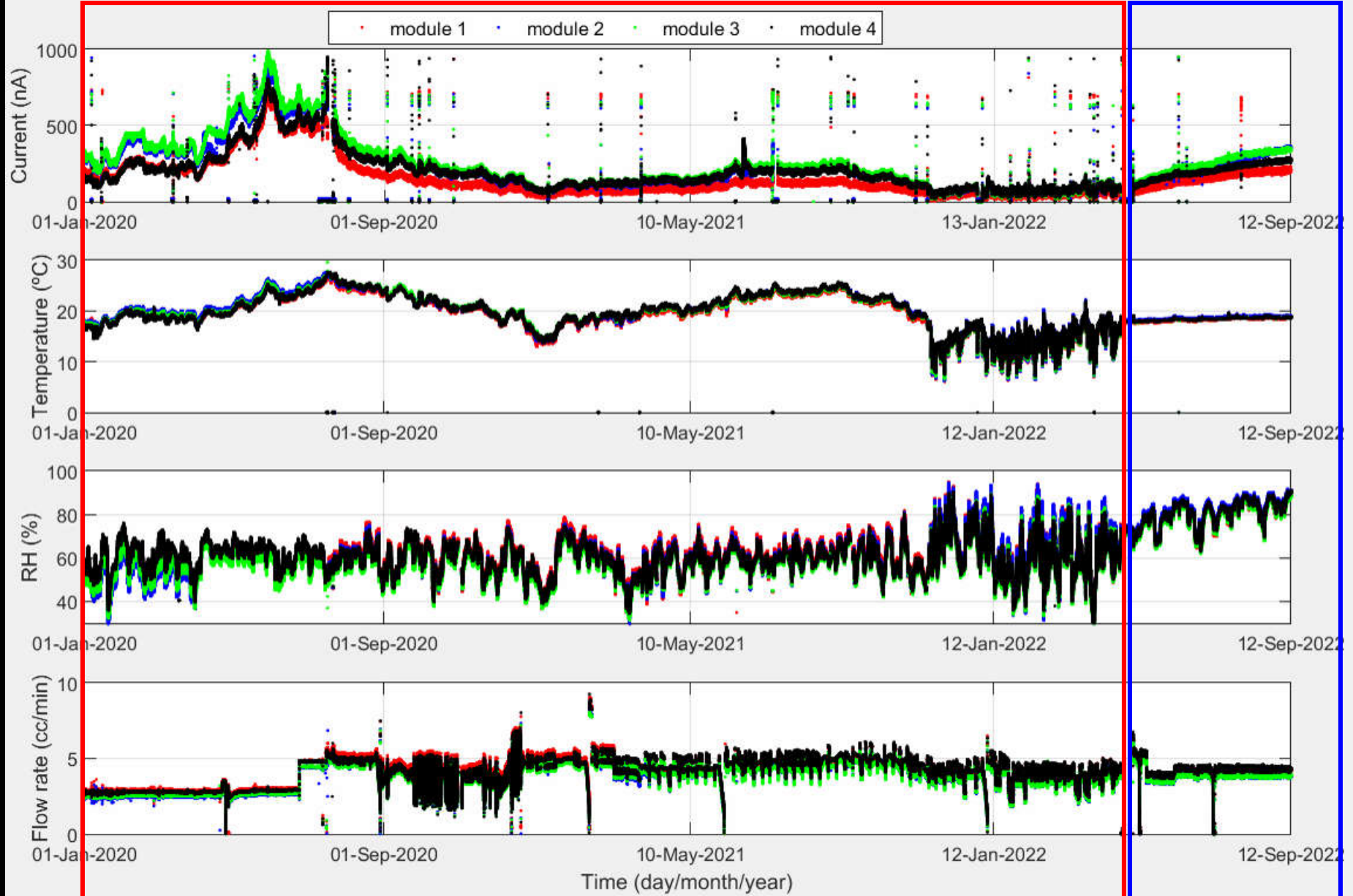
LouMu @ Lousal mine



@ the Lab

@ the Mine

LouMu @ Lousal mine



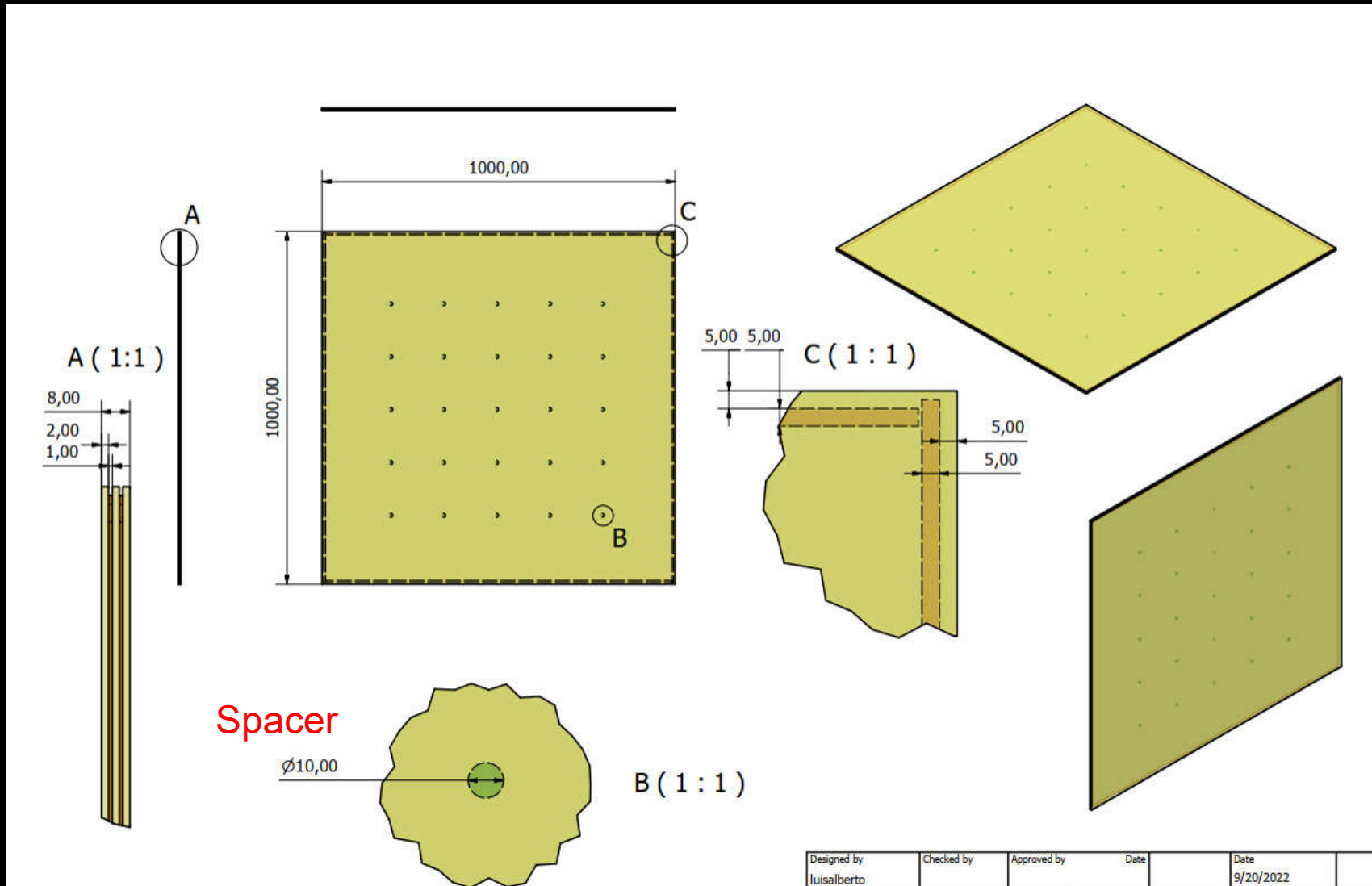
@ the Lab

@ the Mine

Sealed Chamber



Double 1 mm gap, ~1m² sensitive area, 95% C₂H₂F₄+ 5% SF₆

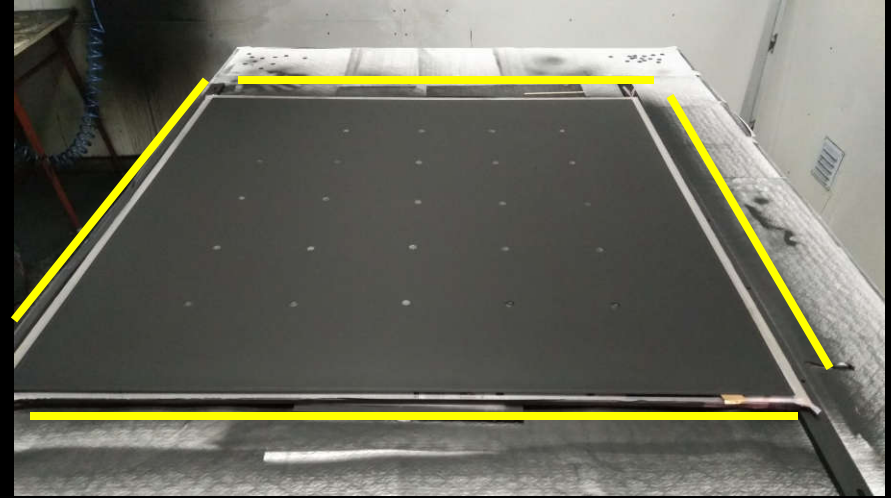
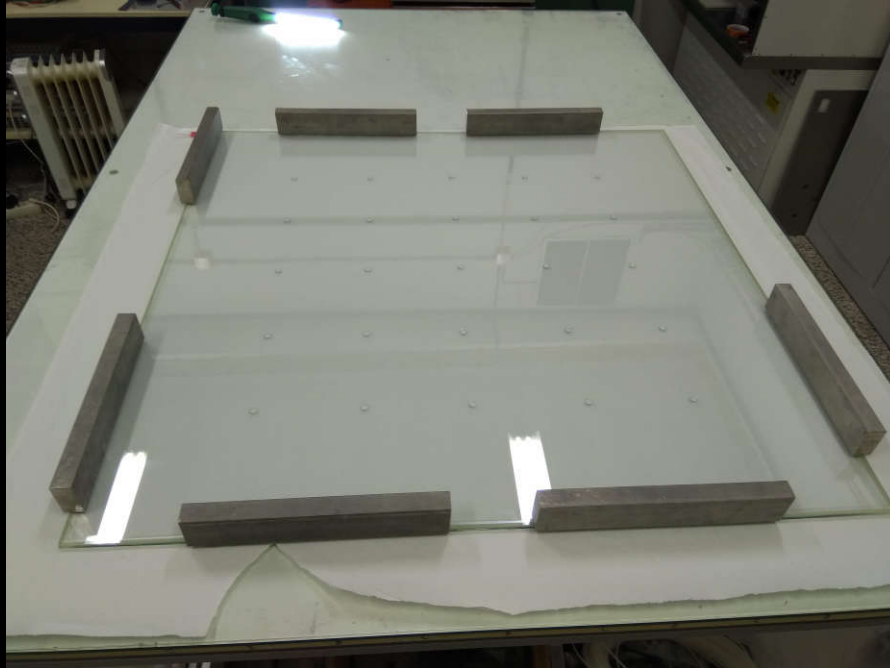


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| luisalberto | | | | 9/20/2022 |

Sealed Chamber



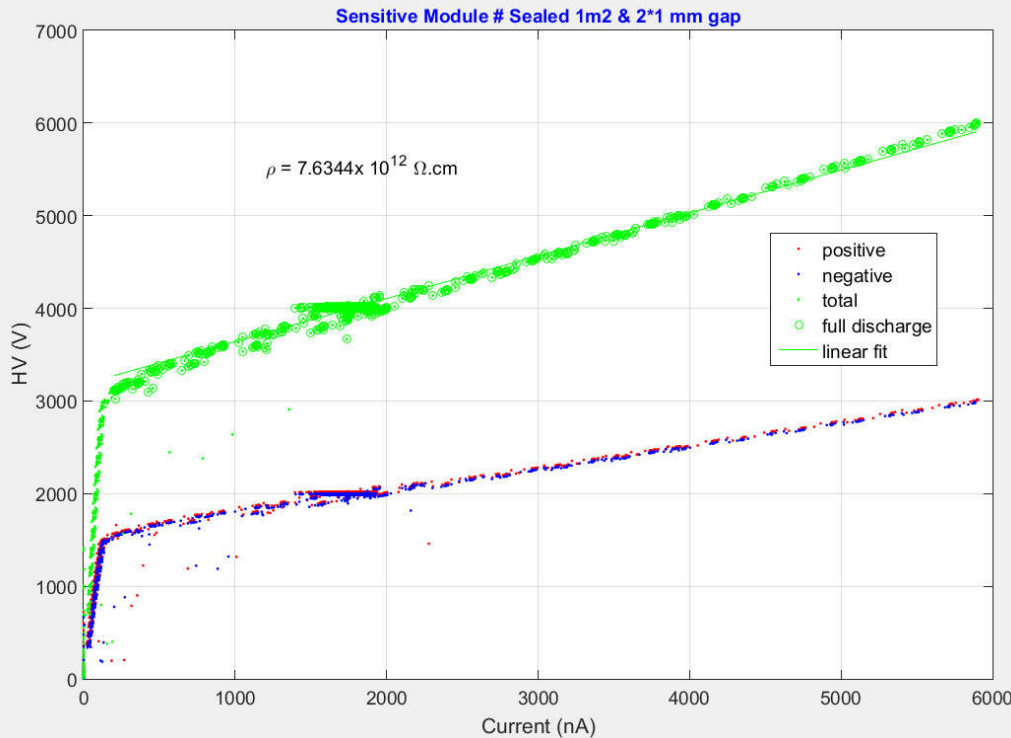
Sealing of gaps and HV electrode paint



Leave **15 mm without paint** to minimize leakage current and current flow over full glass paths, **no paint in the spacer area**

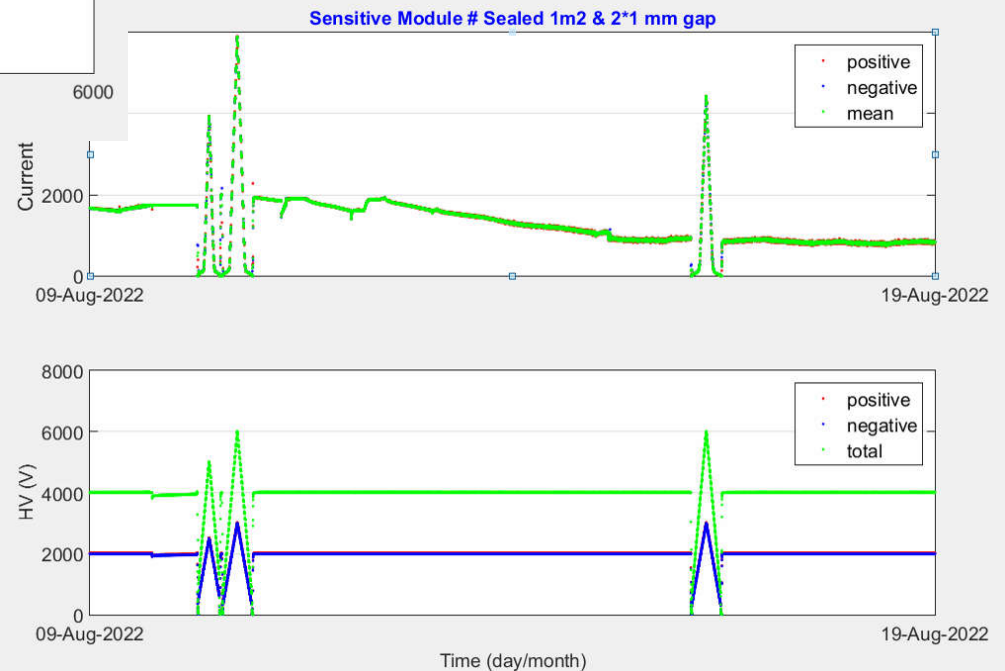


Sealed Chamber

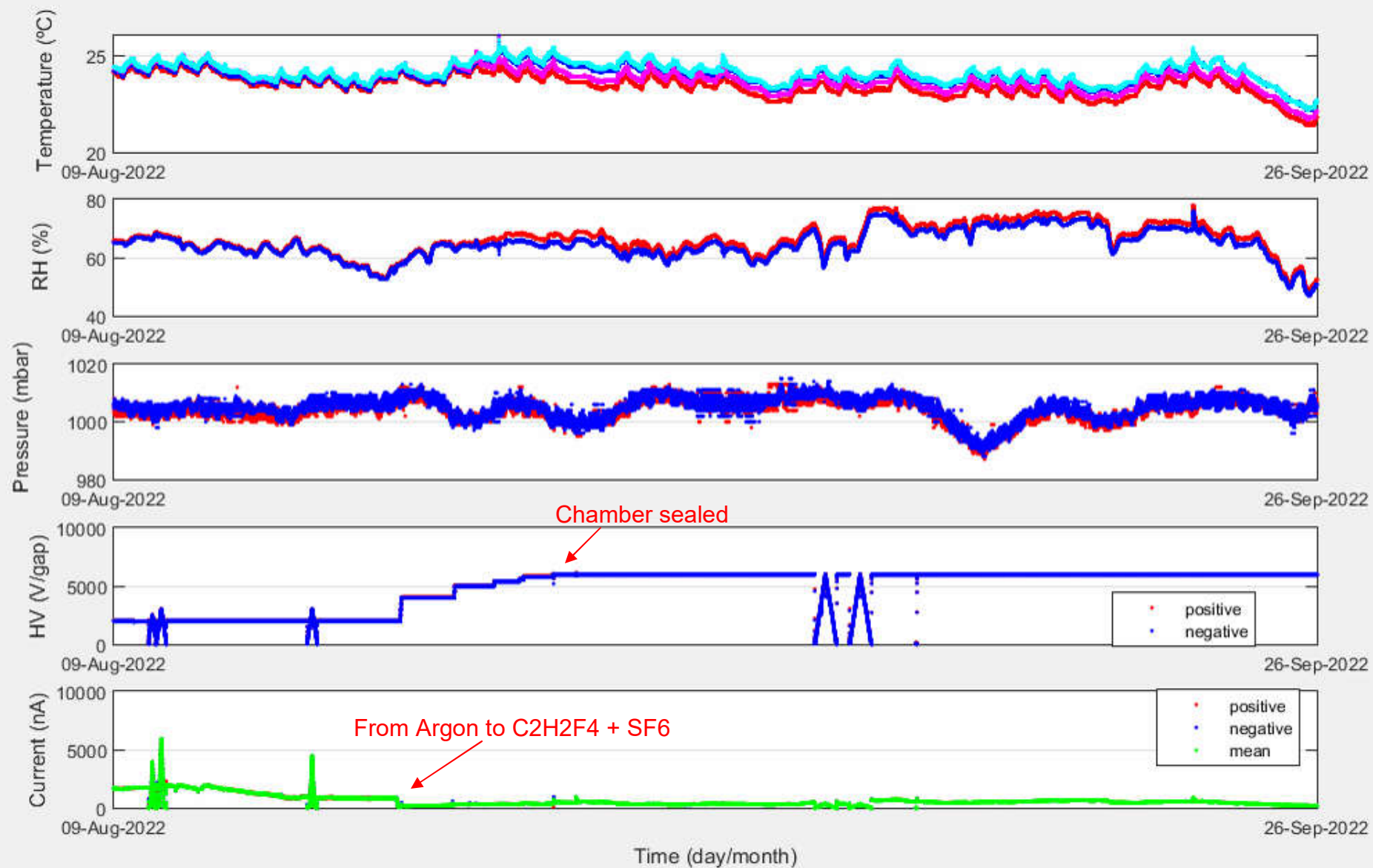


Argon permanent discharge.
Very good gap uniformity. Able to extract correct glass bulk resistivity

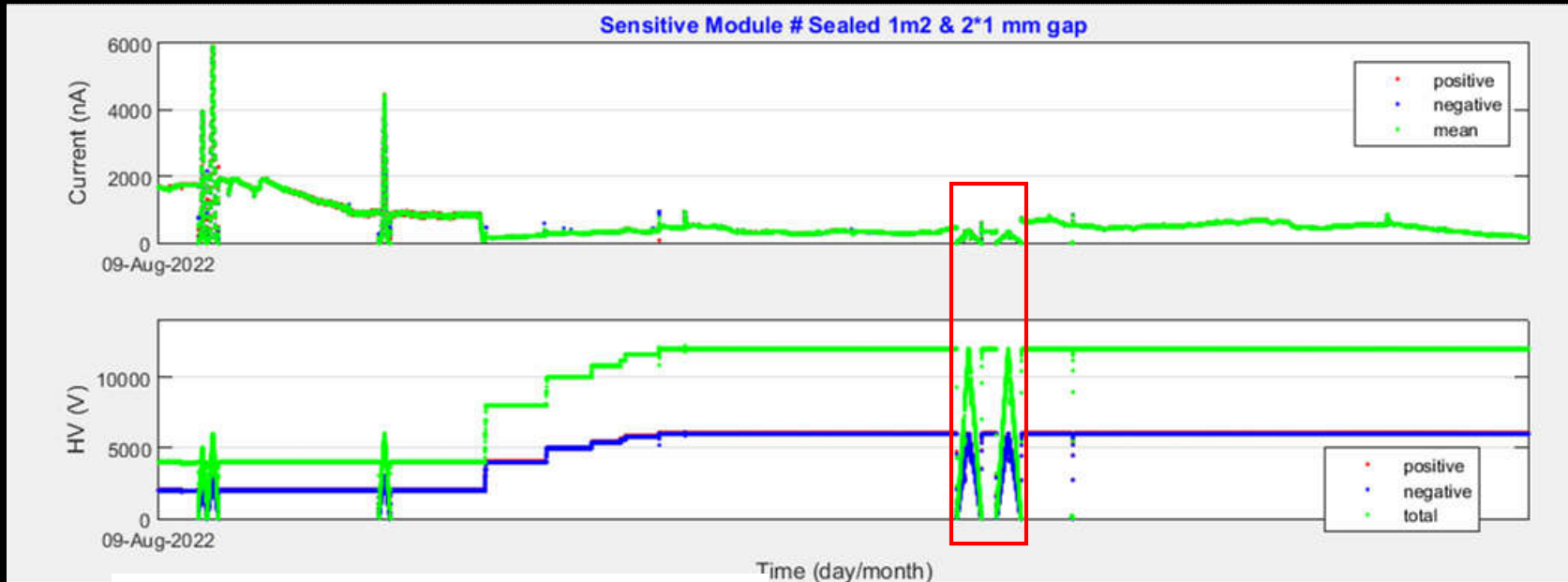
For better gap cleaning we should keep Argon discharge for at least one month... No time so only 10 days....



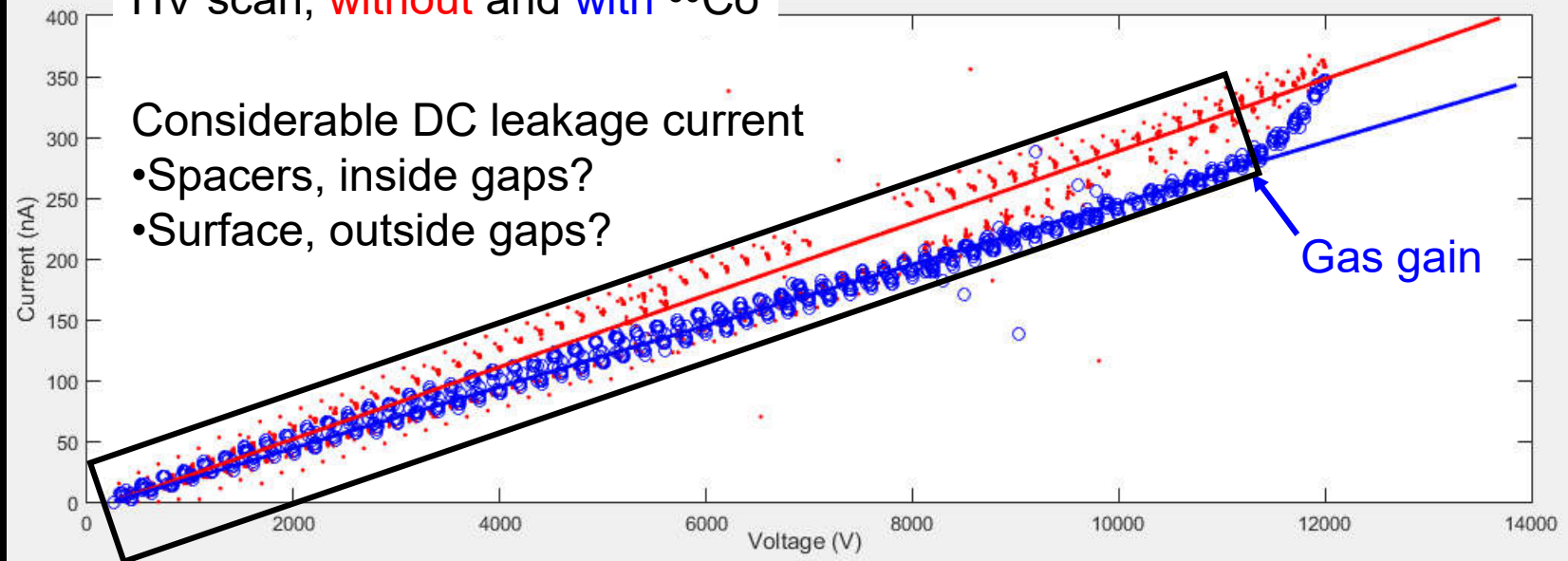
Sealed Chamber



Sealed Chamber



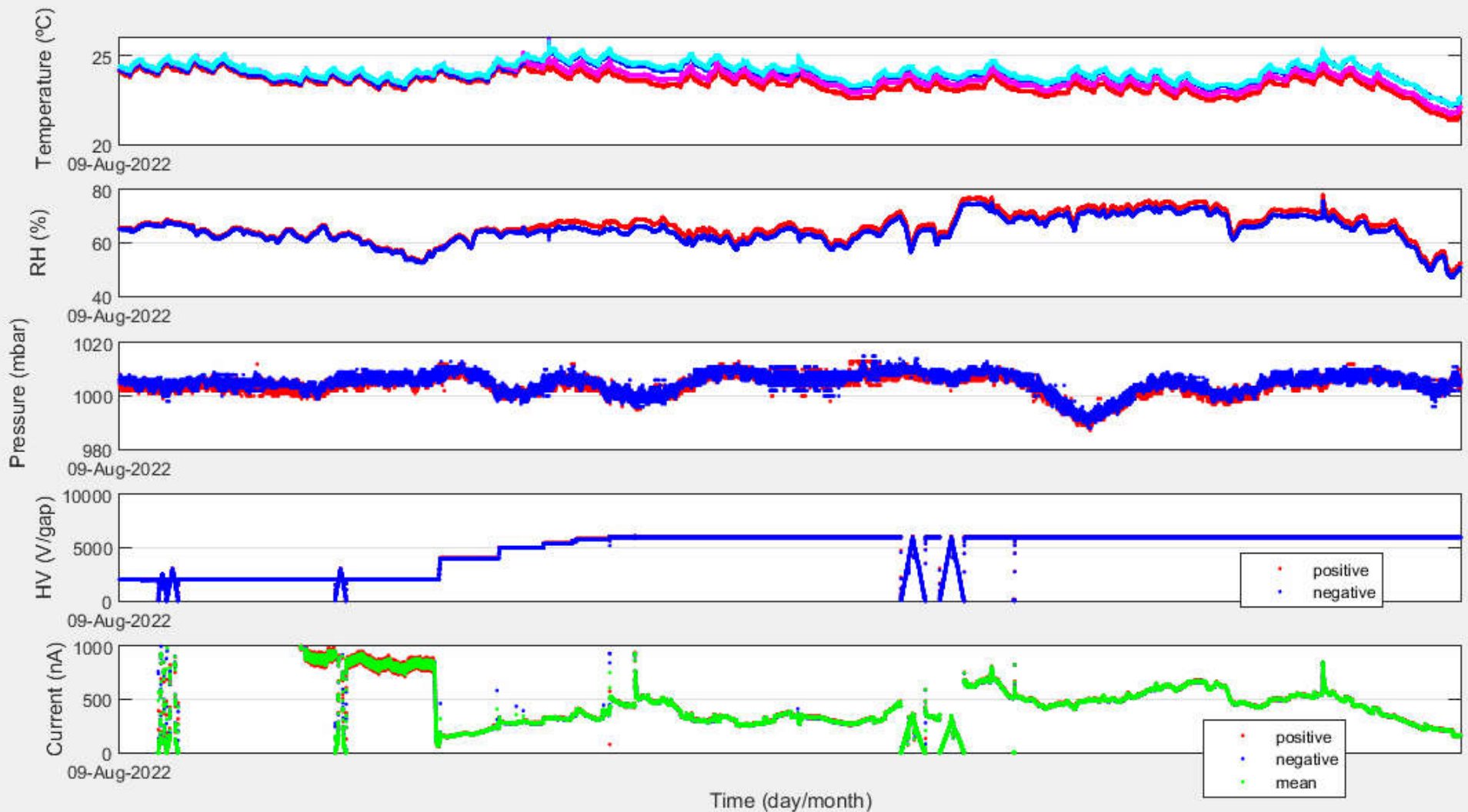
HV scan, **without** and **with** ^{60}Co



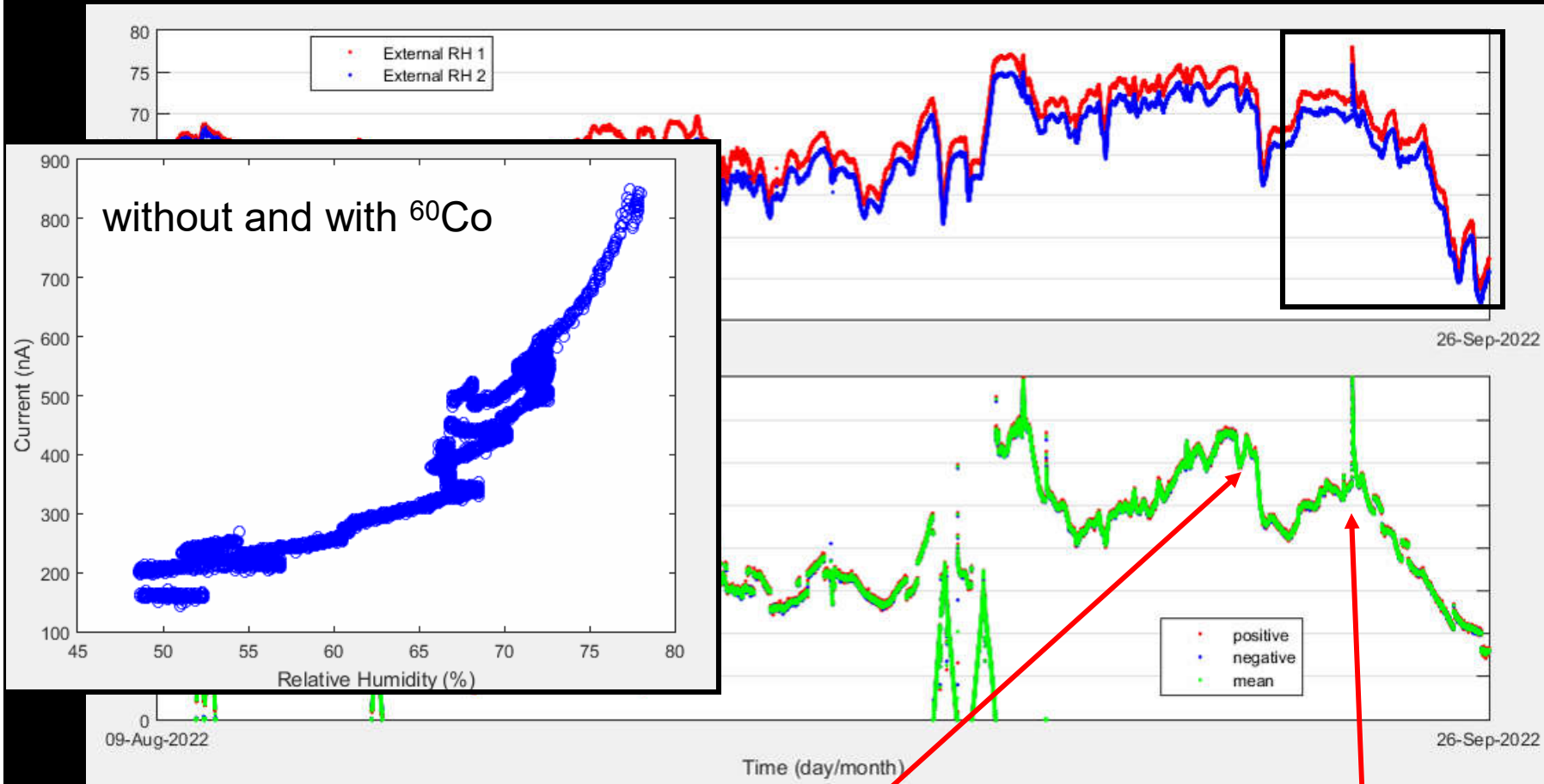
Sealed Chamber



Easily we can see that current follows the room RH more than any other variable!!
Good! Bad from leakage current but, important confirmation of gaps sealing procedure



Sealed Chamber

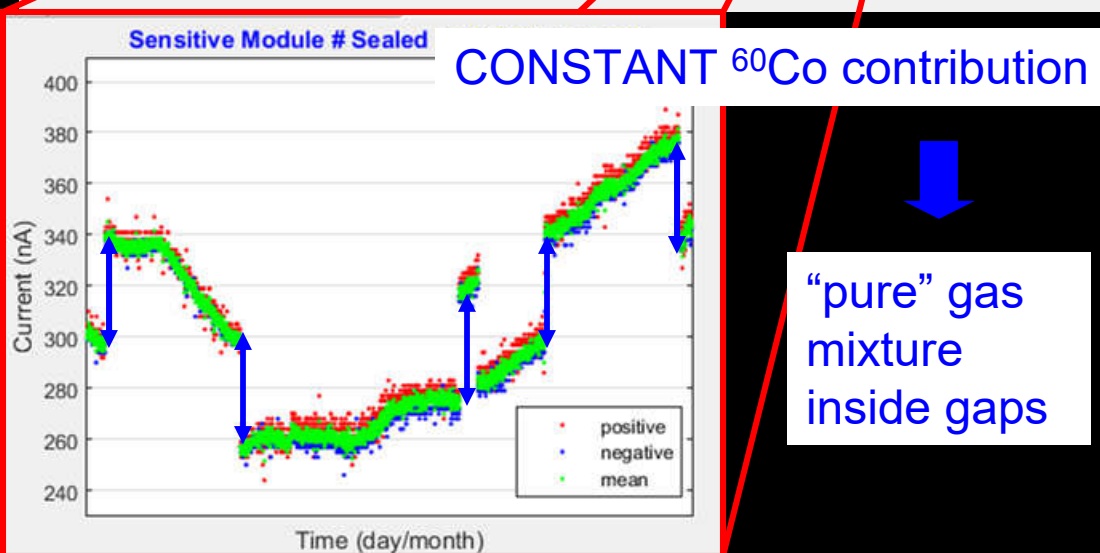
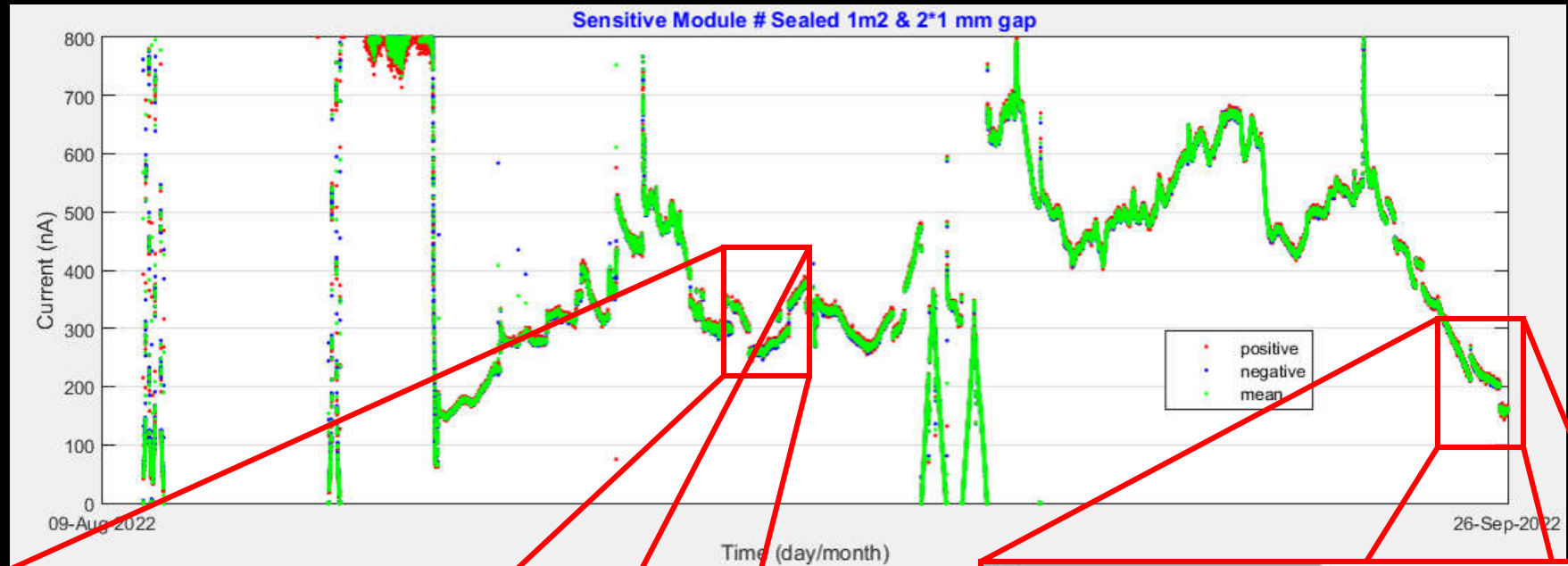


Humidity reduced via Argon atmosphere

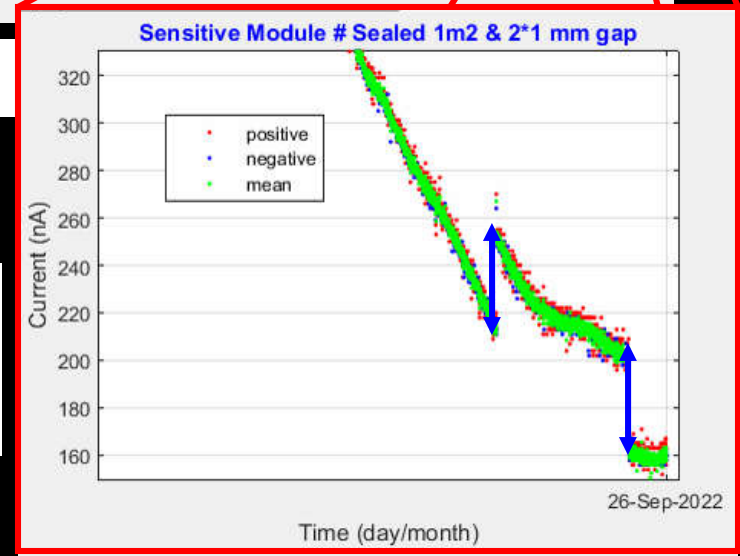
30 persons inside the room

This can only come from leaks between the HV electrodes, through glass and epoxy surfaces!!
We will work on it in the next prototypes, that are already in the oven..

Sealed Chamber



“pure” gas mixture inside gaps



Conclusions and near future



- MARTA

- Need to work on improvement of gas system distribution.
- Urgent to finalize DAQ to have constant data taking, which is of major importance for detector/system improvement.

- LouMu

- Gas delivery lines need new material to limit moisture pollution of the gas.
- All system very stable and producing good physics results

- Sealed Chamber

- First 1 m² prototype, pop on some challenges with respect to leakage currents influenced by room RH. Need to work on stable solution.
- Double gap sealing process seems to be correctly done.
- Apart from DC leakage currents chamber operate stable over 1.5 months, test ongoing.
- New prototypes already in production.
- Full characterization of the detectors also in the line.
- Important after getting a stable and reproducible chamber. Study the effect of temperature excursions (minimum 10-15 °C) on the chamber mechanical robustness and sealing
- Most important, how long the chambers are able to operate smooth.