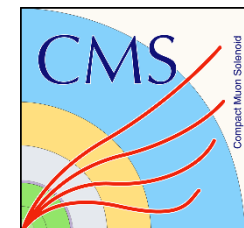
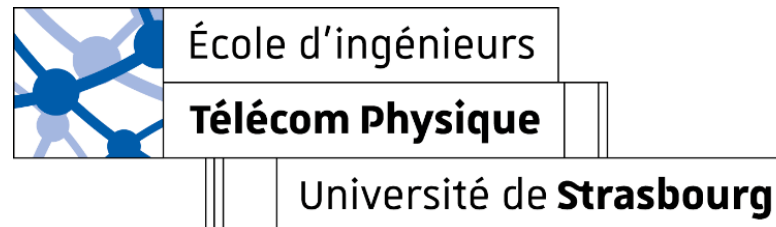


Discharge Studies on Super Chamber

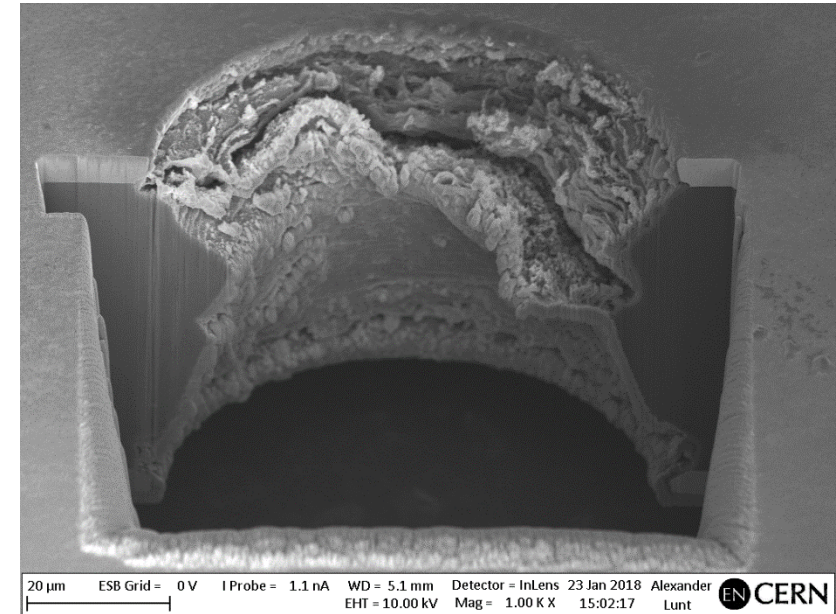
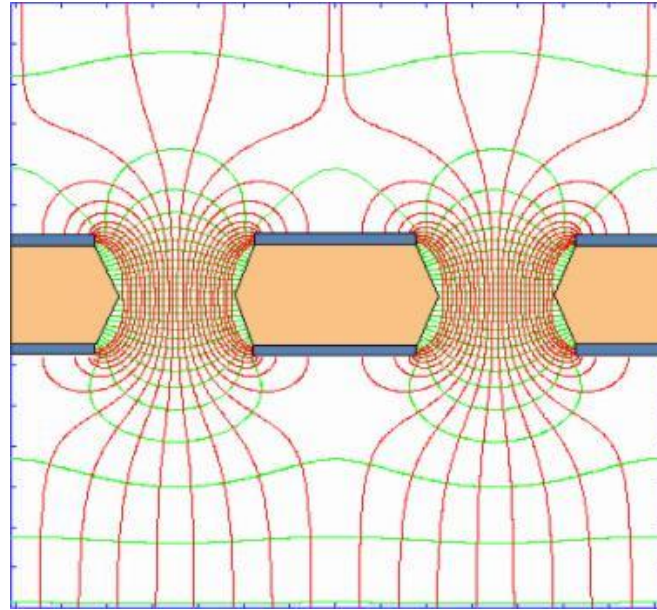
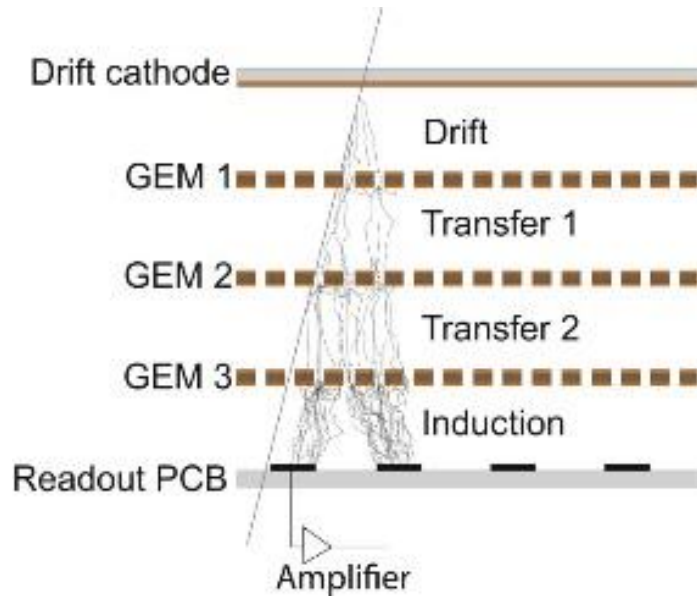
Océane PERRIN : 2nd year engineer student - intern from 03/07/2019 to 30/08/2019
Supervisors : Francesco Fallavollita and Jérémie A. Merlin

My contribution in the Lab :

- Assembly Stand
- Low Voltage monitoring system in Labview
- Study discharges on super chamber



What is a discharge ?



Damages due to destructive discharge

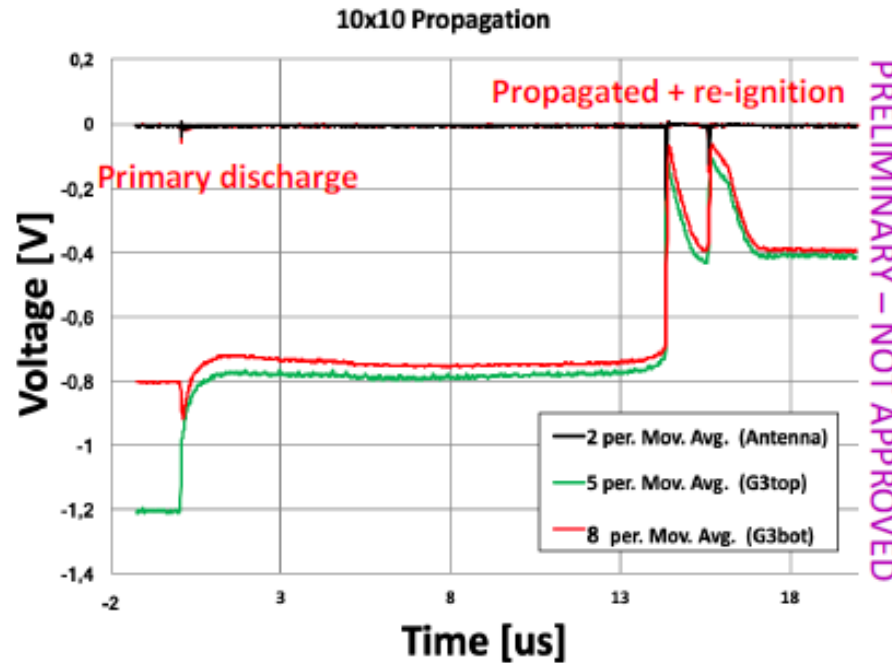
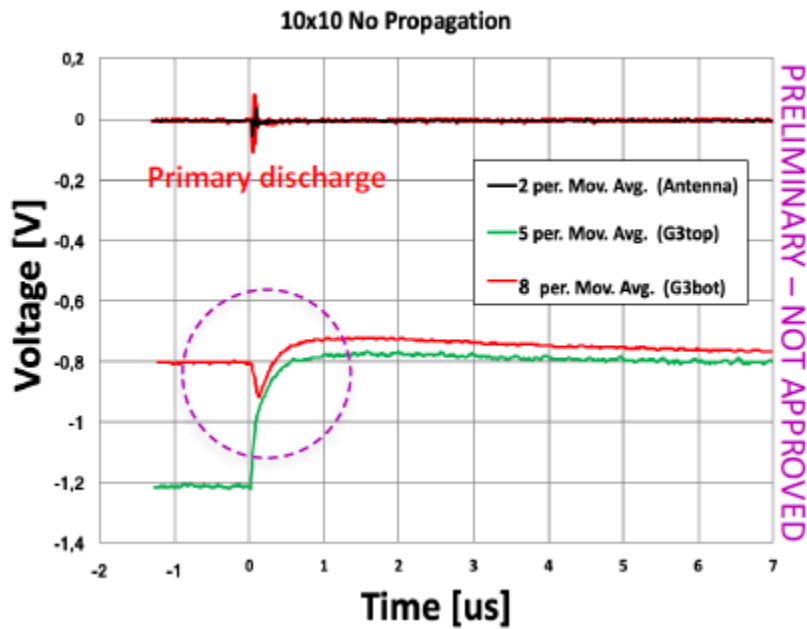
Discharge is a spark between the top and the bottom of the GEM foil.

A trip correspond at a complete discharge of the chamber.

Damages can appear when the total charge in the avalanche reaches critical value Q_{max} (Raether limit)

$$Q_{max} \approx 10^{-7} e^-$$

What is the goal ?



There are various kind of discharges:

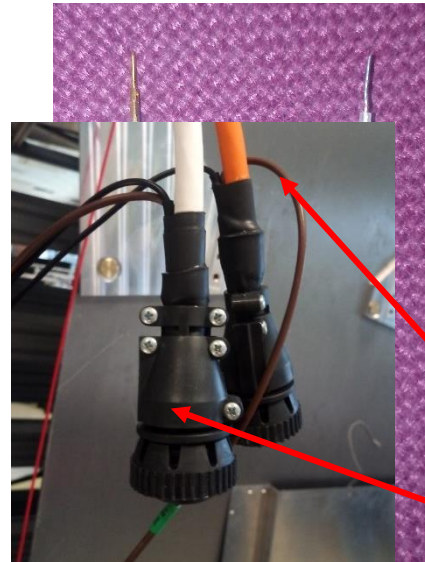
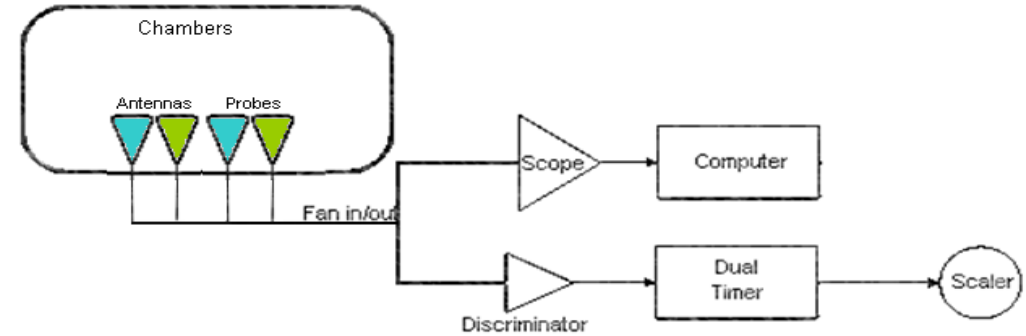
- Single discharge without re-ignition
- Multiples discharges w/wo reignitions
- Destructives discharges

The goal :

- Evaluate the discharge rate
- To know what kind of discharges are present
- How to decrease the number of discharges ?
- Collect data on several days, because discharges are not immediates.

The experiment

- Monitoring 2 antennas in order to save all the discharges
- Add antennas directly into the HV cable
- Use probes able to distinguish the nature of the discharge

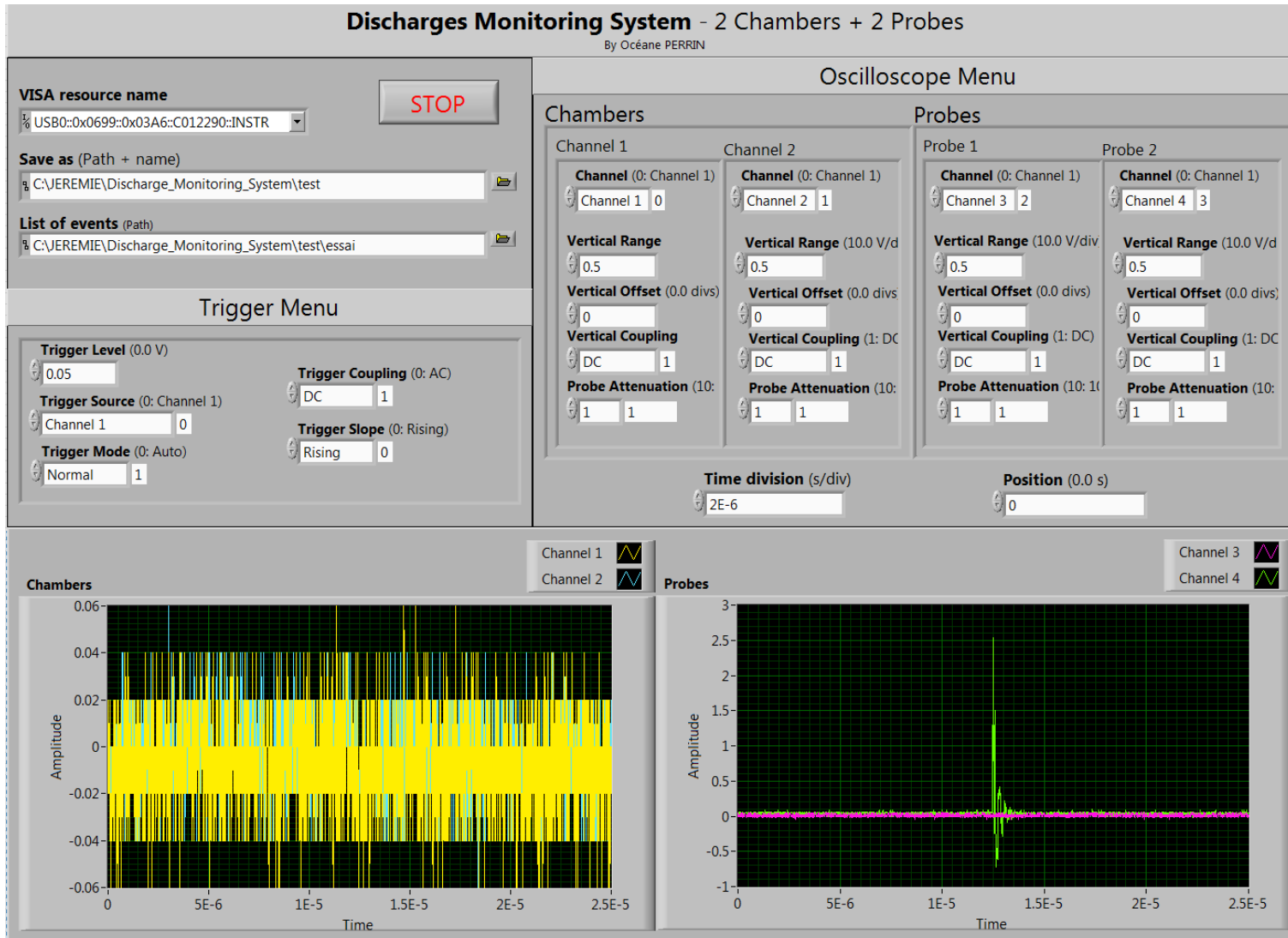


Antenna

High Voltage



The program



GE1/1-X-SCS-0007 :

- G11-X-S-CERN-0008
- G11-X-S-INDIA-0007

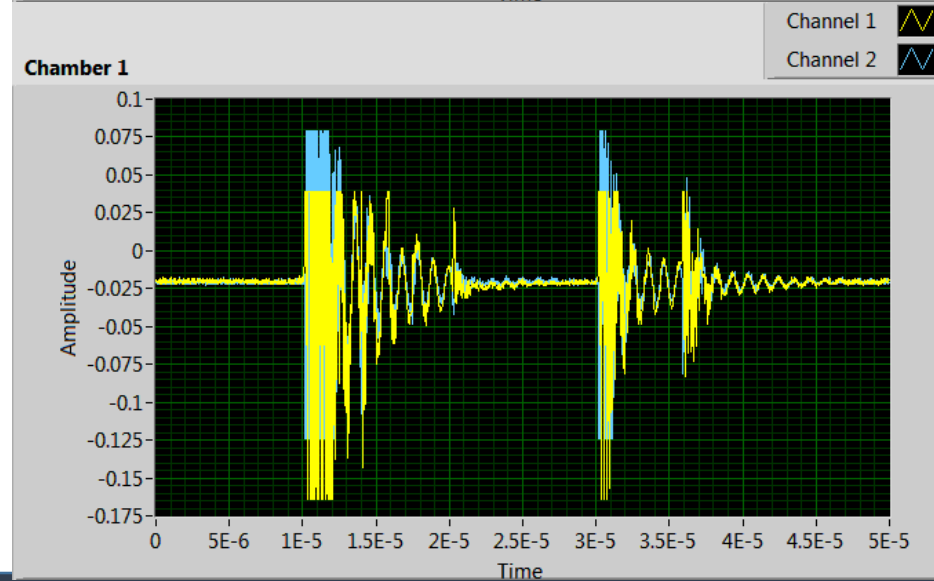
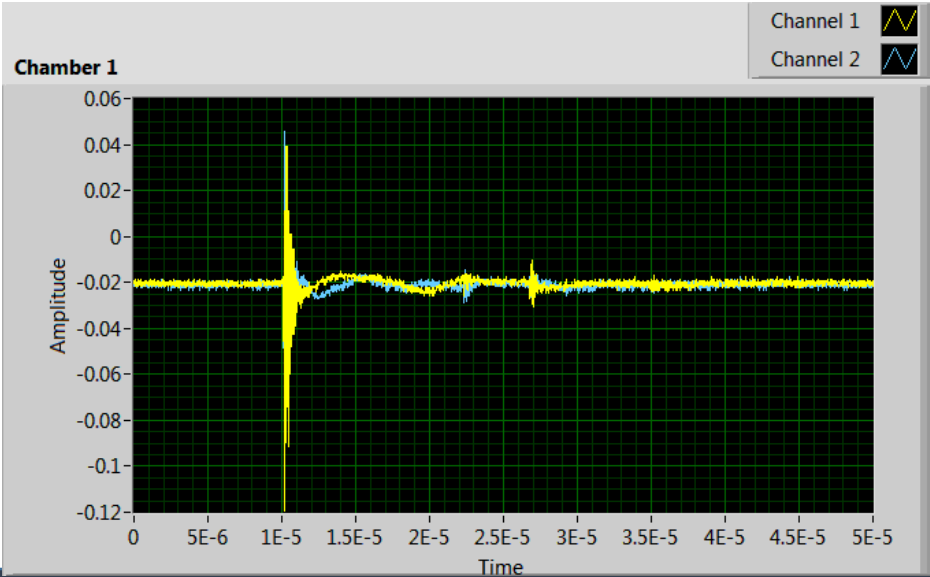
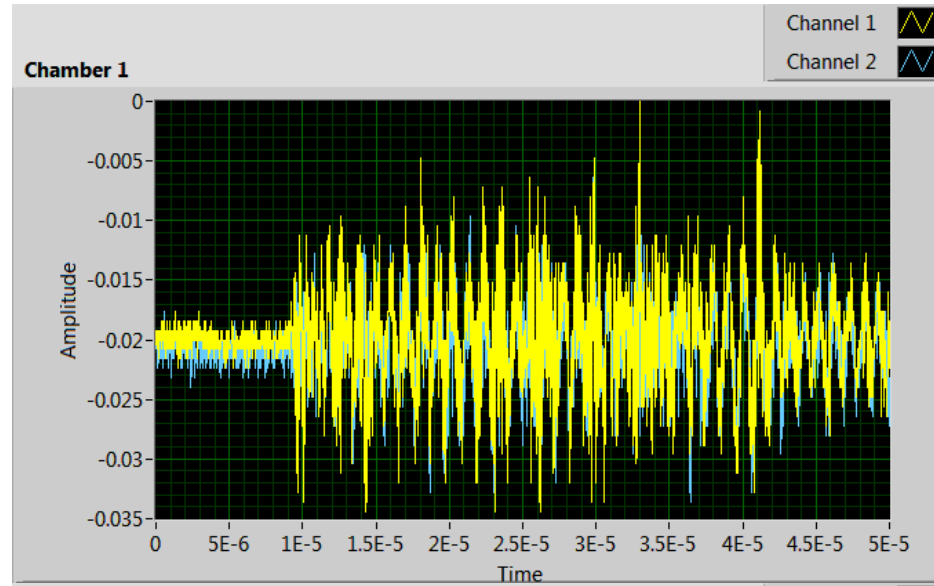
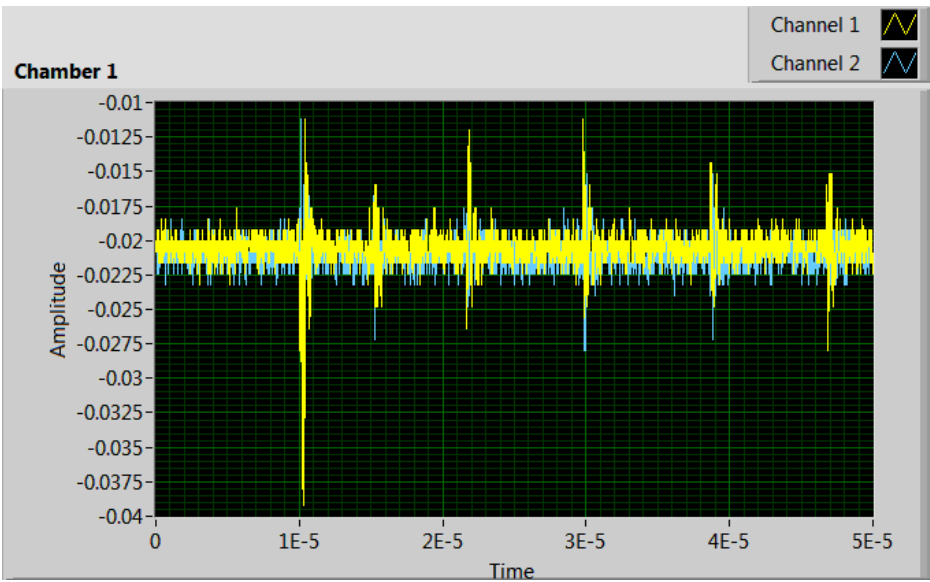
- Save data under .txt and .png
- Monitoring the trigger
- Monitoring the scope
- 2 graphs : one for the probes and one for the antennas

First Experiment:

From 03/07/19 to 08/07/19

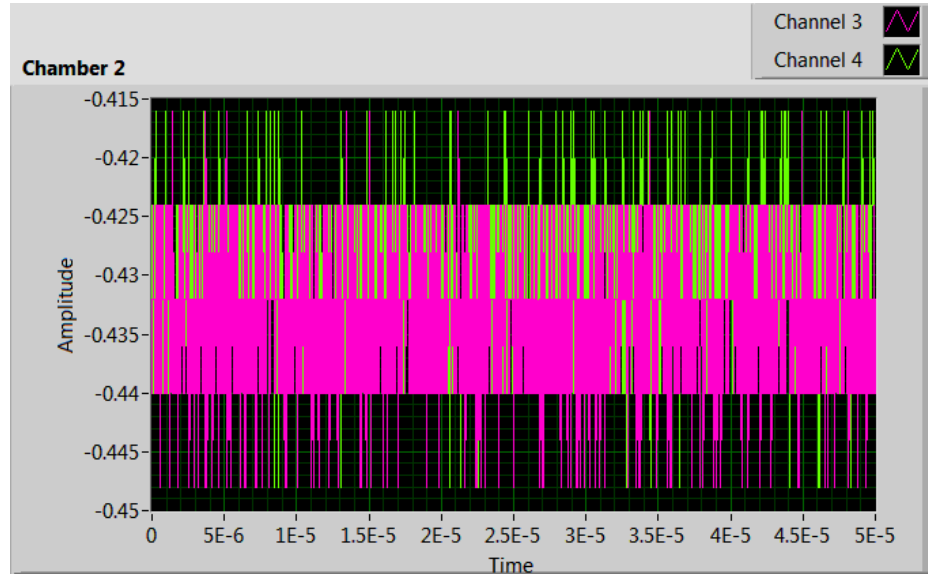
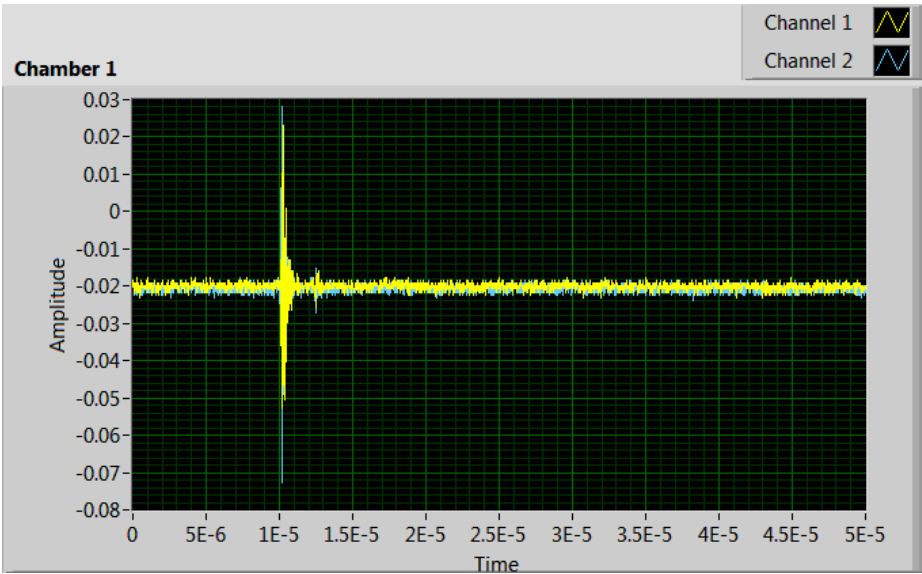
Exemple of noise/fake:

- No discharges
- Influence of the environment (plug USB key)
- Influence of the other chambers



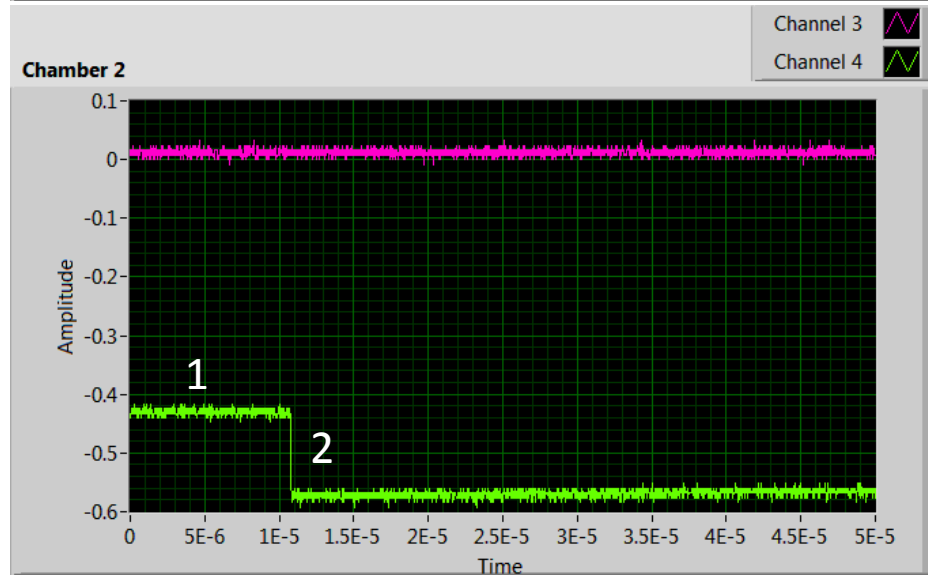
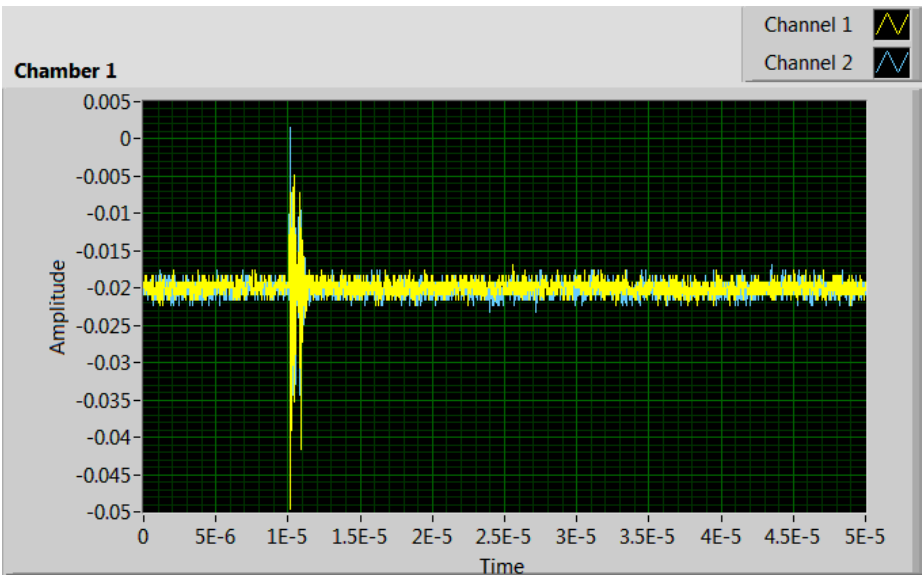
First Experiment:

From 03/07/19 to 08/07/19



Single discharge:

- No detected by the probes
- Append in GEM foil 3

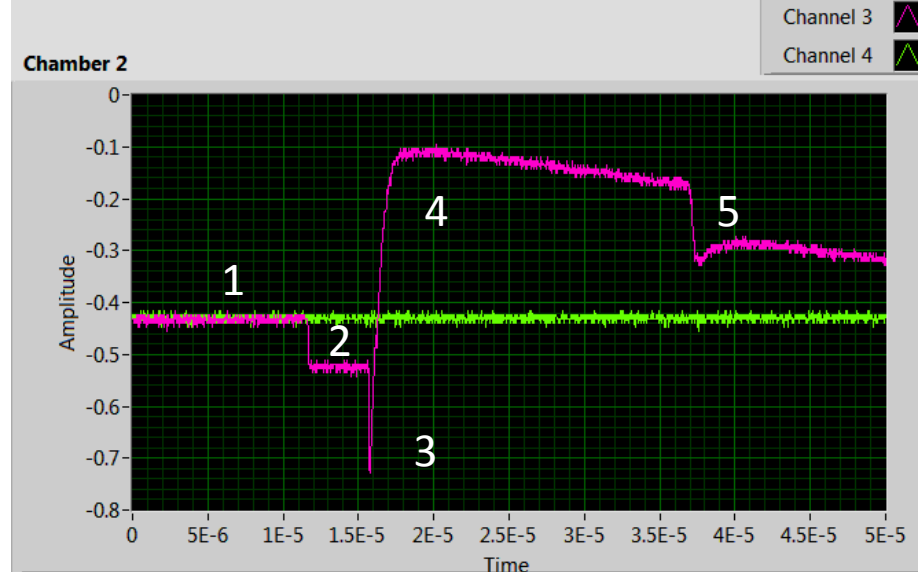
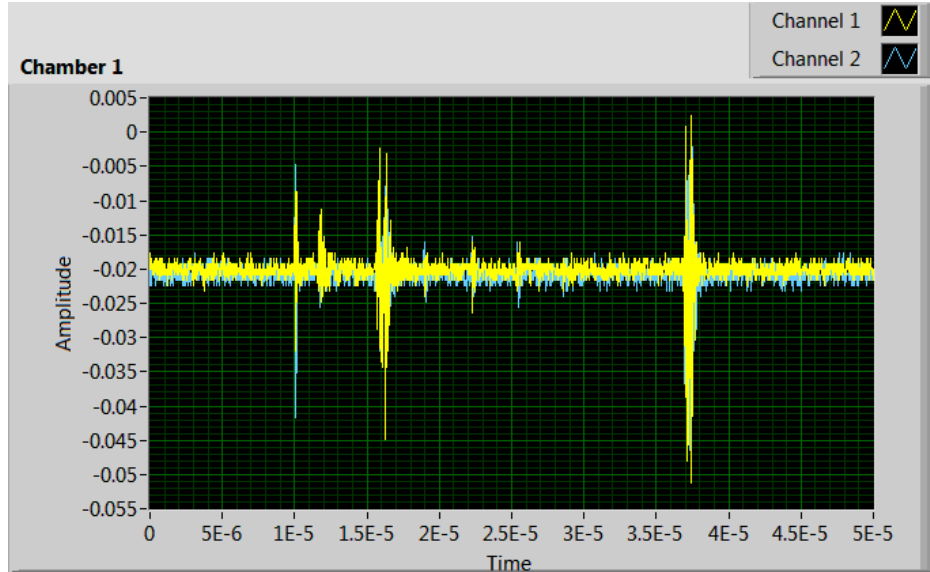
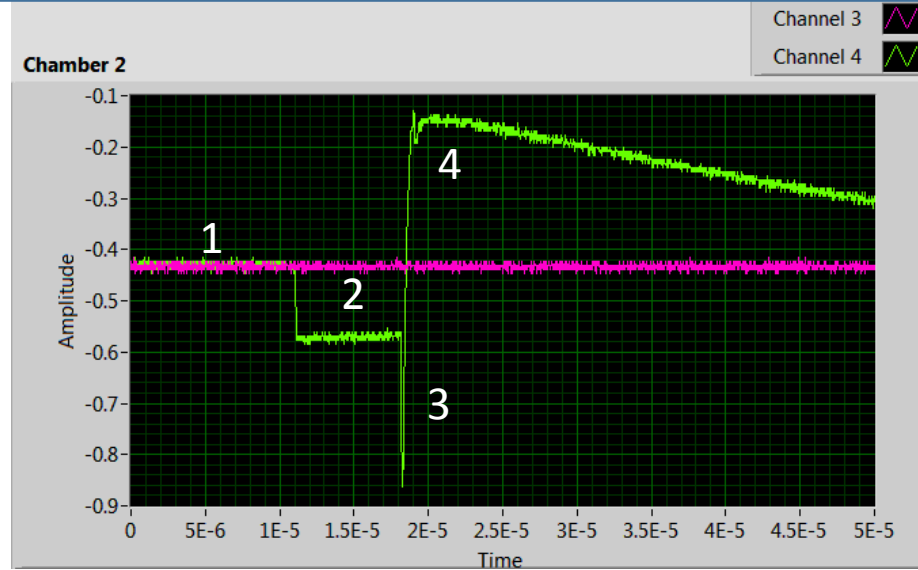
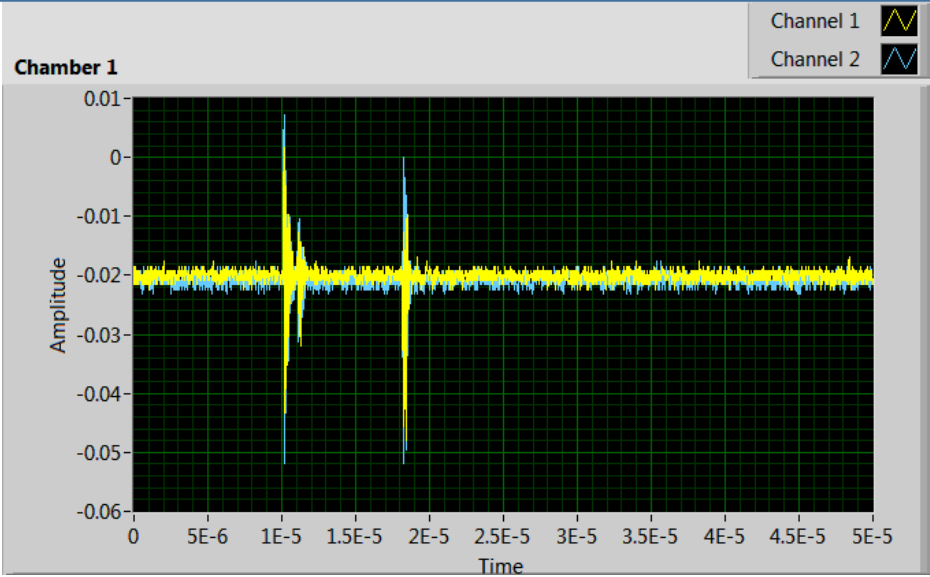


Multiples discharges:

- Append in GEM foil 3 then GEM foil 1 or 2

First Experiment:

From 03/07/19 to 08/07/19



Multiples discharges:

1. GEM foil
2. GEM foil 2 or 1
3. GEM foil 3
4. from GEM foil 3 to readout
5. A new discharge

5 steps discharge GEM foils, this is a trip. Sometimes 4 steps are enough to trip.

First Experiment:

From 03/07/19 to 08/07/19

Switch on	Switch off	Cern 0008	India 0007
04/07/2019 09:40	04/07/2019 12:51	3:11:00	3:11:00
04/07/2019 13:50	04/07/2019 20:15	31:04:00	6:25:00
05/07/2019 09:18	05/07/2019 19:22		10:04:00
	05/07/2019 20:54	45:47:00	41:37:00
06/07/2019 14:13	08/07/2019 07:50		0:27:00
08/07/2019 09:27	08/07/2019 09:54		0:25:00
08/07/2019 11:35	08/07/2019 12:00		
Total		80:02:00	62:09:00

Date	Trip	Fake	Discharge	
04/05/2019	2	25	28	± 3
05/07/2019	2	137	87	± 23
06/07/2019	1	22	23	± 5
07/07/2019	0	16	28	± 5
08/07/2019	2	26	19	± 5
Total	7	226	185	

Date	Discharge	Discharge Step 1+2	Step 1+2+3+4	Trip	Total
04/05/2019	24	1	1	2	28
05/07/2019	81	3	1	2	87
06/07/2019	20	1	1	1	23
07/07/2019	18	5	5	0	28
08/07/2019	15	1	1	2	19
Total	158	11	9	7	185

Comments:

- 1.5 trips per day
- 2 discharges per hours

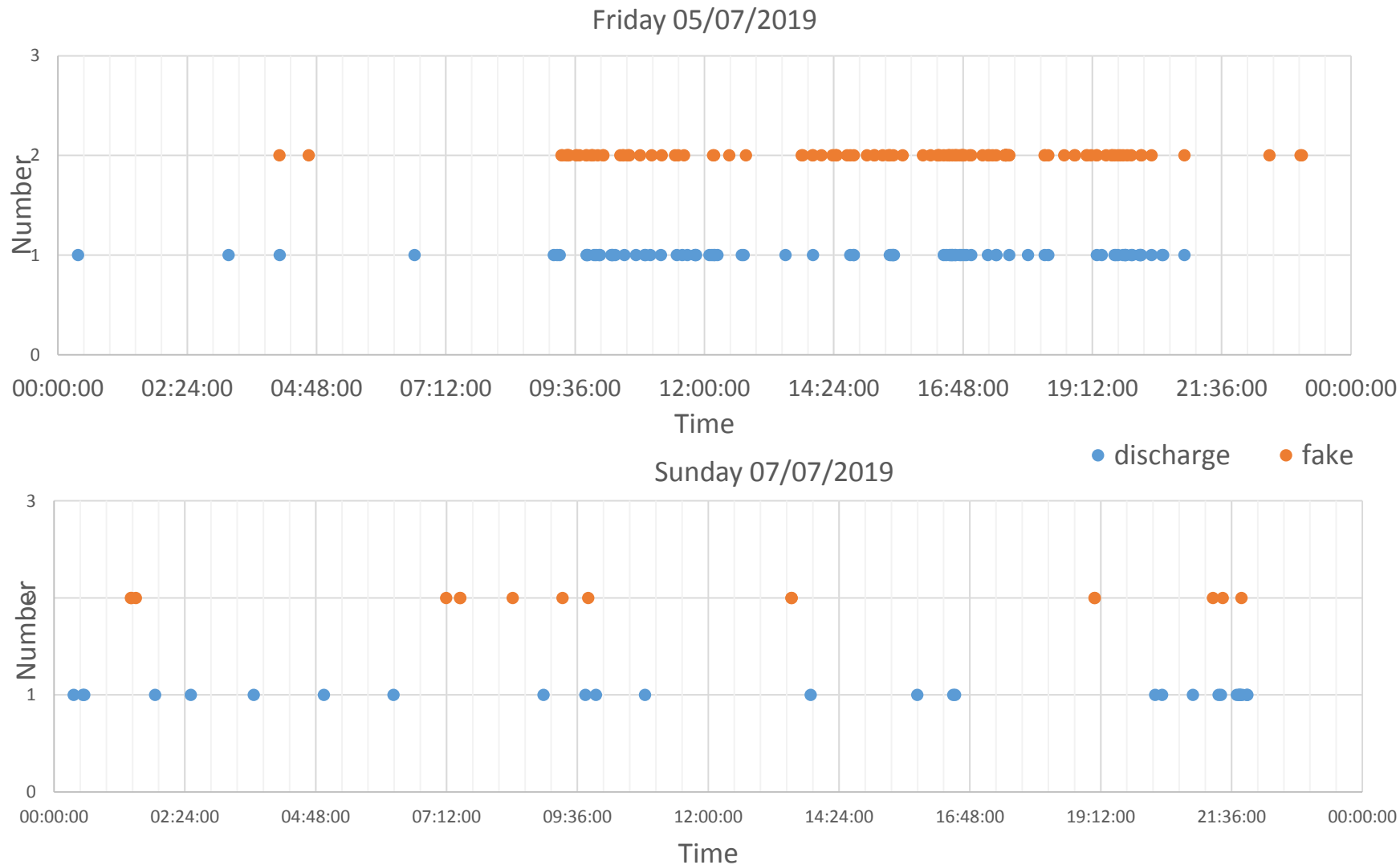
$R_{\text{discharge}}(\text{all det.}) \sim 1.1 \pm 0.17 \text{ [/hr]}$

$R_{\text{TRIP}} \sim 0.05 \text{ [/hr]}$

$R_{\text{fullPropa}}(\text{all det.}) \sim 0.06 \text{ [/hr]}$

First Experiment: additional remarks

From 03/07/19 to 08/07/19



Influence of the environment:

- The number of the discharge increases between 9am and 8pm.
- Comparaison with the data saved during the weekend.
- Try to explain it (air conditionning, lights...)

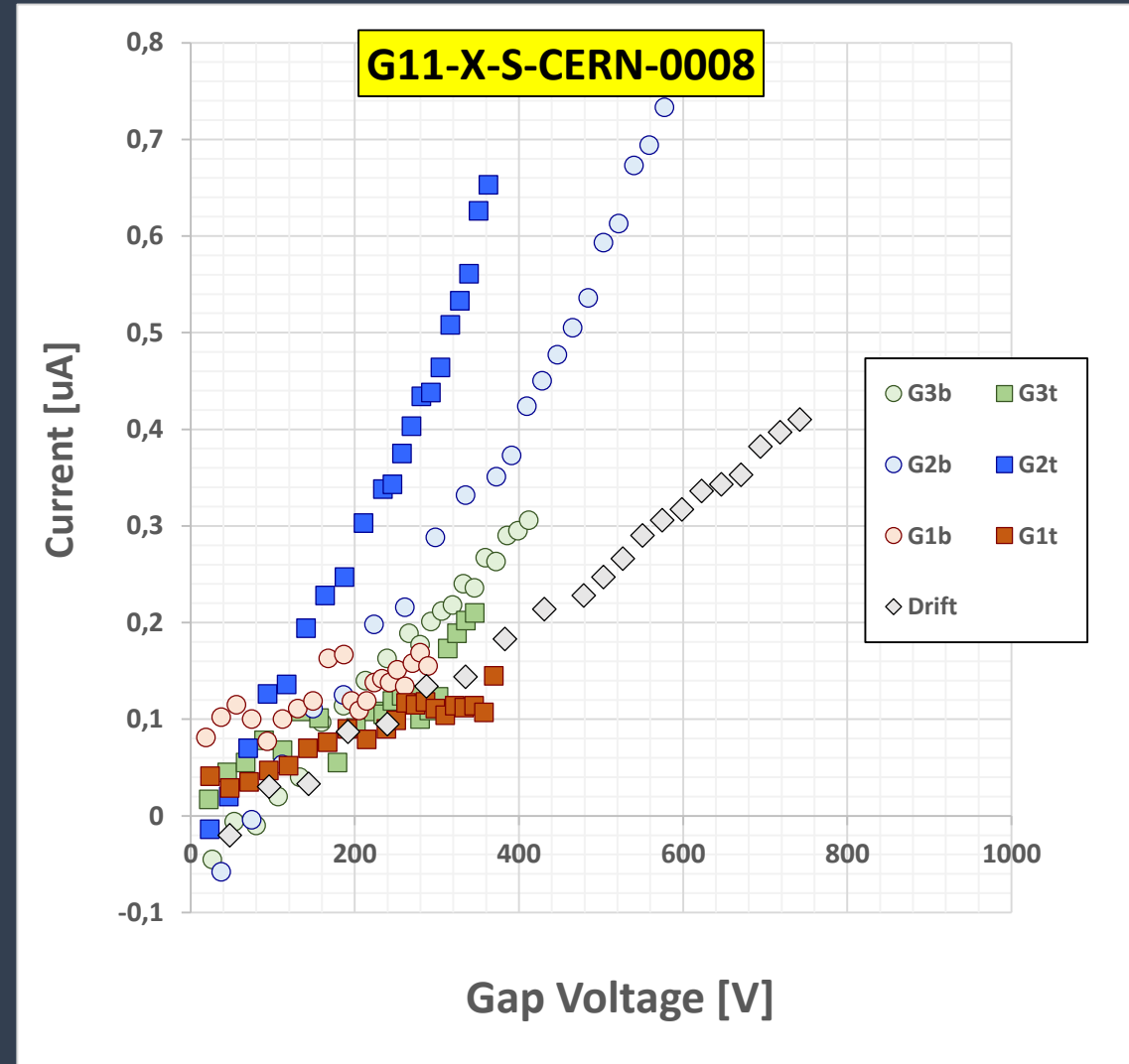
QC6 test

Sometimes we receive the GEM with little defects or the GEM can be contaminated by small dirts.

In order to « clean » the chamber, the chamber went to the QC6 test (see Margaux's presentation).

Everything was normal.

So we repeat the experiment.



Second Experiment:

From 17/07/19 to 22/07/19

Switch on	Switch off	Cern 0008	India 0007
17/07/2019 09:30	17/07/2019 12:32	10:22:00	3:02:00
17/07/2019 12:36	17/07/2019 19:52		119:54:00
18/07/2019 09:03	19/07/2019 14:57	29:54:00	
19/07/2019 15:44	22/07/2019 12:30	68:46:00	
123:00:00	Total	109:02:00	122:56:00

Date	Trip	Fake	Discharge		Total
17/07/2019	2	98	45	5	145
18/07/2019	0	455	76	11	531
19/07/2019	1	147	40	13	188
20/07/2019	0	22	15	2	37
21/07/2019	0	7	13	0	20
22/07/2019	0	56	21	4	77
Total	3	729	210		

Comments:

- 0.5 trip per day
- 1.7 discharges per hour

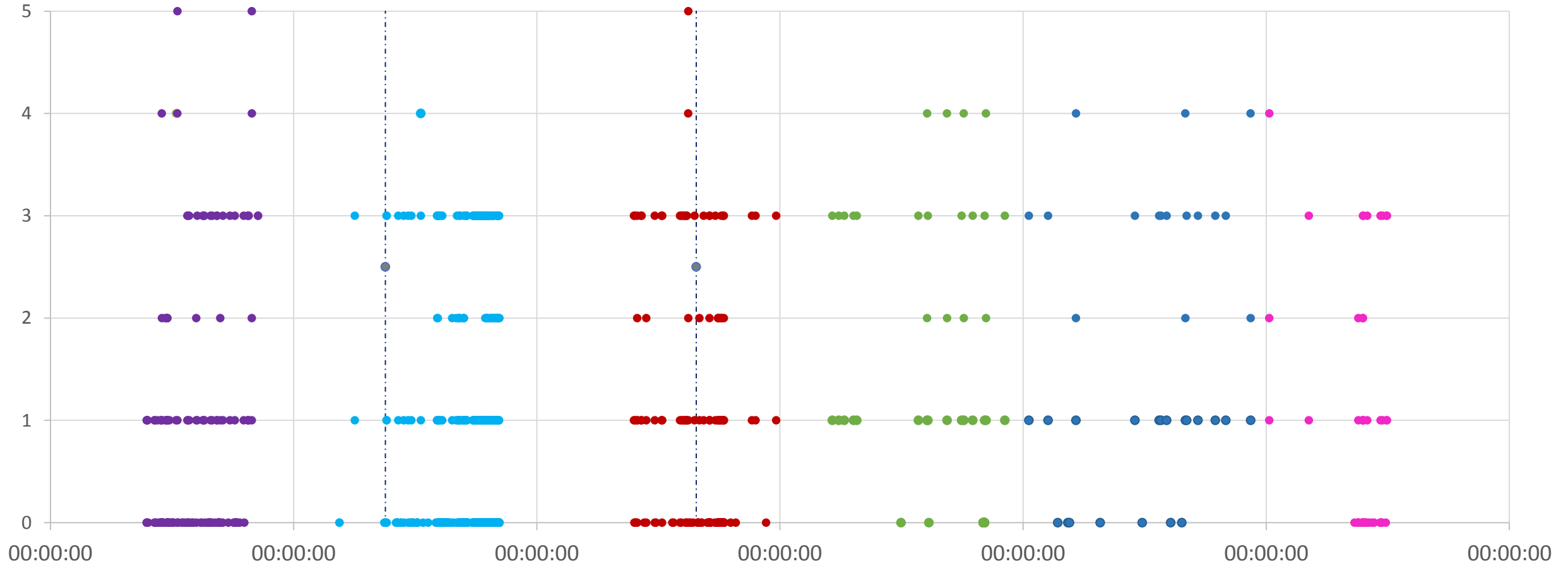
Date	Single	Multiples	Discharge Step 1+2	Discharge Step 1+2+3+4	Trip	4 Steps
17/07/2019	37	8	0	4	2	2
18/07/2019	62	14	1	0	0	0
19/07/2019	28	12	0	0	1	0
20/07/2019	11	4	4	0	0	0
21/07/2019	10	3	2	1	0	0
22/07/2019	16	5	1	0	0	0
Total	164	46	8	5	3	2

$R_{\text{discharge}}(\text{all det.}) \sim 0.9 \pm 0.14 \text{ [hr]}$
 $R_{\text{TRIP}} \sim 0.01 \text{ [hr]} \text{ (factor } \sim 5 \text{ less)}$
 $R_{\text{fullPropa}}(\text{all det.}) \sim 0.02 \text{ [hr]} \text{ (factor } \sim 3 \text{ less)}$

Second Experiment:

From 17/07/19 to 22/07/19

ran for 123h : 0= Fake ; 1= Discharge ; 2= Multiples ; 3 = Single ; 4 = Probe ; 5 = Trip



● 17.07 ● 18.07 ● 19.07 ● Power on - CERN ● 20.7 ● 21,07 ● 22.07 ● Probe

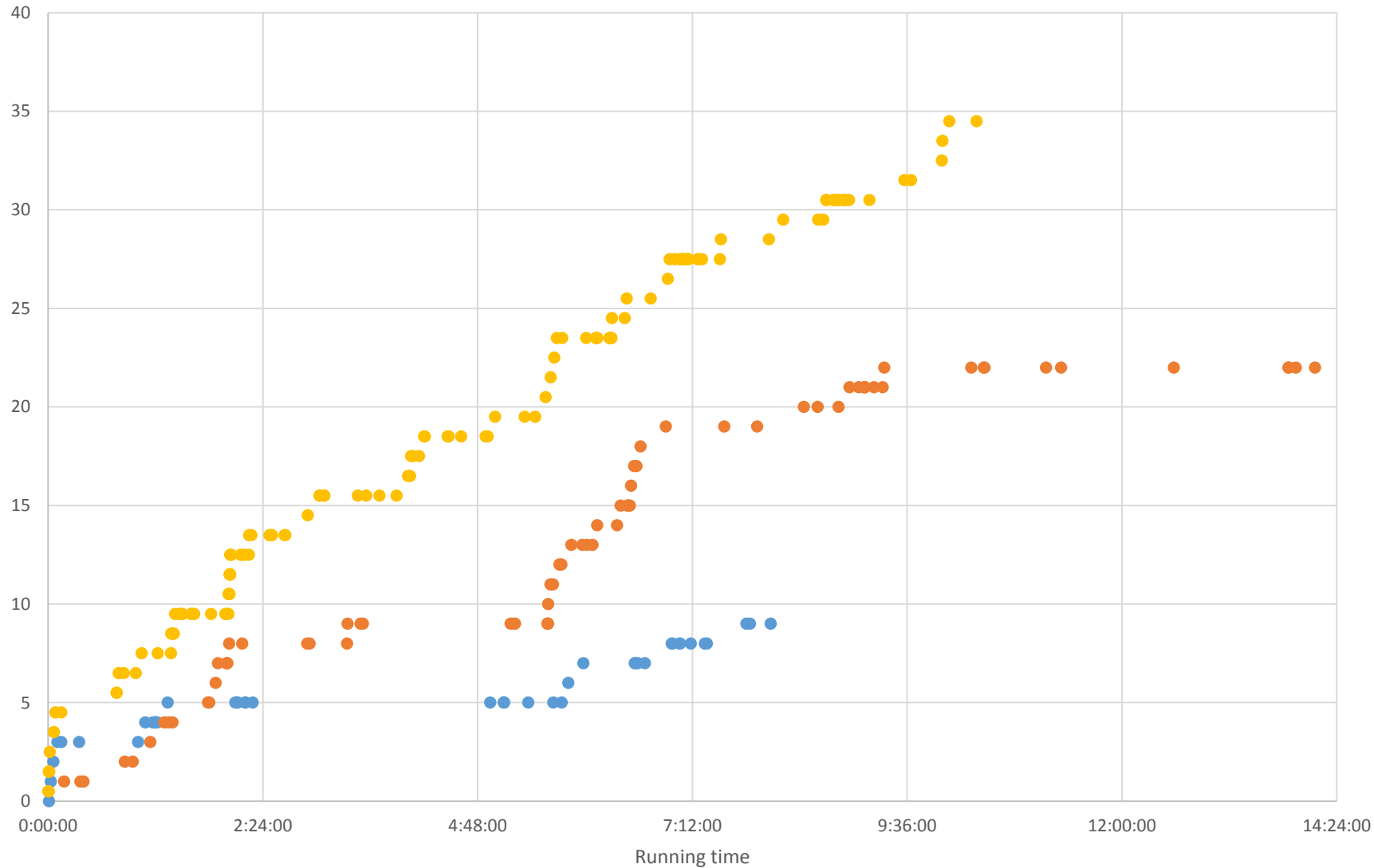
Conclusion:

Discharges can be destructives for the GEM and the electronics.
The experiment shows that the QC6 test is efficient to decrease the number of discharge.
We distinguished various kind of discharges (without reignitions).
But the experiment shows an influence of the environment (only in the lab).

On going work : try to explain this influence.

Thank you !

Second Experiment: after QC6 Test



Evolution of the number of discharges since the chambers have been running.

● 23,07
● 24,07
● 17,07

Observations:
Quickly increase of the number just after the start-up.