Tests on RPC6: F⁻deposit

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ECOGAS@GIF++ COLLABORATION



Detectors status

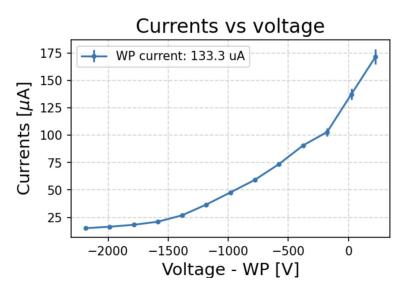


RPC 6, Eff: 80.99 %, SP: 0.76 %, WP: 10435 V RPC 6, IC4H10/R134A/SF6 - 4.5/95.2/0.3 1.0 1.0 0.8 0.8 Streamer Probability ~ 50% efficiency at Efficiency (%) 0.6 9600 V 0.2 0.2 0.0 0.0 8500 9000 9500 10000 10500 Voltage (V)

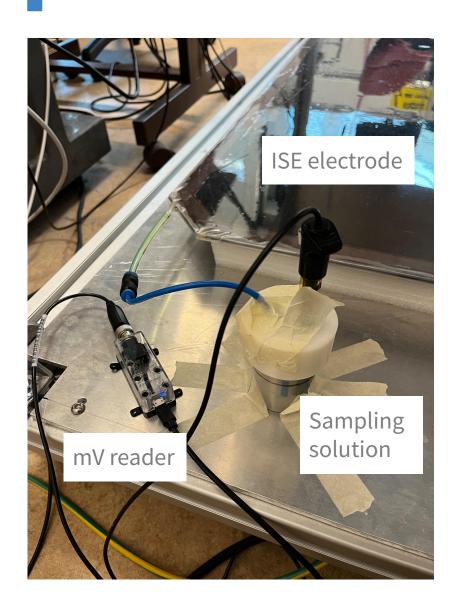
Integrated a total of 300 mC/cm²

Detector dismounted and tested in the lab with cosmic muons

Data taken with STD gas mixture in April 2023



Setup and test idea



Goals of the tests:

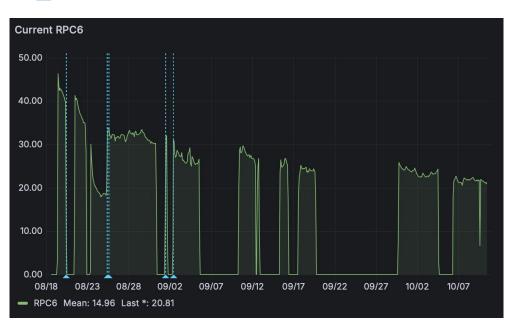
- Determine the <u>time required</u> to remove the F- deposit from the gas gap
- Investigate the difference between the <u>detector on and off condition</u>
- Study the correlation <u>between F-removal and the detector current</u>

The detector is flowed with **pure argon**, not humidified at 1 ln/h

All detector's exhaust is left bubbling in the sampling solution.

Electrode calibration performed periodically

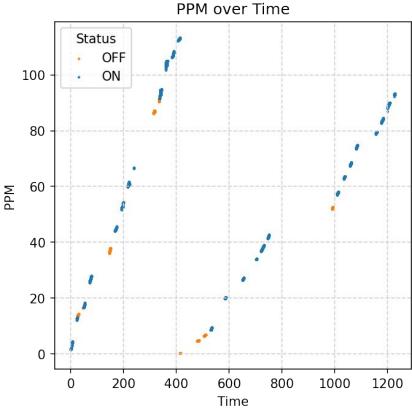
Data Overview





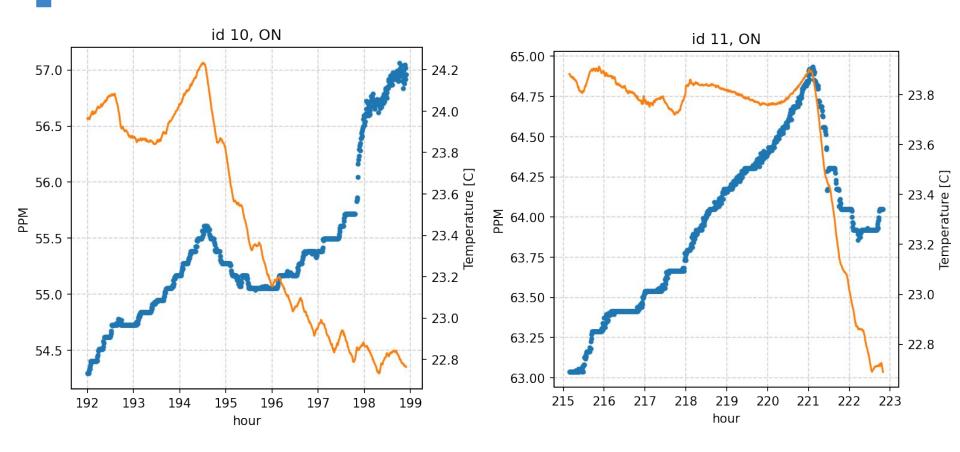
the HV was selected to have initially around 40 uA (2175 V)

The electrode is left in the solution for 6-7 h/day



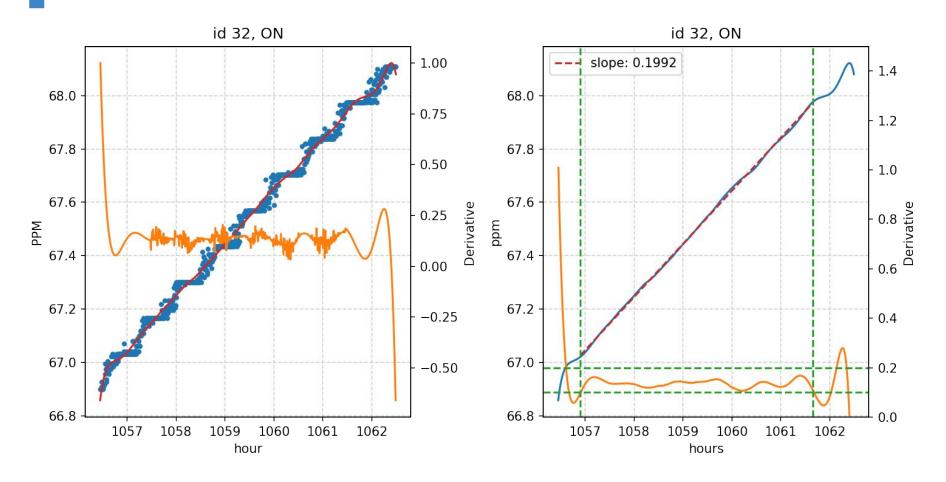
For each measurements, a linear fit was considered to extract PPM/h, selecting the dataset for which the temperature remains stable (+- 0.2 °C wrt mean)

Temperature dependence



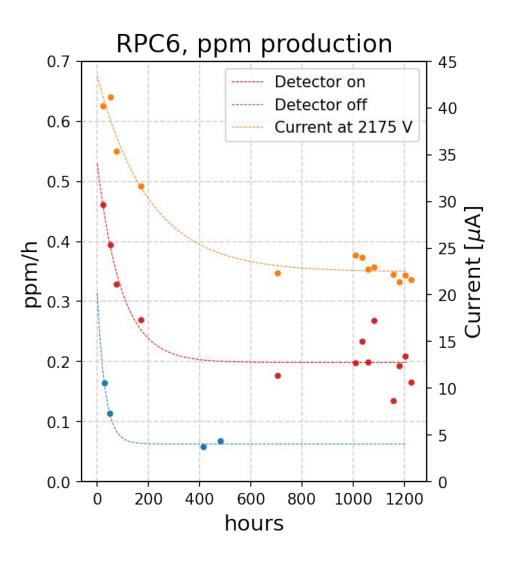
- 1. The measurements is influenced by the laboratory environment
- 2. Future tests with a fixed ppm solution could study the correlation between temperature and measurements, allowing to perform a correction on the data
- 3. For this reason, some interval are not considered in this analysis

Data Example



- 1. Applying Savgol filter to smooth the data
- 2. Computing the derivative + smoothing
- 3. Selecting the bigger interval with the stable derivative (within 0.1)
- 4. Perform a linear fit and extract the slope on the selected interval

Data Results



- The detector ON condition allows faster removal of F- compared to the OFF condition
- The removal rate stabilizes at around 0.2 ppm/h, indicating a constant Fremoval after 600 hours
- The detector current decreases with a similar trend to the F- removal rate, suggesting a linear correlation between the current and the removal rate, even in the absence of fluorinated gases

Future tests

- This test demonstrates the feasibility of quantifying the amount of F- accumulated on the detector surface and the possibility of correlating its removal with the detector current
- After these measurements, the detector will be re-tested with the standard gas mixture to verify any improvement in performance
- The test could also be repeated using a working detector on the ECOGAS trolley, to verify this effect, including tests with humidified argon

Overall, these tests confirm the results previously observed in the ALICE gas system, while providing a better understanding of the phenomenon and its timescale.

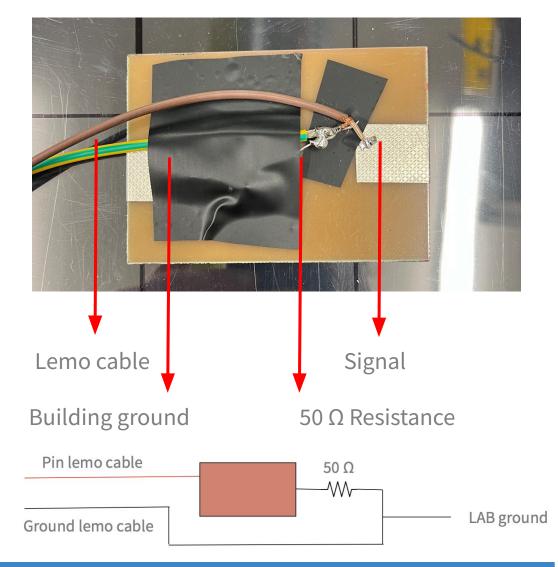
Backup



Set up



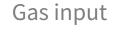
- RPC divided into 9x10 square
- Used digitizer 1730 Desktop for the acquisition

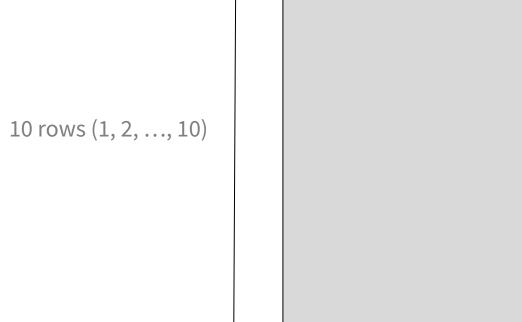




Set up

9 columns (A, B, ..., I)







Plot available here

Gas output

Rate gradient



Rate gradient



| Rate: |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 96.4 | 255.1 | 429.6 | 51.1 | 15.2 | 9.8 | 83.7 | 426.2 | 293.4 |
| Hz/cm2 |
| Rate: |
| 438.2 | 59.8 | 234.9 | 435.3 | 437.2 | 435.7 | 432.1 | 69.2 | 422.8 |
| Hz/cm2 |
| Rate: |
| 30.0 | 0.1 | 0.6 | 1.9 | 2.4 | 4.8 | 28.3 | 286.0 | 435.6 |
| Hz/cm2 |
| Rate: |
| 4.8 | 0.4 | 0.8 | 4.4 | 4.2 | 18.1 | 4.2 | 0.7 | 1.8 |
| Hz/cm2 |
| Rate: |
| 0.3 | 12.5 | 0.1 | 34.7 | nan | 0.5 | 0.3 | 25.5 | 60.7 |
| Hz/cm2 |
| Rate: |
| 1.8 | 47.6 | 73.2 | 6.6 | 2.9 | 6.6 | 0.7 | 121.6 | 3.9 |
| Hz/cm2 |
| Rate: |
| 3.9 | 0.1 | 2.3 | 2.7 | 4.1 | 10.5 | 1.5 | 1.1 | 2.9 |
| Hz/cm2 |
| Rate: |
| 16.0 | 1.0 | 8.4 | 38.1 | 3.5 | 9.4 | 1.0 | 0.3 | 1.9 |
| Hz/cm2 |
| Rate: |
| 60.4 | 16.1 | 0.2 | 0.1 | 0.3 | 8.8 | 3.6 | 0.7 | 5.3 |
| Hz/cm2 |
| Rate: |
| 54.2 | 71.2 | 1.5 | 0.4 | 1.0 | 2.7 | 8.8 | 3.2 | 11.1 |
| Hz/cm2 |

	Rate:								
	421.8	340.9	402.9	281.2	2.6	6.8	141.9	328.2	434.6
	Hz/cm2								
- 400	Rate:								
	29.8	6.7	409.7	70.2	44.9	11.2	12.5	300.7	433.1
	Hz/cm2								
- 350	Rate:								
	72.6	0.1	0.2	0.5	1.0	436.3	432.2	434.0	435.3
	Hz/cm2								
- 300	Rate:								
	5.1	0.6	0.2	1.9	11.7	13.6	9.5	3.3	71.8
	Hz/cm2								
- 250	Rate:								
	1.0	38.1	25.7	236.0	145.5	1.4	2.7	32.8	117.0
	Hz/cm2								
- 200	Rate:								
	3.2	3.2	52.1	5.1	10.2	36.4	3.8	91.1	4.7
	Hz/cm2								
- 150	Rate:								
	4.7	0.7	22.5	15.6	5.1	18.5	3.8	5.2	10.0
	Hz/cm2								
- 100	Rate:								
	11.9	1.3	1.1	3.0	6.3	3.1	52.0	1.3	12.6
	Hz/cm2								
- 50	Rate:								
	42.7	26.1	1.1	0.6	51.5	36.7	12.4	2.9	3.8
	Hz/cm2								
	Rate:								
	85.1	85.2	16.4	0.6	1.2	6.1	1.5	1.6	13.1
	Hz/cm2								



