RPC Gas system report

2nd RPC general meeting

L. Benussi

Istituto Nazionale di Fisica Nucleare - Lab. Nazionali di Frascati

Contents

- Result from the 2011 gas leak search campaign
- Preliminary result from GGM about SF6 saga

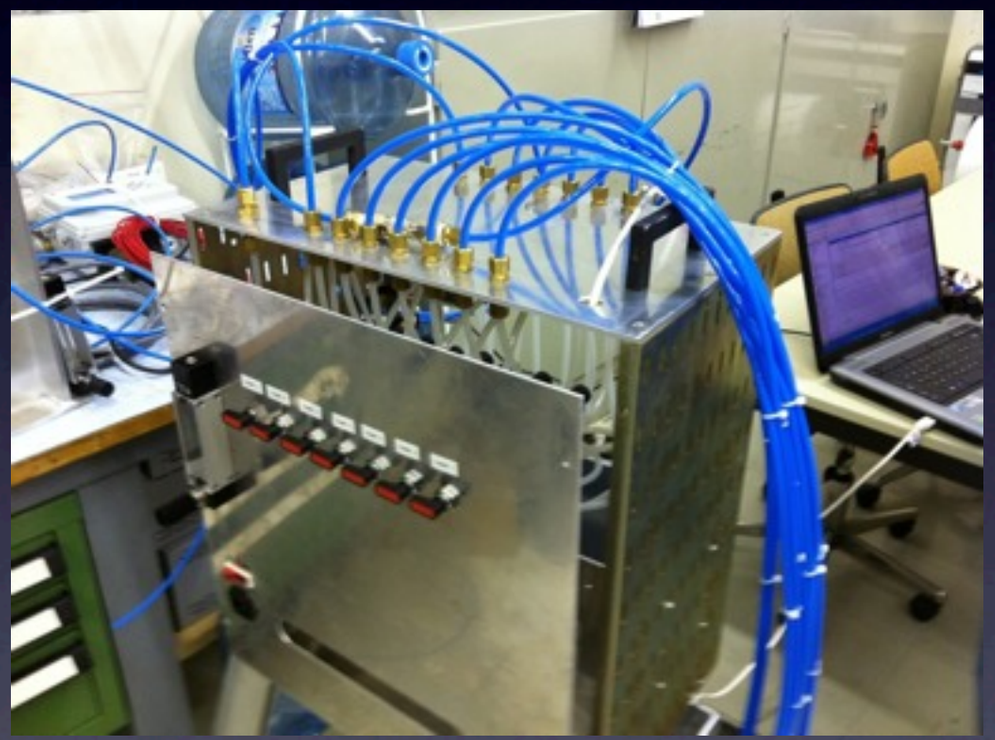
First let me thanks....

Angelo Vicini for building up the leak box
Nicola Lacalamita and Michele Franco for helping us into the 2011 test.

Also Anna, Nicolas and Ian that helped in the data taking.
Also Roberto...as our reference in all gas issues

2011 Gas leak search setup

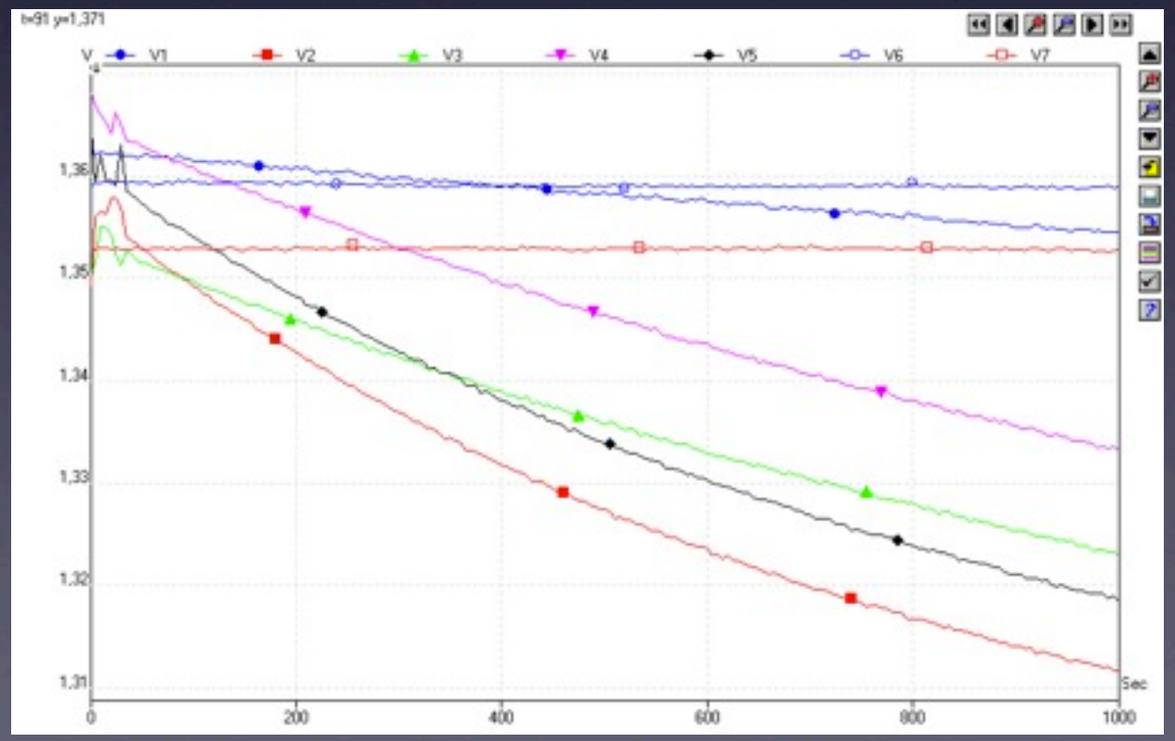
- Used a 7 channels leak box which allow to pressurize each chamber up to 5 mbar
- used pure Argon to pressurize chambers

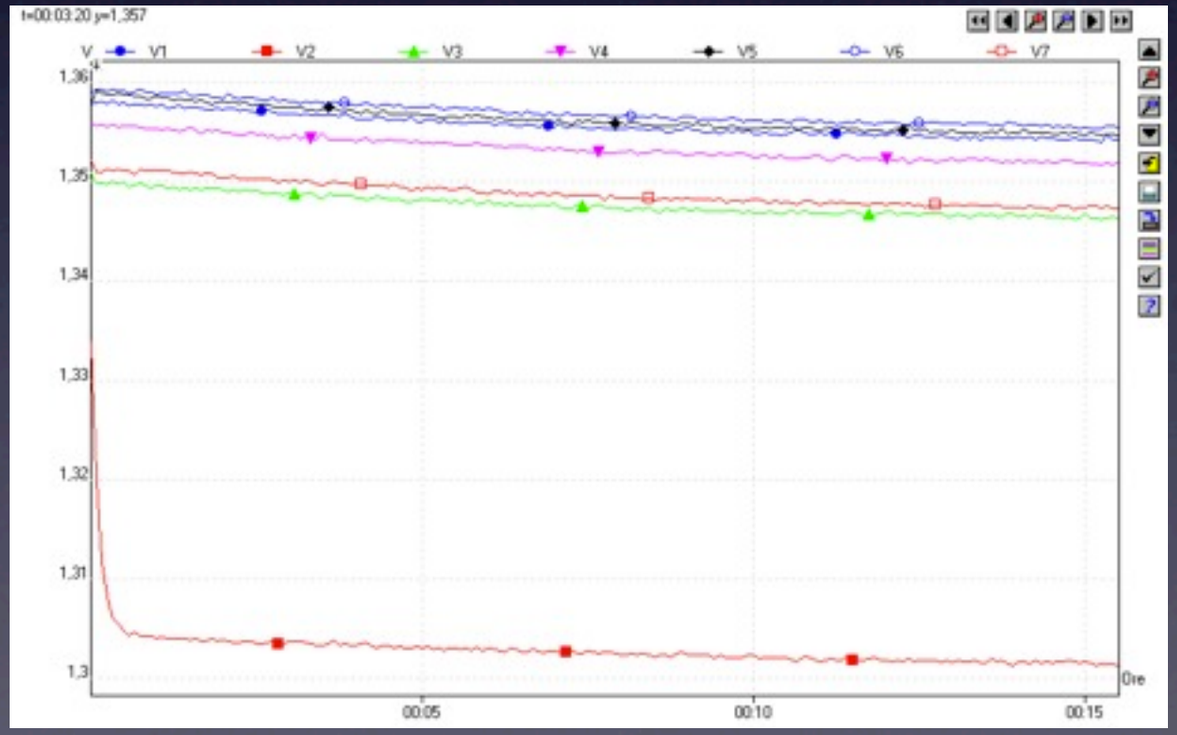


Pressure sensors (one for each channel) acquired with a PICO data logger

2011 Gas leak search setup

- The measurement protocol:
  - flux chambers with Ar for at least 2 hours
  - unplug the manifold lines to and from chamber
  - plug the leak box line to the chambers in and out pipes
  - plug the Ar pipe to the main input of the leak box
  - pressurize the chamber up to 5 mbar and close the Ar flux
  - Start the data recording.





2011 Gas leak search results

- To estimate the leak I used the following formula:
  Leak= Vx(Pi-Pf)/(Tf-Ti)xPi/Patm

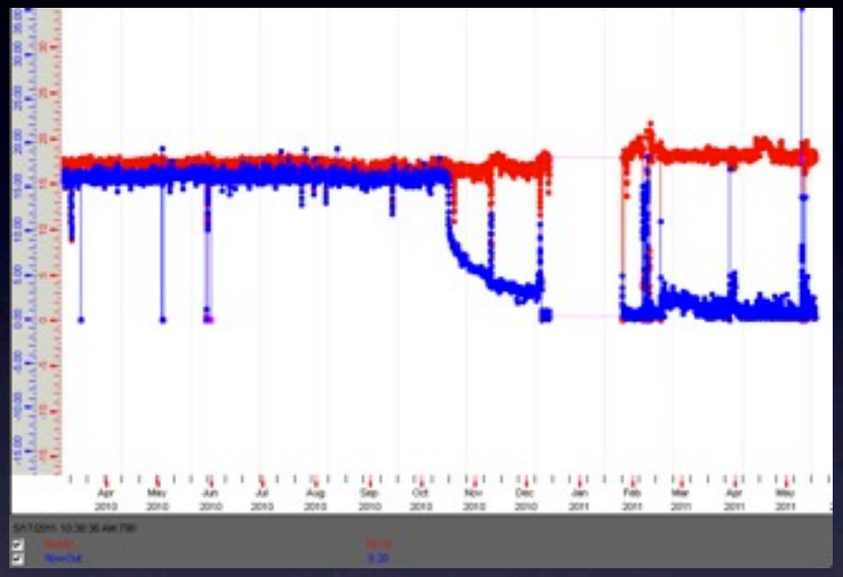
  assuming Tatm constant during the measurement

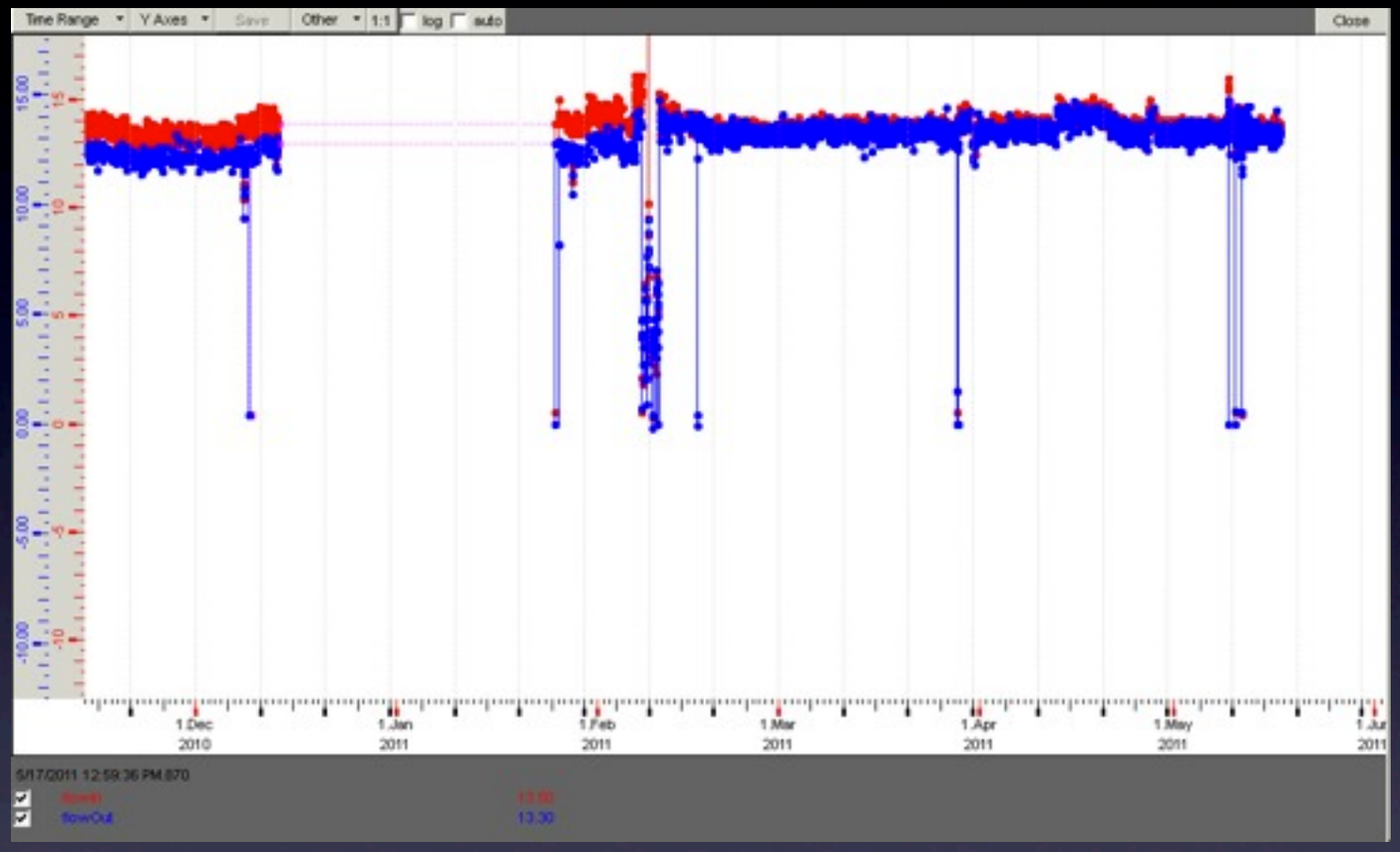
  “Some” number on the next slides....only for barrel...similar table also for endcap

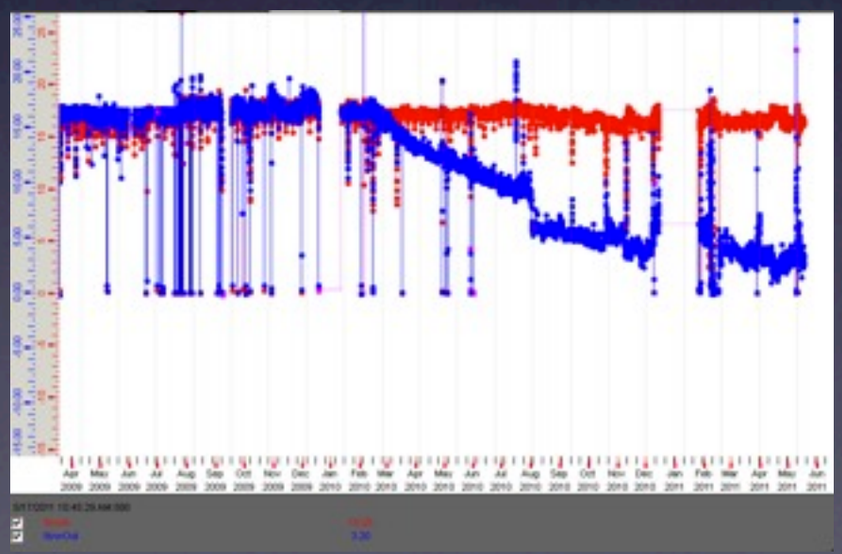
manifold ID	W+2 2011	W+2 2007	W+1 2011	W+1 2007	W0 2011	W0 2007	W-1 2011	W-1 2007	W-2 2011	W-2 2007	RPC Barrel total leak rate
1	-0.026	0.006	-0.013	0.000	-0.016	0.000	-0.018	0.007	-0.020	0.004	
2	-0.018	0.006	-0.013	3.754	-0.023	30.055	-20.600	0.008	-0.020	0.004	
3	-0.032	0.006	-0.016	0.006	-0.029	0.003	-0.022	-0.023	-0.025	0.005	
4	-0.032	0.006	-0.016	0.006	-0.019	18.917	-0.011	0.005	-0.033	0.021	
5	-0.027	0.028	-0.010	0.017	-15.700	1.409	-0.007	-0.001	-0.015	-0.002	
6	-0.020	0.393	-0.020	0.050	-0.012	1.382	-0.014	-0.000	-0.015	0.003	
7	-0.028	0.000	-0.041	0.000	-0.016	0.000	-0.019	0.002	-0.028	14.000	
8	-0.007	0.000	0.000	0.000	0.000	14.000	0.000	0.028	0.000	0.002	
9	-20.600	0.006	0.000	0.006	0.000	0.014	-0.008	0.003	0.000	0.003	
10	-0.007	0.000	0.000	0.017	0.000	0.002	0.000	0.002	-0.009	0.765	
11	-0.008	0.006	0.000	0.000	-0.056	0.120	-0.010	0.010	0.000	0.009	
12	-25.400	0.017	0.000	0.000	0.000	0.011	-25.400	0.006	0.000	14.000	
13	0.000	0.011	0.000	0.006	0.000	0.003	-15.700	0.006	0.000	0.011	
14	-0.045	0.017	0.000	0.000	0.000	14.000	-15.700	-0.005	0.000	0.009	
15	-0.003	0.006	-0.031	0.000	0.000	0.032	-0.015	0.003	0.000	0.001	
16	-0.003	0.011	-0.008	0.000	0.000	0.003	0.000	0.007	0.000	0.001	
17	-0.003	0.006	-0.008	0.000	-0.084	14.000	0.000	-0.000	0.000	0.011	
18	-0.003	0.011	-0.007	0.006	0.000	0.005	0.000	0.002	0.000	0.008	
19	-0.003	3.975	-0.007	0.000	0.000	0.001	-20.600	0.002	-20.600	0.004	
20	-0.004	0.006	0.000	0.000	0.000	0.002	0.000	0.006	0.000	0.006	
21	-25.400	0.006	0.000	0.006	-25.400	0.002	-25.400	0.004	0.000	0.000	
22	-0.007	0.017	-0.005	14.000	-15.700	0.001	0.000	0.000	0.000	0.010	
23	0.000	0.006	0.000	0.000	-0.003	0.000	-0.002	0.047	0.000	-0.021	
24	0.000	0.000	-0.006	0.000	0.000	0.000	-0.001	0.009	0.000	14.000	
25	0.000	0.000	0.000	0.000	-0.004	-0.000	0.000	0.006	0.000	0.021	
26	-0.009	0.006	0.000	0.006	0.000	0.003	-0.003	0.002	-0.009	0.016	
27	0.000	0.022	0.000	3.092	0.000	0.002	-0.005	0.010	0.000	0.005	
28	-25.400	0.039	-0.008	0.006	0.000	0.001	-0.003	0.145	-0.043	0.307	
29	0.000	0.006	-0.004	0.006	-0.010	0.007	-0.011	0.003	-0.012	0.132	
30	-0.009	0.011	0.000	0.000	-15.700	14.144	0.000	0.036	0.000	0.009	
31	-0.004	0.006	0.000	0.006	-0.006	0.005	0.000	0.004	0.000	0.004	
32	-0.006	0.017	0.000	0.000	0.000	0.006	-0.010	0.021	0.000	0.002	
33	0.000	0.011	0.000	0.006	-0.004	0.002	0.000	0.005	-0.005	0.006	
34	0.000	0.000	-0.081	14.000	0.000	-0.001	-0.009	0.003	0.000	0.007	
35	-0.011	0.006	0.000	0.167	-0.008	0.000	-0.009	14.000	0.000	-0.001	
36	0.000	0.006	-0.009	0.265	0.000	0.000	-0.018	0.006	-25.400	0.001	
37	0.000	3.313	-0.018	0.039	-0.010	0.000	-0.018	14.000	-0.004	0.100	
38	0.000	0.006	0.000	0.011	0.000	-0.000	-0.011	0.005	-15.700	0.007	
39	-0.117	14.360	0.000	0.011	-0.006	0.003	0.000	14.000	-0.002	0.009	
40	-0.006	0.011	-0.008	0.006	0.000	-0.001	0.000	0.000	-0.002	0.008	
41	-21.700	0.017	0.000	0.067	-0.009	0.006	0.000	-0.003	-0.003	0.003	
42	0.000	14.360	-0.070	5.300	0.000	0.004	-21.700	-0.003	-0.001	0.001	
43	0.000	0.006	-0.044	0.011	-0.048	0.000	-0.056	0.005	0.000	0.003	
44	0.000	0.011	-0.017	0.006	-0.169	0.316	0.000	0.006	0.000	0.003	
45	0.000	0.011	-0.027	14.000	-0.067	0.000	0.000	0.001	0.000	0.756	
46	0.000	0.011	-0.027	0.006	-0.059	0.001	-0.017	0.002	-0.012	-0.006	
47	0.000	0.006	-0.017	0.006	-0.009	0.000	-0.011	0.001	-0.007	0.003	
48	0.000	0.011	-0.021	0.017	-0.009	0.000	-0.011	0.022	-0.007	0.204	
49	0.000	0.011	-0.023	0.006	-0.012	0.003	0.000	0.012	0.000	0.005	
50	0.000	0.022	0.000	0.000	-0.012	0.000	-21.700	0.074	0.000	0.006	
Total leak rate (including BAD chambers)	**-118.9**	**36.8**	**-0.6**	**54.9**	**-73.2**	**108.5**	**-167.1**	**42.5**	**-62.0**	**44.5**	**-421.8**

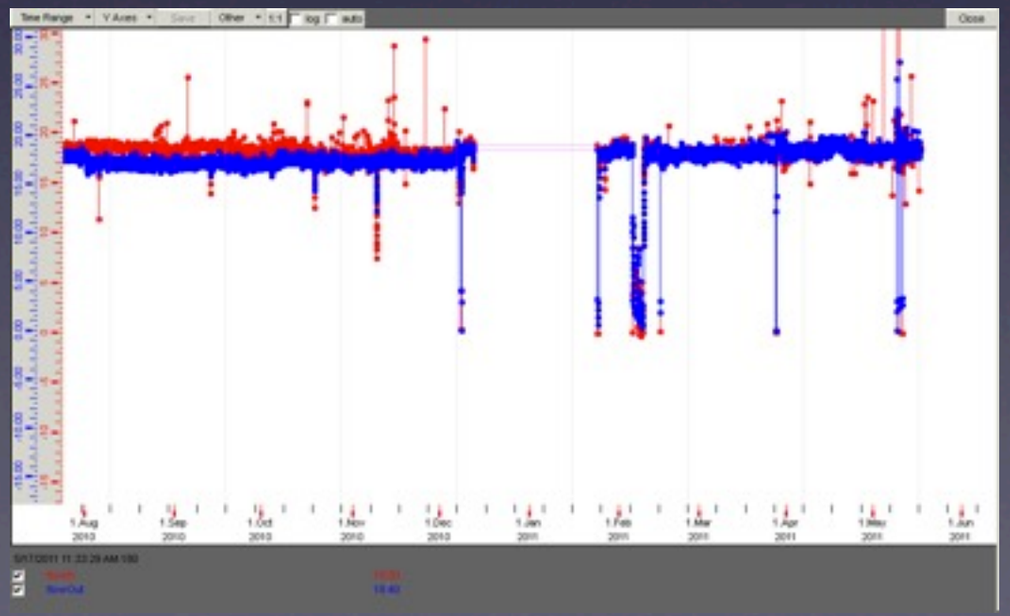
2011 Gas leak search results

- I tried to cross check the results by using the FlowCell data.

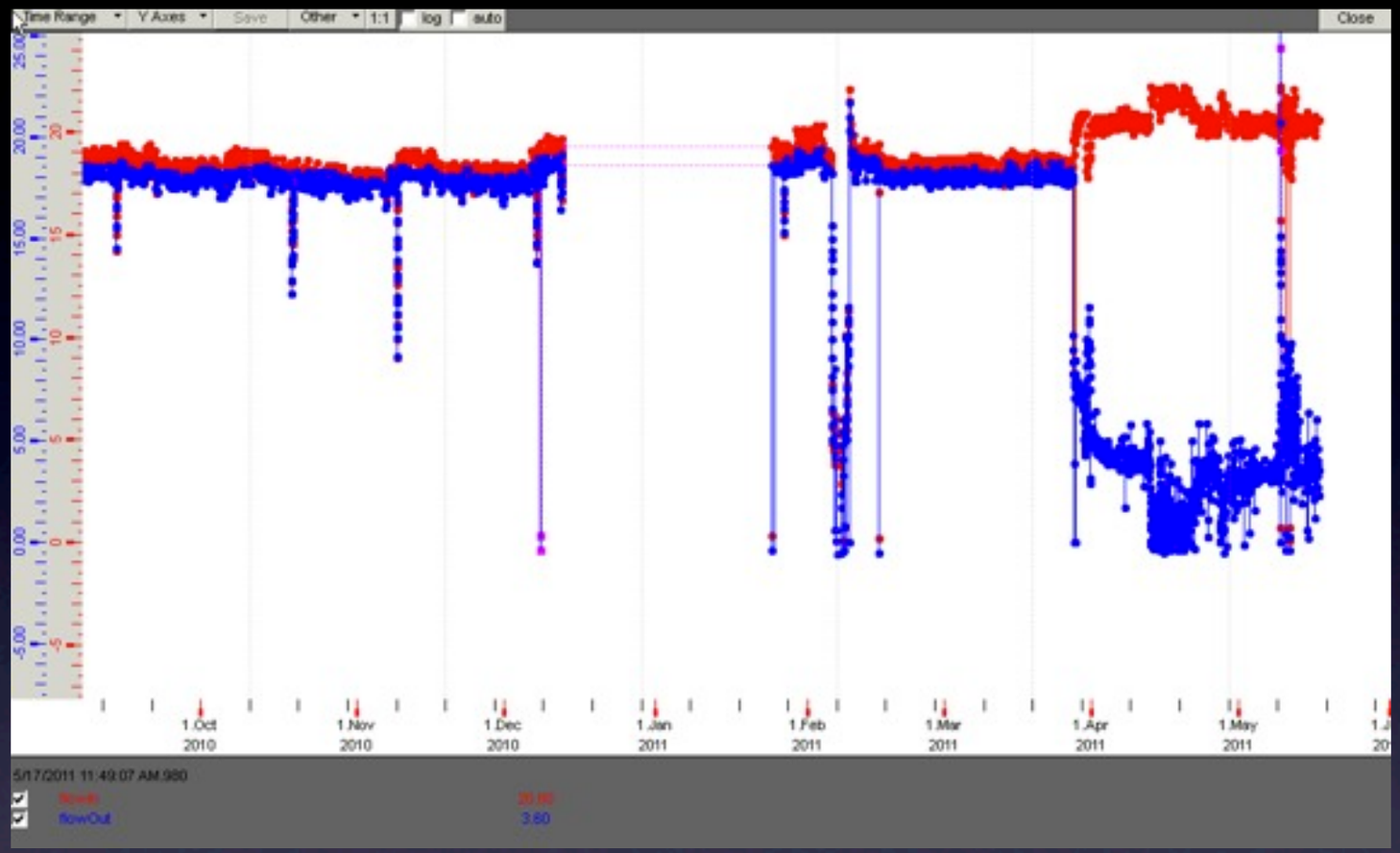








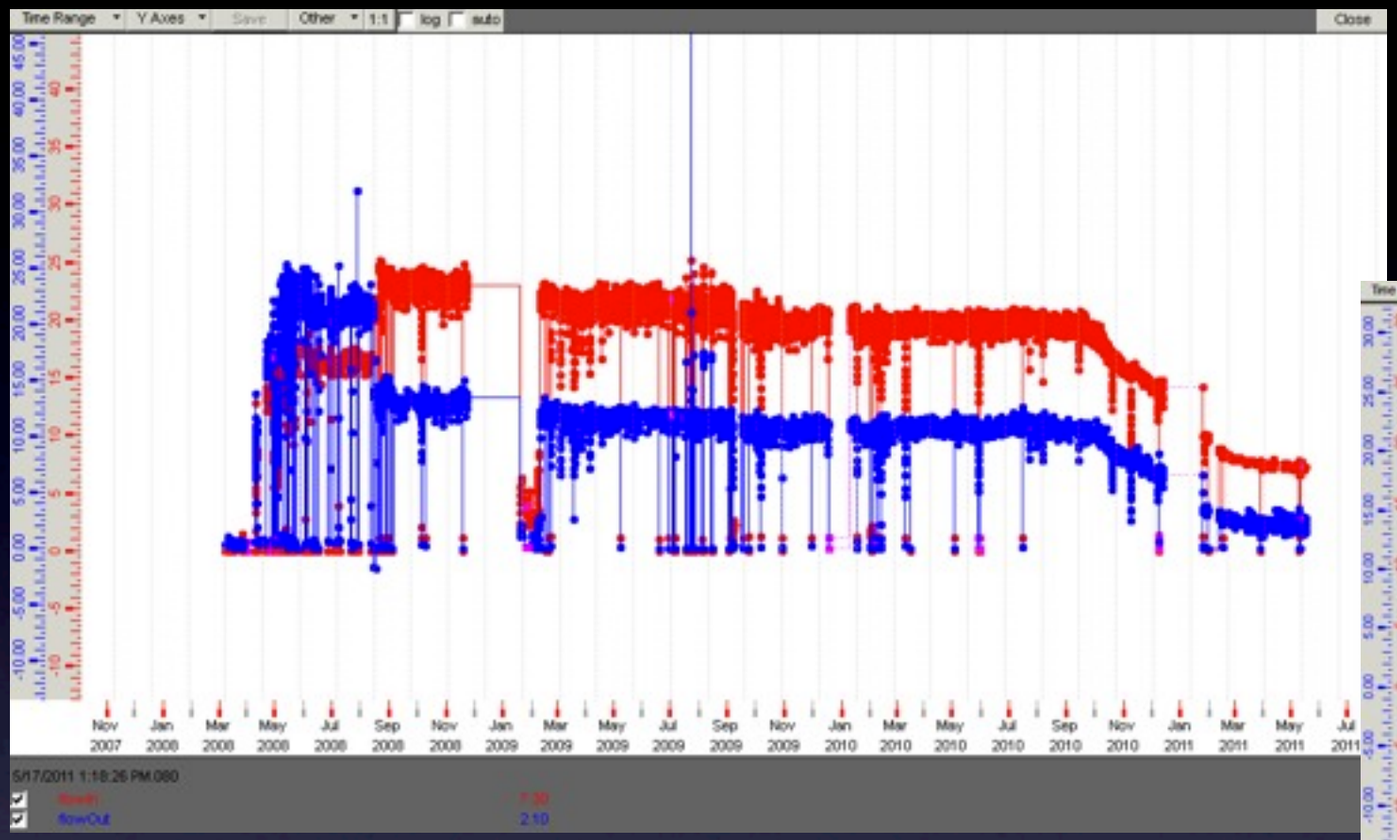
2011 Gas leak search results

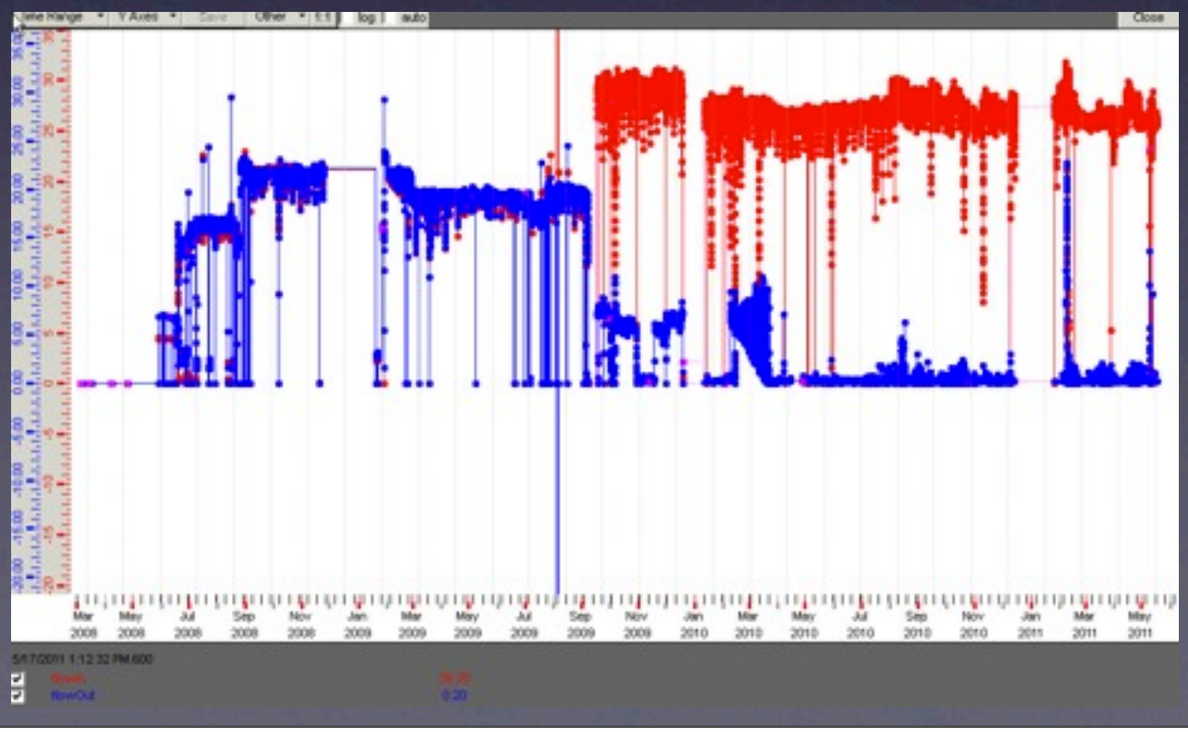


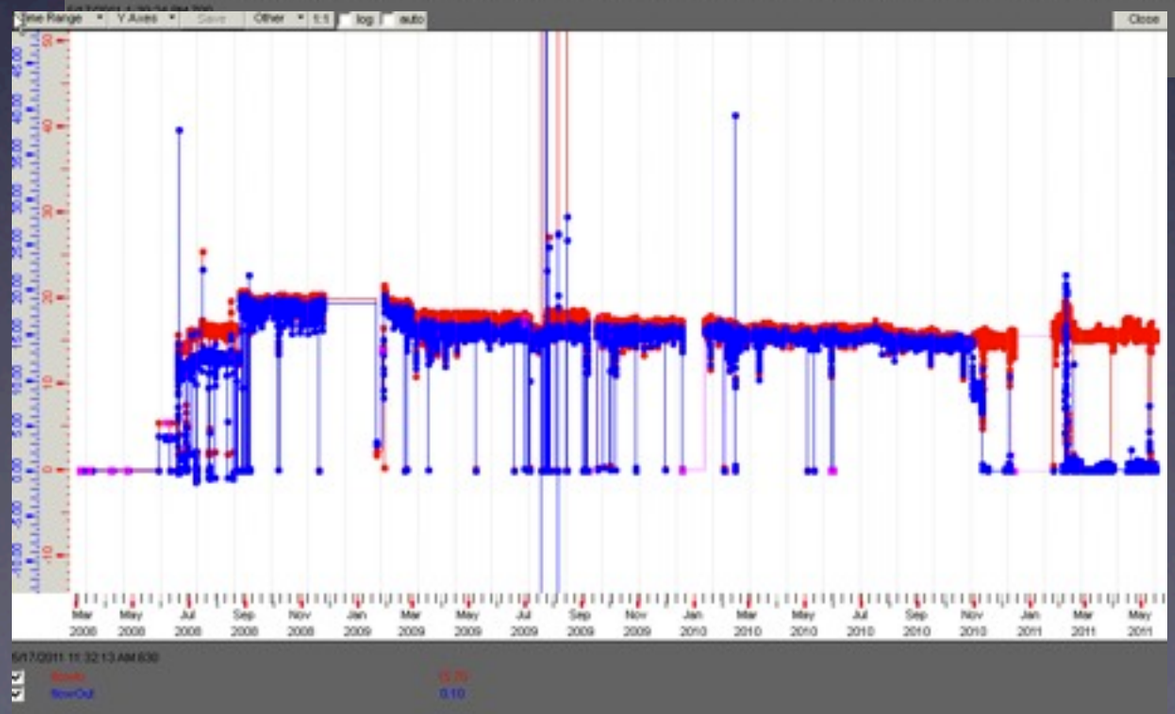
During the cross check...I got the brand new problem!

2011 Gas leak search results

...But also bad FlowCell (chamber?) not showing leak in the leak search campaign!







2011 Gas leak search results

The comparison with FlowCell data seems to confirm the results of the leak rate test.

The Barrel have a much bigger leak then EndCap,
which also according to FlowCell do not present high leakage

- Results:
  Total Barrel leak rate 421 l/h
  Total EndCap leak rate 75 l/h
  Total RPC leak rate 496 l/h
  TOTAL RPC LEAK (DCS) 513 l/h

- A more accurate analysis of the FlowCell data is needed to understand the channels not presenting leak during the leak search test.

- CERN gas group did few days ago a leak test on the system:
  RE- 48 l/h
  RBbot 115 l/h
  RBtop 225 l/h
  RE+ 76 l/h
  Total leak from pressure test 464 l/h

  The leak of the gas system (excluding chambers) has been found to be < 15 l/h

SF6 Saga...some results from GGM

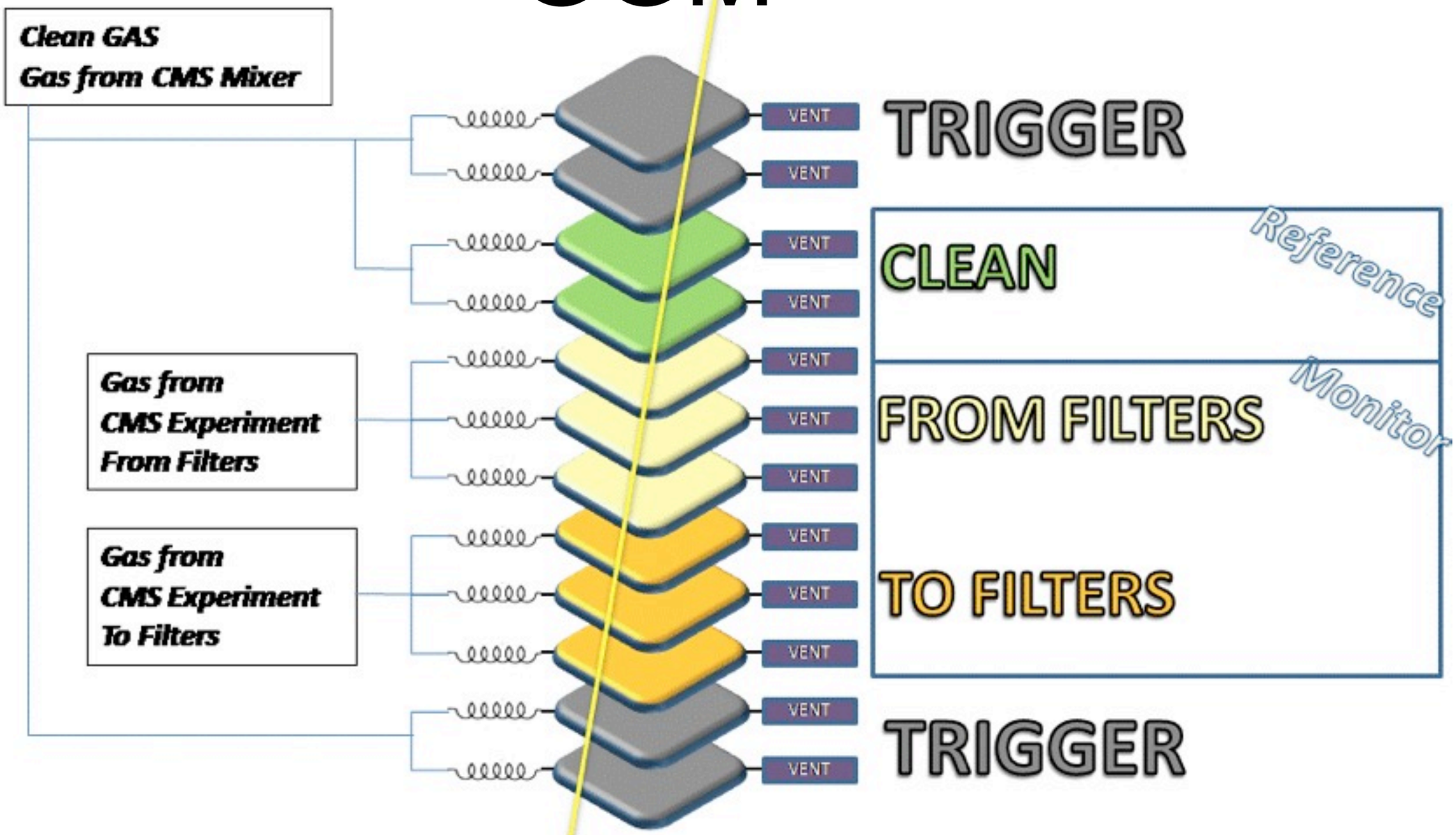
- All of you about the problem RPC had with SF6 percentage.
- GGM crew is investigating if it can spot out such kind of problem if will occur again

GAS

1. **Gas review at cern about SF6 MFC (0.30% --> 0.39%) on May 4th**
   https://indico.cern.ch/conferenceDisplay.py?confId=137611

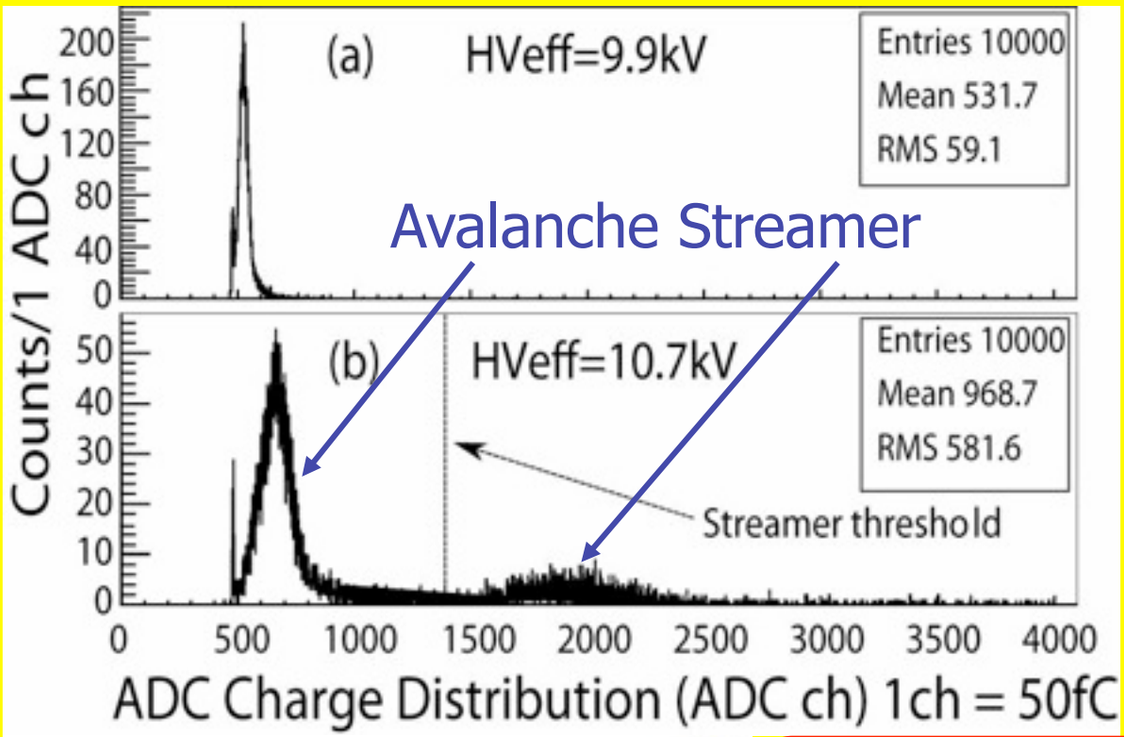
Please look there for more detailed informations

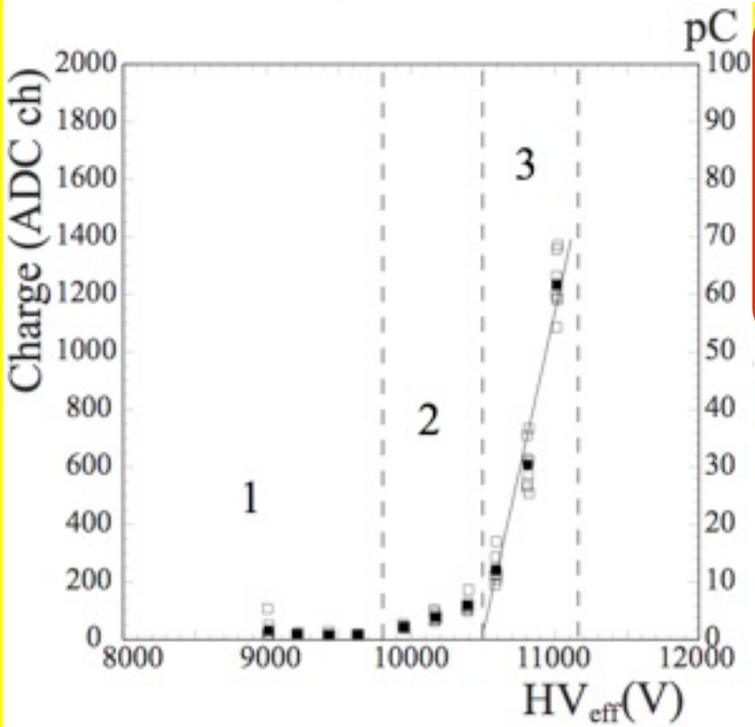
GGM



- **The GGM is not designed for detecting overall gas mixture changes**
- Monitoring of working point for changes due to differences among clean, after-purifiers, before-purifiers gas mixtures.
- Monitoring of charge ratios (afterPurifiers/clean, beforePurifiers/clean) allows cancellation of p,T,H effects

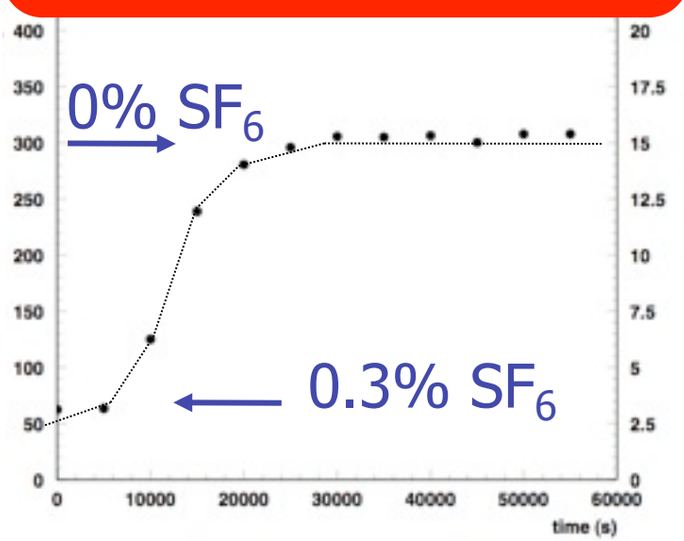
Gas Gain Monitoring Performance

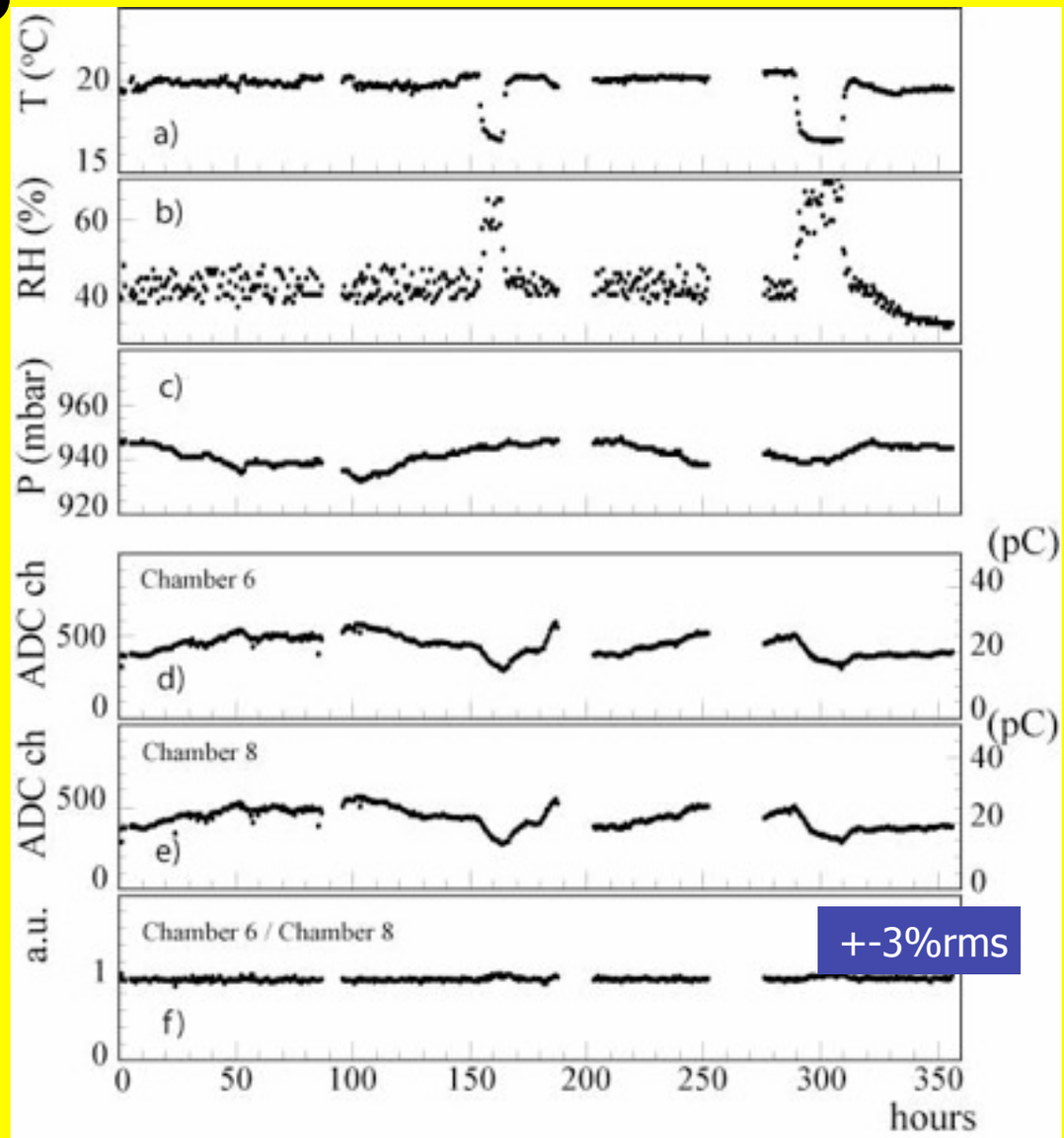




Anode charge in avalanche-streamer transition region monitors shifts in working point.

SENSITIVITY ~ 20V





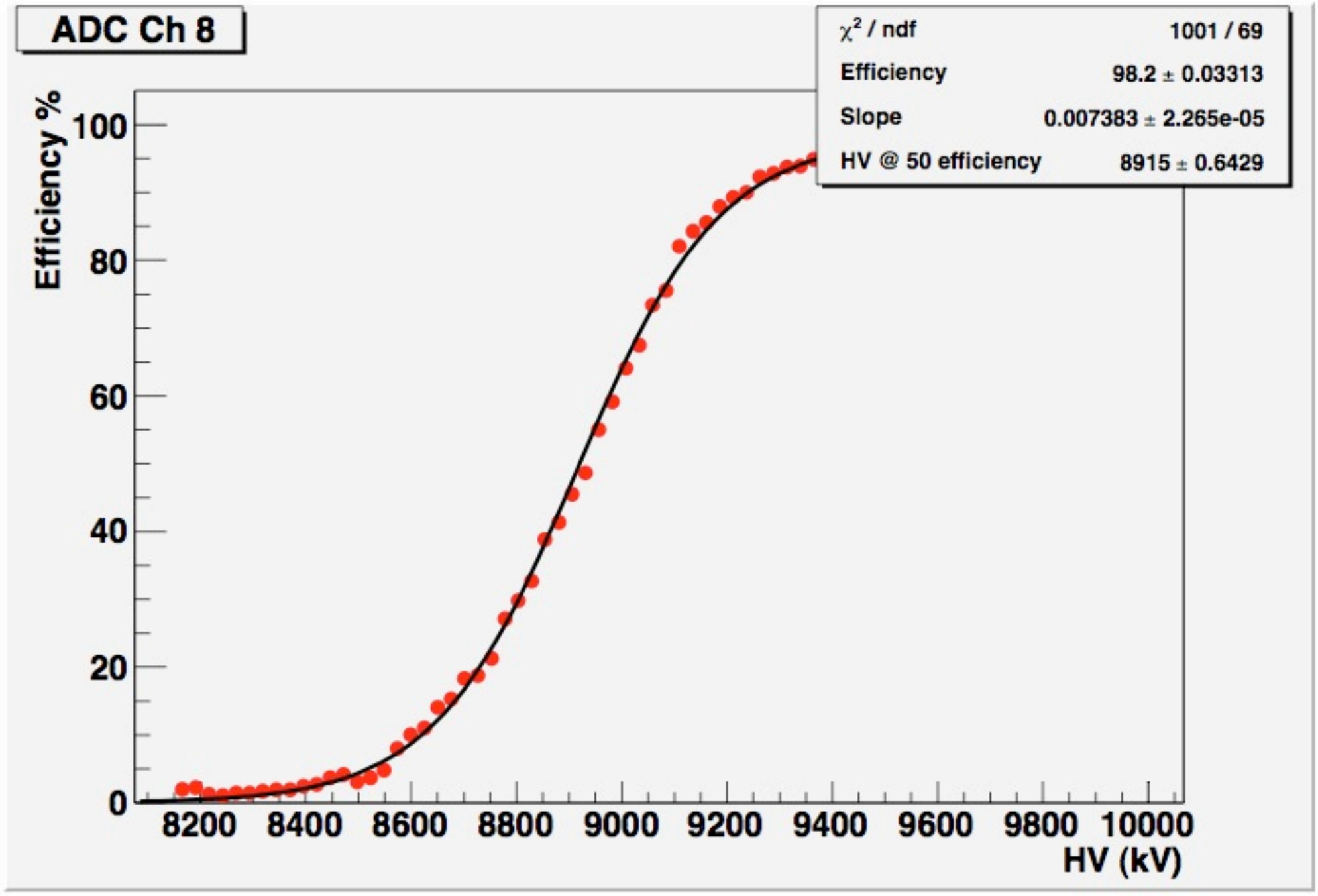
Coherent effects cancel out due to system redundancy. The two-gap ratio cancels out

LONG-TERM ENVIRONMENTAL EFFECTS AT THE +-3% LEVEL

GGM on PVSS


CMS_RPCfwGGM/CMS_RPCfwGGM_all_ch.pnl
Avalanche Area
Time Range
Y Axes
Save
Other
1:1
log
auto
Clean Up 2969.00
Clean Down 8961.00
Before Up 8514.00
Before Middle 9038.00
Before Down 9022.00
After Up 8903.00
After Middle 8654.00
After Down 9020.00
Streamer Area
Clean Up 14.00
Clean Down 789.00
Before Up 35.00
Before Middle 660.00
Before Down 715.00
After Up 41.00
After Middle 1127.00
After Down 820.00
Anodic charge
Environmental corrected anodic charge
Clean Up 37.06
Clean Down 264.01
Before Up 35.52
Before Middle 230.23
Before Down 261.73
After Up 28.18
After Middle 296.58
After Down 237.96
Efficiency
Clean Up 29.86
Clean Down 97.58
Before Up 85.56
Before Middle 97.06
Before Down 97.46
After Up 89.51
After Middle 97.90
After Down 98.49
Currents
Clean Up 0.03
Clean Down 0.07
Before Up 0.04
Before Middle 0.03
Before Down 0.03
After Up 0.03
After Middle 0.22
After Down 0.08
Voltage
Clean Up 9409.00
Clean Down 10210.0
Before Up 9409.00
Before Middle 10209.0
Before Down 10205.0
After Up 9397.00
After Middle 10197.0
After Down 10199.0
Close

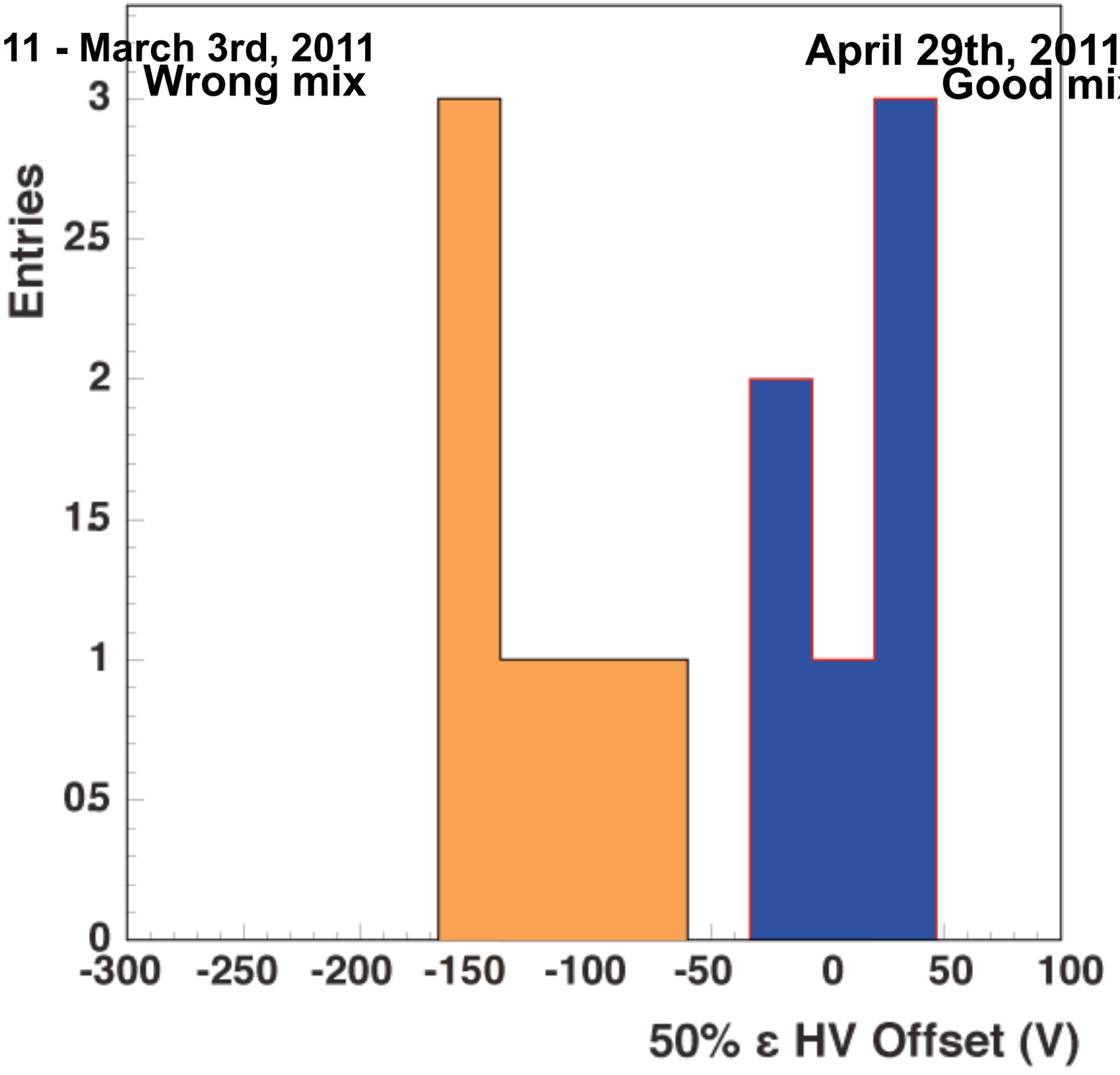
TYPICAL GGM HV SCAN



GGM preliminary results on wrong mix problem

April 29th, 2011 - March 3rd, 2011
Good mix
Wrong mix

April 29th, 2011 - January 2010
Good mix
Good mix

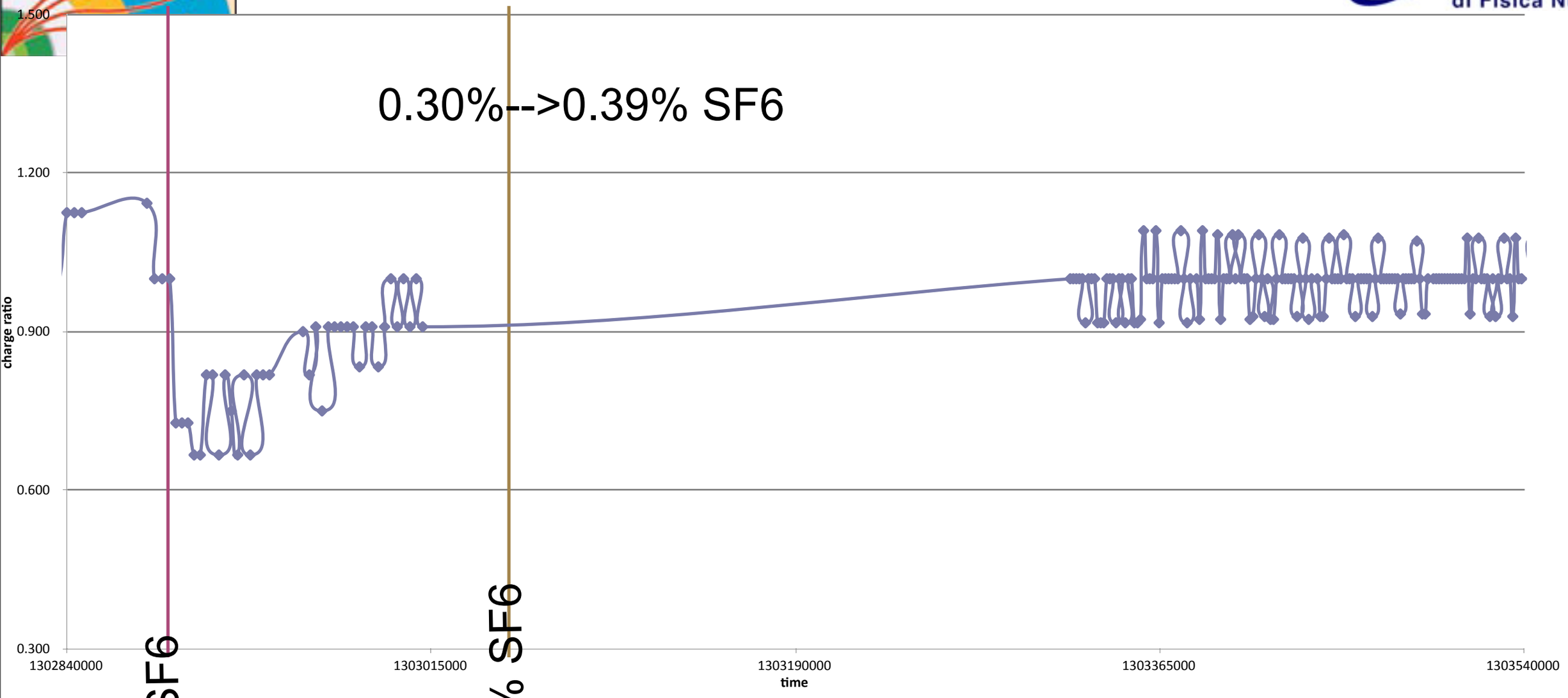


GGM on wrong mix problem

The GGM HV scan confirms shift of WP due to wrong mix

In progress analysis of charge ratios timeline to spot (wrongMix->goodMix) transition which should have occurred delayed in clean and (after/before) gas mixtures. A small transient effect possible.

after down


0.30%-->0.39% SF6
1.500
1.200
0.900
0.600
0.300
charge ratio
1302840000
1303015000
1303190000
1303365000
1303540000
time
0.39%-->0.30% SF6
0.30%-->0.39% SF6

CONCLUSIONS

1. The GGM is able to spot out any change of the gas mixture quality, both pollution and wrong % of components
2. A twin of GGM in Frascati is going to perform detailed studies of gas mixture % variation
   - SF6 = 0.30/0.39/0.33/0.30/0.25
3. Systematic errors are under studies by doing different HV scan with the GGM at P5