

RPC WORKING POINT CORRECTION

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2nd CMS RPC general meeting

RPC HV WORKING POINT CORRECTION

- Temperature distribution after the Winter Shutdown has been partially improved :

→ narrower overall distribution 😊

→ increased inhomogeneity in the upper sectors 😞

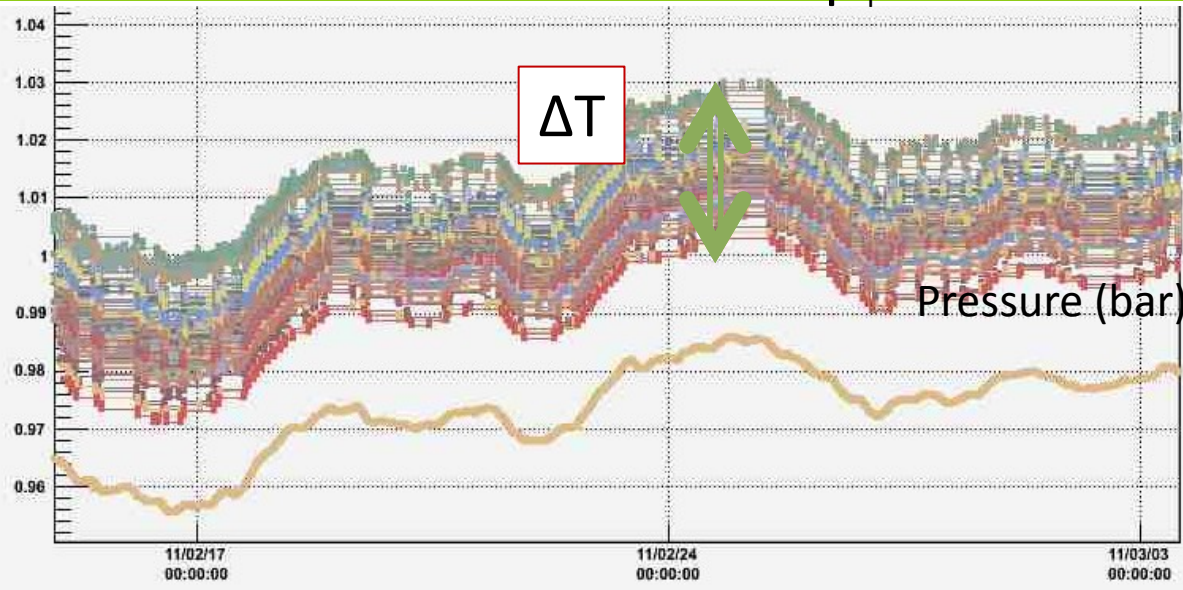
→ 9°C spread 😞

BM.Confirm												
Sum of 16/02/2011 04:26												
Row Labels	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6
1	22,88		22,90		24,34			25,06		24,26		23,83
2		25,19		24,78		25,57	25,35				25,48	
3	24,75		24,01		25,91			26,02		24,47		24,59
4		27,48		26,18		26,33	27,69		25,39		27,10	
5	26,78		27,60		26,51			23,16		23,49		23,95
6		25,74		25,05		25,30	23,49		19,58		20,07	
7	23,79		24,99		24,41			24,63				24,19
8				25,97		24,65	24,06		25,06		25,91	
9	22,98		22,65		22,70			23,53		20,13		24,54
10		23,28		23,13		22,35	23,53		23,75		24,04	
11	23,13		23,45		21,53			23,03		22,84		23,05
12		21,43		21,43		21,74	21,61		21,53		22,48	
13	21,20		22,19		20,75			22,73		22,30		21,00
14				20,28		20,90	18,84		18,46		20,45	
15	22,46		22,98		23,30			22,02				22,07
16		24,16		24,09			22,35		23,50		24,39	

- Correlation of efficiencies/gap currents/trigger rates with atmospheric pressure seen during 2010 data taking (period I); effect clearly visible in STANDBY (9000 V) but also at 9600 V

RPC HV WORKING POINT CORRECTION

ρ_i



- ⊙ Distribution of correction factors (where $i \leftrightarrow$ HV channels)
- ⊙ Spread due to HV layers with different temperatures ($\pm 4^\circ$)
- ⊙ Overall trend is clearly related to pressure variation (typically in the range 955-990 mbar)

RPC HV WORKING POINT CORRECTION

- ① $\rho = \rho_T \cdot \rho_P$
- ① $\rho_T = 1 + \alpha_T \cdot [(T_0/T_i) - 1]$
- ① $\rho_P = 1 + \alpha_P \cdot [(P/P_0) - 1]$

$$\left\{ \begin{array}{l} P_0 = 0.970 \text{ bar} \\ T_0 = 24 \text{ }^\circ\text{C} \\ \alpha_T = 0.5 \\ \alpha_P = 0.8 \end{array} \right.$$

Max correction range



$$\Delta \rho = 1.02 \leftrightarrow 0.98$$

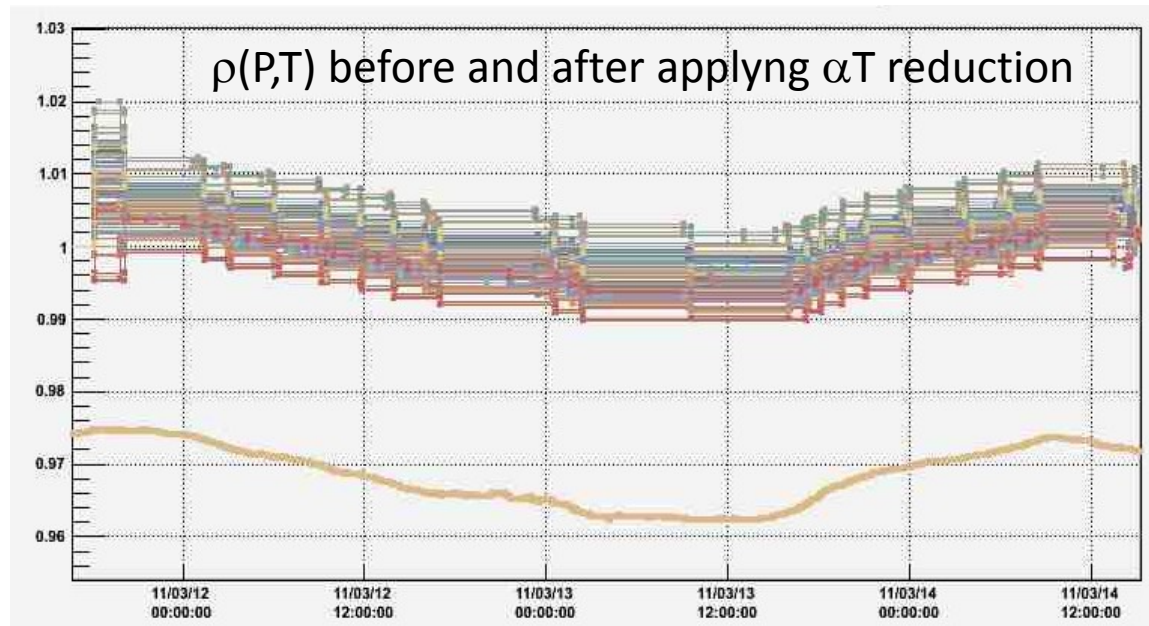
In case of $V_{\text{CONFIG}} = 9600 \text{ V}$



$$\Delta V = 9888 \text{ V} \leftrightarrow 9312 \text{ V}$$

INITIAL PROPOSAL

- ① To avoid an over correction we decide to be more conservative and reduce the spread due to ΔT to 50% $\rightarrow \alpha_T = 0.5 \rightarrow$ to be refined and validated
- ② More precise experimental studies suggested us to reduce the overall ΔP effect to 80% $\rightarrow \alpha_p = 0.8$
- ③ As a further precaution against high temperature operation risk, we set V_{CONFIG} to 9500 V for the HV layers with Temperatures $> 26^\circ \text{C}$ (actually 8/284 HV channels)



DCS IMPLEMENTATION: 2 PVSS CONTROL MANAGERS

◎ CORRECTION FACTOR CALCULATOR

- ◎ control of the temperatures (no values out of a reasonable bound; no spikes)
- ◎ averaging of the values available (2 sensors for each HV channel)
- ◎ calculation of the correction factor to be applied each 2 minutes
- ◎ → in case the ρ is too low or too big (respect to ρ_{\min} or ρ_{\max} parameters), the correction is limited
- ◎ → in case the ρ calculated is not enough different from the previous one, the values is not updated

◎ CORRECTION FACTOR APPLIER

- ◎ has to deal with the standard HV operation (ramping); i.e. activate the W. P. correction only at STABLE BEAM (lowering before the ramp to 1 V/s)
- ◎ applies the correction factor to the HV channel through a change of a conversion parameter (`_cmd_conv`) each 2 minutes
- ◎ → the setting values are clearly visible and correspond to the Configuration values (9600 V)
- ◎ → the read back of the settings tell us the real values on the HV channel (9610,9605,9585...)

DCS IMPLEMENTATION: CONTROL PANEL

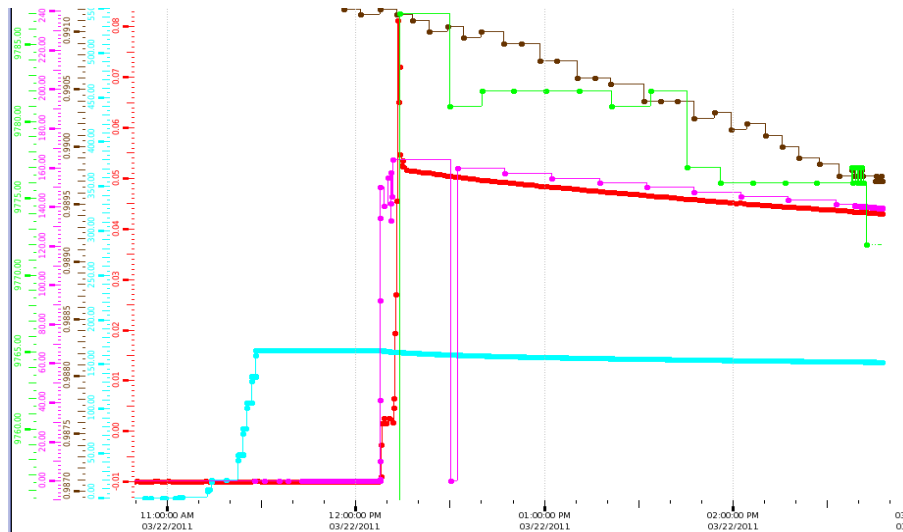
Rpc Environmental Correction Parameters

Correction Status	Time Update	Correction Status	Time Update	Correction Status	Time Update	Correction Status	Time Update	
TEST	120 sec	TEST	120 sec	TEST	120 sec	TEST	120 sec	Modify Settings
Temperature Parameters								
Alpha_T	0.5	Alpha_T	0.5	Alpha_T	0.5	Alpha_T	0.5	
T_0	24	T_0	24	T_0	24	T_0	24	
Tmax	28.5	Tmax	28.5	Tmax	28.5	Tmax	28.5	
Tmin	17.5	Tmin	17.5	Tmin	17.5	Tmin	17.5	
Pressure Parameters								
Alpha_P	0.8	Alpha_P	0.8	Alpha_P	0.8	Alpha_P	0.8	
P_0	0.97	P_0	0.97	P_0	0.97	P_0	0.97	
P_max	1.01	P_max	1.01	P_max	1.01	P_max	1.01	
P_min	0.94	P_min	0.94	P_min	0.94	P_min	0.94	
Global Correction Parameters								
Min_Variation	0.5 ‰	Min_Variation	0.5 ‰	Min_Variation	0.5 ‰	Min_Variation	0.5 ‰	
Rho_0	1	Rho_0	1	Rho_0	1	Rho_0	1	
Rho_max	1.02	Rho_max	1.02	Rho_max	1.02	Rho_max	1.02	
Rho_min	0.98	Rho_min	0.98	Rho_min	0.98	Rho_min	0.98	
Corr_Mode	PT	Corr_Mode	PT	Corr_Mode	PT	Corr_Mode	PT	

- ⦿ In REAL-TIME possible to:
 - ENABLE,DISABLE the two managers independently
 - mask the HV channel where the correction has not to be applied
 - mask the Temperature sensor that may start giving crazy values
 - change the parameters of the correction α_T α_P T_0 P_0 minVar
 - change the configuration values of a channel

OPERATION SCHEME

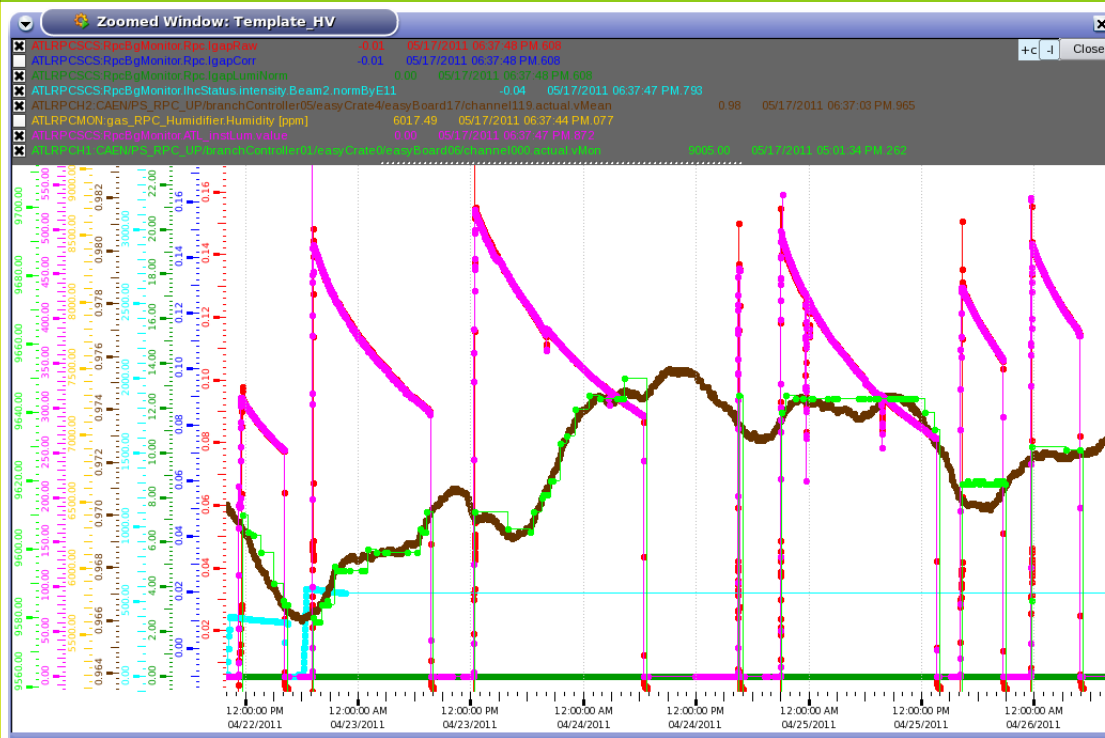
Detector at STANDBY		Detector at READY (stable beam)	
Vconfig	9000 V	Vconfig T<26°C	9600 V (24°C 970 mbar)
Vset (default)	9000 V	Vset (default)	$V_{\text{applied}} = V_{\text{config}} * \rho$
ρ	1	ρ	$\rho_T \cdot \rho_P$
Ramping	20 V/s	Ramping	1 V/s
Calc. dead-band	2 min	Calc. dead-band	2 min
Write dead-band	n.a.	Write dead-band	$\Delta V > 4V$



Reduce aliasing effect:

- ⊙ PID like logic to be implemented
- ⊙ Derivative term necessary

CURRENT VS. LUMINOSITY: A TEST



- ⊙ Global RPC averaged gap current (red almost invisible) agrees with LHC instantaneous luminosity (pink) over a large time and pressure range
- ⊙ A given HV channel calculated r value (green) is following the pressure change (brown)