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Study of gas mixtures and high voltage in a single gap RPC monitoring system

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A single-gap RPC 12-detector array is in operation at Frascati in a controlled environment cosmic-ray setup. Preliminary results are presented on a gas mixture study aimed to fully characterize the RPC working point.

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1. Introduction

The response of Resistive Plate Counters (RPC) detectors depends on both gas mixture and environmental parameters such as temperature, humidity, atmospheric pressure. An array composed of 12 single-gap square (50 x 50) cm^2 RPC detectors is in operation at Frascati national laboratories of INFN with anodic charge readout in an environmental controlled cosmic ray telescope. The system is a copy of the Gas Gain Monitoring (GGM) system of the Compact Muon Solenoid (CMS) RPC muon detector at the Large Hadron Collider (LHC) of CERN, Geneva, Switzerland. The GGM is described elsewhere [1,2,3,4,5,6]. Preliminary results are presented on a campaign aimed to characterize the RPC response (efficiency, anode charge) as a function of several gas mixtures.

2.Experimental Setup

The system located in the Astra lab of INFN Frascati is composed of 12 single-gap bakelite RPC detectors with anodic charge readout via a double square (50 x 50) cm^2 pad. The system is located inside a T, RH controlled box, located in the experimental hut (Fig.1). Baseline gas mixture used is 95.2% $C_2H_2F_4$ - 4.5% Iso-C_4H_{10} - 0.3% SF_6 gas mixture humidified at about 40%.

Figure 1 The GGM hut in the Astra laboratory in Frascati. The detail shows the 12 RPC detectors stack.

The data acquisition trigger is provided by a cosmic ray hodoscope using scintillator counters. The triggering logic, shown in Fig.2, is based on the 3/4 majority coincidence of four out of twelve gaps of the stack, while the remaining eight gaps are used to monitor the working point stability.

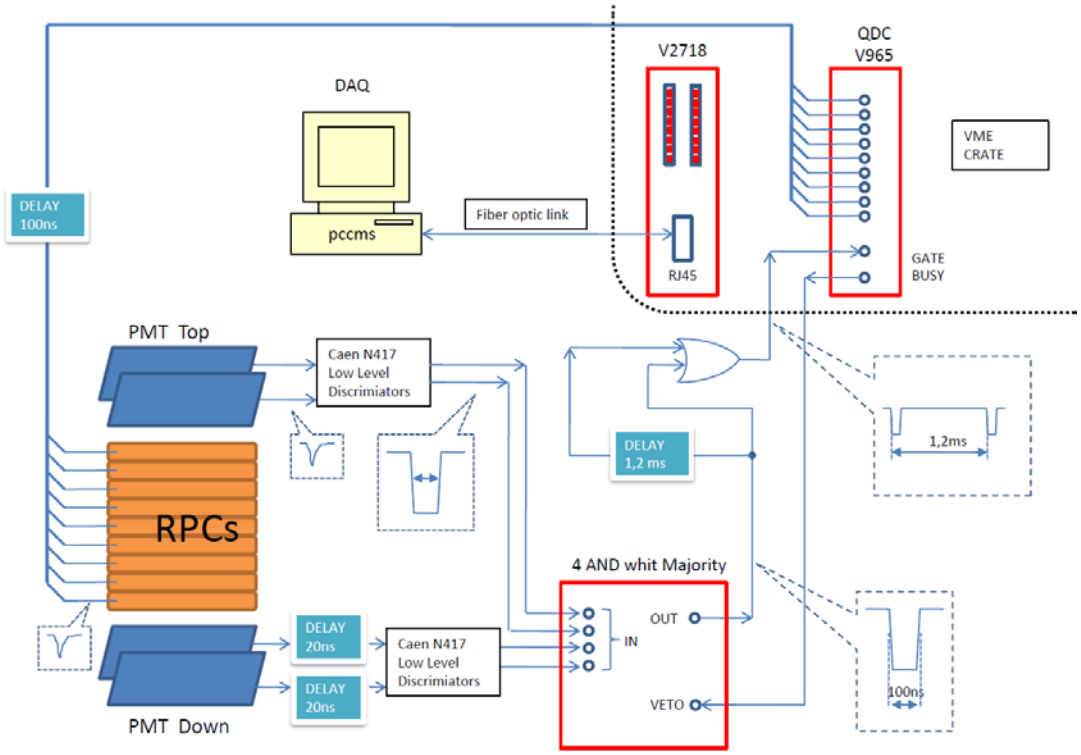

Figure 2 GGM triggering logic

Figure 3 shows how the effective operating voltage (HV_{eff}) is affected by the variation of SF_6 concentration (%). The HV_{eff} is defined as the high voltage set on the HV power supply corrected for the local atmospheric pressure and temperature.

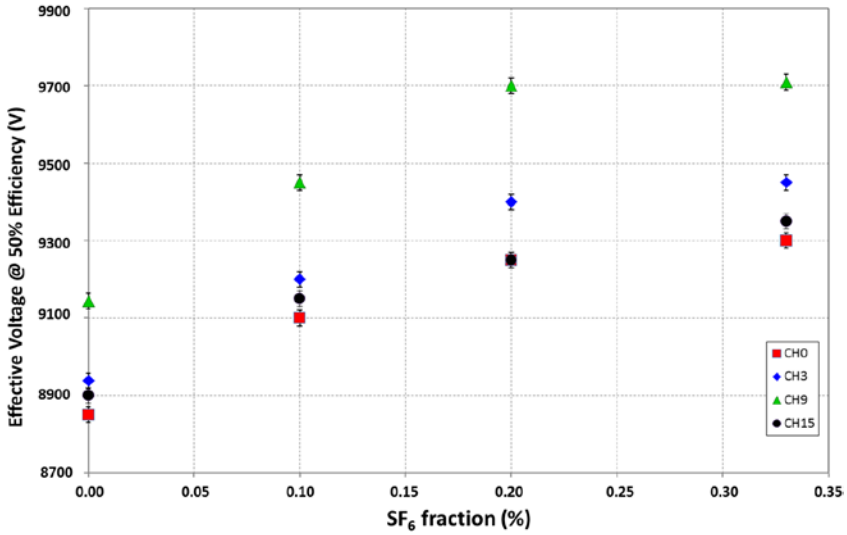

Figure 3: Effective voltage variation due to the SF_6 concentration (%) in the GGM mixture.

Figure 4 shows the average charge variation (in ADC counts and pC) during the time interval in which the SF_6 fraction is varied from 0.3% to 0%.

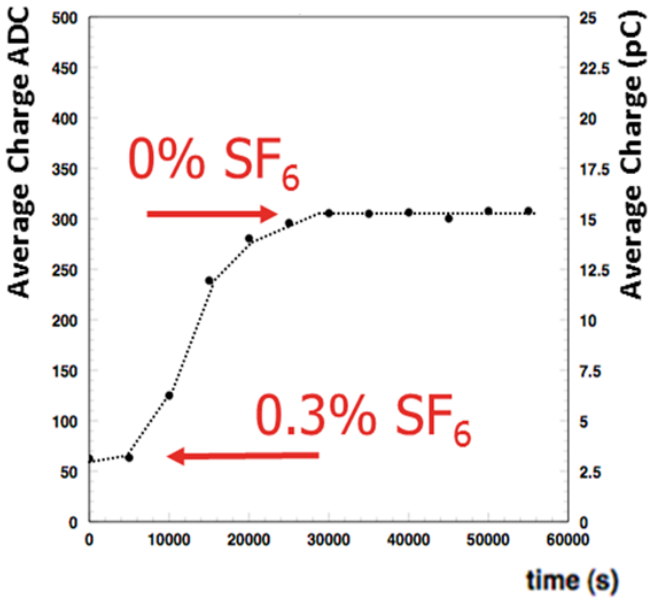

Figure 4 Charge variation during the SF_6 fraction changes

3. Conclusions

Preliminary results have been presented on the response of square bakelite RPC detectors to several gas mixture changes. The system used is sensitive and well suited to perform detailed, systematic studies of the dependence of anodic charge and efficiency for gas mixture changes and environmental variables changes. A detailed study campaign is in progress.

References

[1] M. Abbrescia et al., *Gas analysis and monitoring systems for the RPC detector of CMS at the LHC,* [physics/0701014] LNF-06-34-P (Jan 2007) 9p. Presented by S.Bianco at the IEEE2006, S.Diego (USA).

[2] L. Benussi et al., "Sensitivity and environmental response of the CMS RPC gas gain monitoring system," JINST 4 (2009) P08006 [arXiv:0812.1710 [physics.ins-det]].

[3] L. Benussi et al., "Study of gas purifiers for the CMS RPC detector" , Nucl. Instrum. Meth. A 661 (2012) S241-S244.

[4] S. Colafranceschi et al., "Operational experience of the gas gain monitoring system of the CMS RPC muon detectors," Nucl. Instrum. Meth. A 617 (2010) 146.

[5] L. Benussi et al., "The CMS RPC gas gain monitoring system: an overview and preliminary results," Nucl. Instrum. Meth. A 602 (2009) 805 [arXiv:0812.1108 [physics.ins-det]].

[6] L. Benussi et al., "A New approach in modeling the response of RPC detectors," Nucl. Instrum. Meth. A 661 (2012) S182 [arXiv:1012.5508 [physics.ins-det]].