Study on RPC Charge dispersion as a funtion of Surface Resistivity

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Abstract

Operation and performance of the Resistive Plate Chamber (RPCs) crucially depends upon the conductive coating on the outer side of the electrodes. An attempt has been made to study the effect of the surface resistivity of electrode coating (i.e graphite conductive coating) on the RPC characteristics and performance. Tests were carried with two different types of pickup panels, one made up of plastic honeycomb core of pitch 30 mm and the other one was made up of G10 based core material of pitch 6 mm. Effect of the integration time window on charge deposition has also been discussed.

• Introduction

Resistive Plate Chamber (RPCs) [1] is a parallel plate gaseous detector built using electrodes of high volume resistivity. Our experimental study on surface resistivity of electrode coating has shown a remarkable influence on the basic RPC parameters like efficiency, strip rates, pulse shape, position resolution and space dispersion of the induced charge [2]. We intentionally fabricated three prototype RPCs of different surface resistivities namely 1 M$\Omega/\Box$; 100 k$\Omega/\Box$; 40 k/$\Omega/\Box$ and monitored the effects on RPC parameters experimentally. Charge spread across the pickup strips was studied in detail (in millimeters) when tests carried were repeated with G10 based pickup panel of strip pitch 6mm. A double-Gaussian function was used to fit the dispersion of the induced charge of the RPC. As part of detailed optimization studies on Resistive Plate Chambers (RPCs), effects of integration time on the dispersion of the induced charge was also studied.

• Main Objectives

1. To study the variation of basic RPC parameters (Efficiency, Strip rates) with the Graphite conductive coating in (μm) acting as a high voltage provider.
2. To study the space dispersion of induced charge in the RPCs with different surface resistivity (1M $\Omega/\Box$, 100k$\Omega/\Box$, 40k$\Omega/\Box$).
3. To study the Spatial dispersion of induced charge in millimeters and carry tests further with G10 based pickup panel of strip pitch 5mm.
4. To study the effects of integration time on the dispersion of the induced charge as well as position resolution of a prototype RPC.

• Variation of RPC parameters with Graphite Conductive Coating

Efficiency

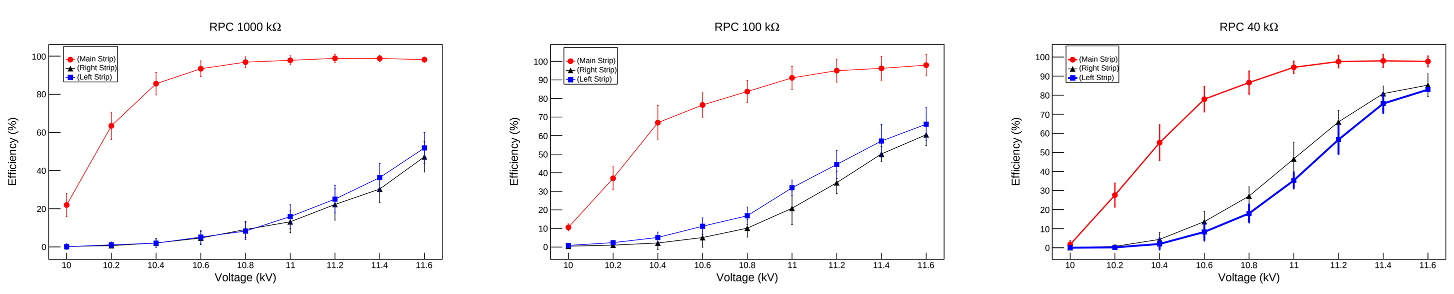


Figure 1: Efficiencies of the RPCs with different resistivities (1 M$\Omega/\Box$, 100 k$\Omega/\Box$ and 40 k$\Omega/\Box$) as a function of applied voltage.

Strip Rates

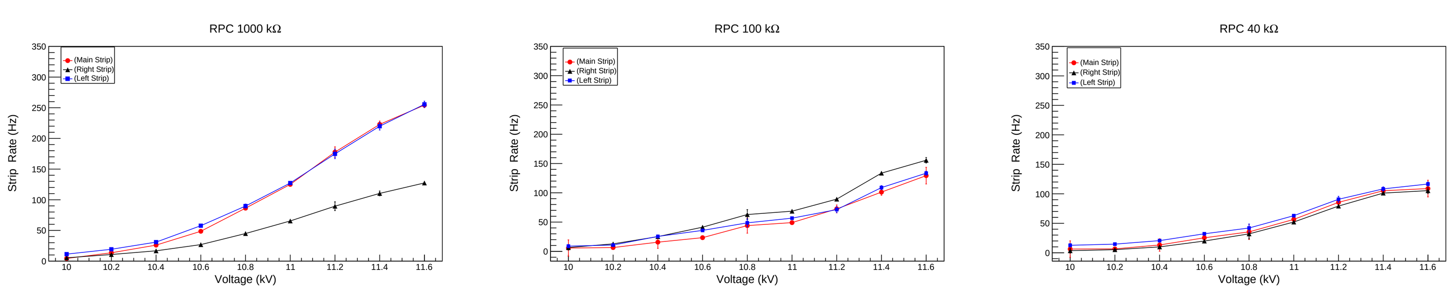
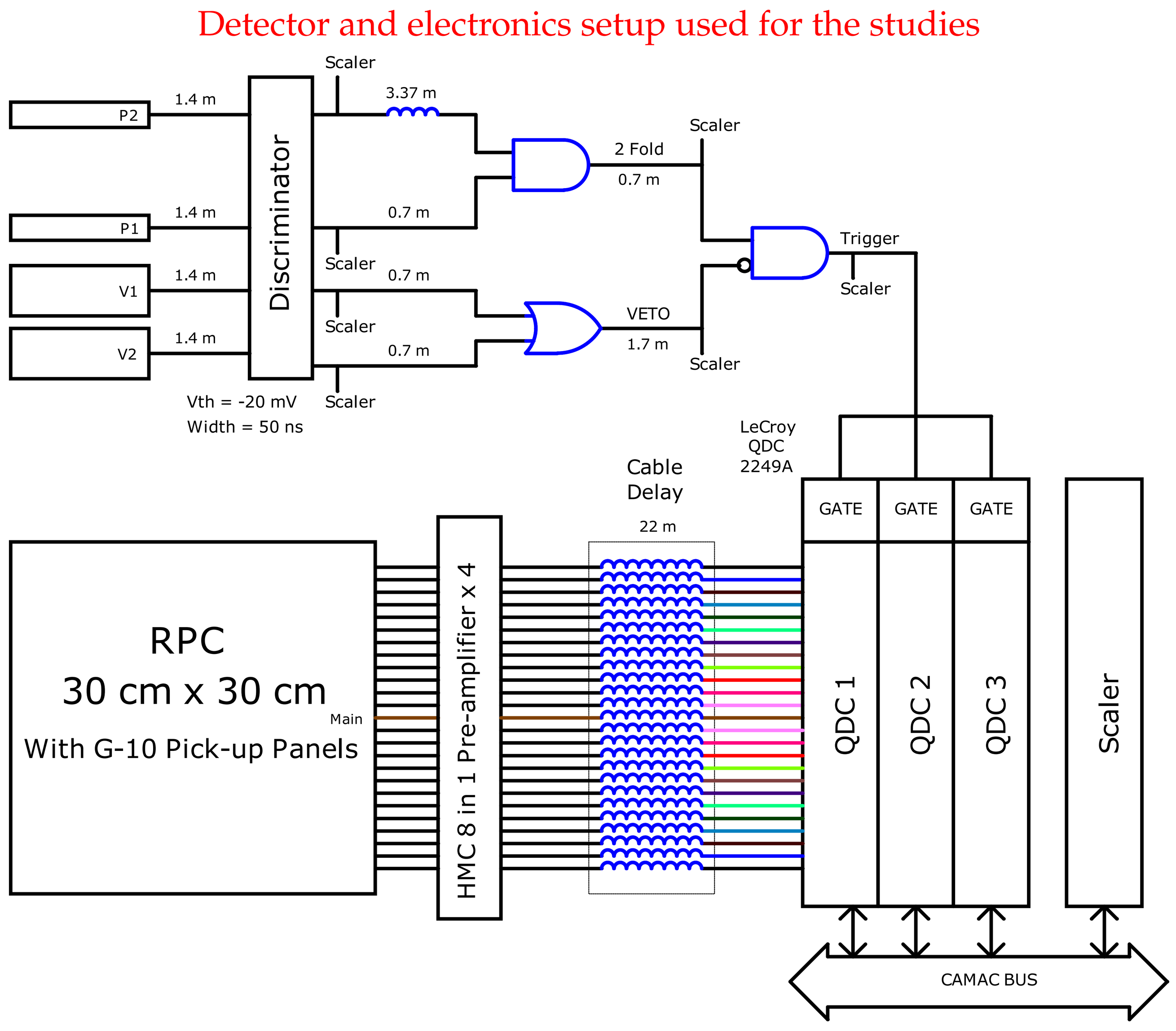


Figure 2: Strip rates of the RPCs with different resistivities (1 M$\Omega/\Box$, 100 k$\Omega/\Box$ and 40 k$\Omega/\Box$) as a function of applied voltage.

• Details of the experimental setup and measurement with G10 based PCB (Strip Pitch=6mm)

Detector and electronics setup used for the studies



• Charge Deposition with 5mm pickup strips

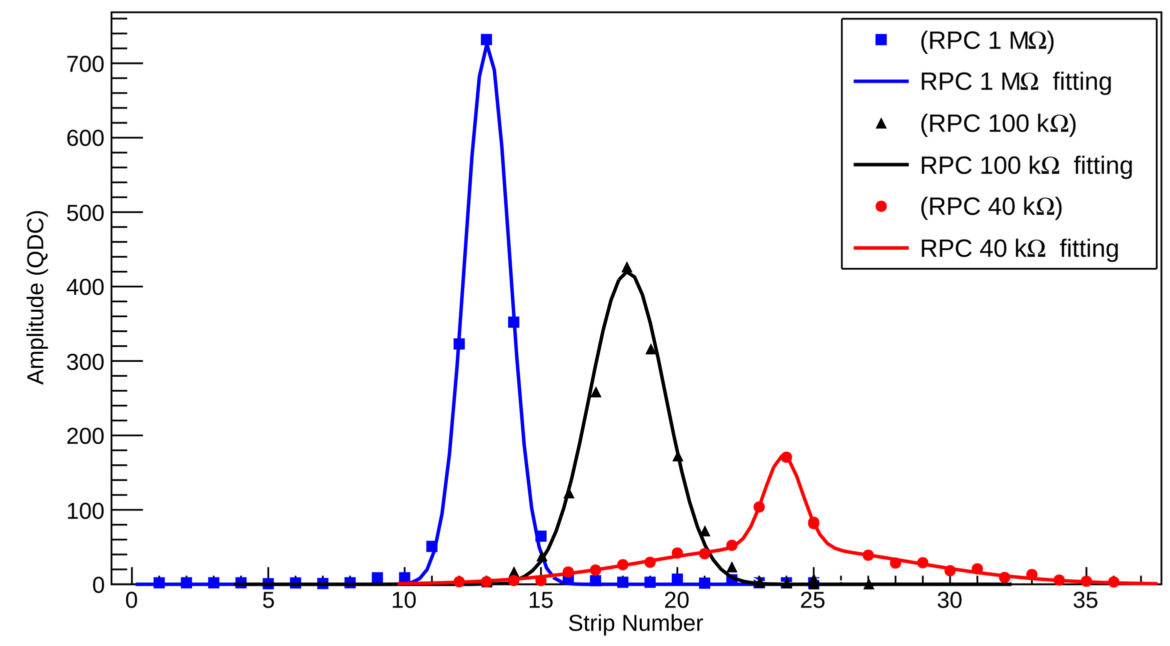


Figure 3: Charge distributions from different incident positions for three events from three RPCs of different surface resistivities, operated at 11.2 kV.

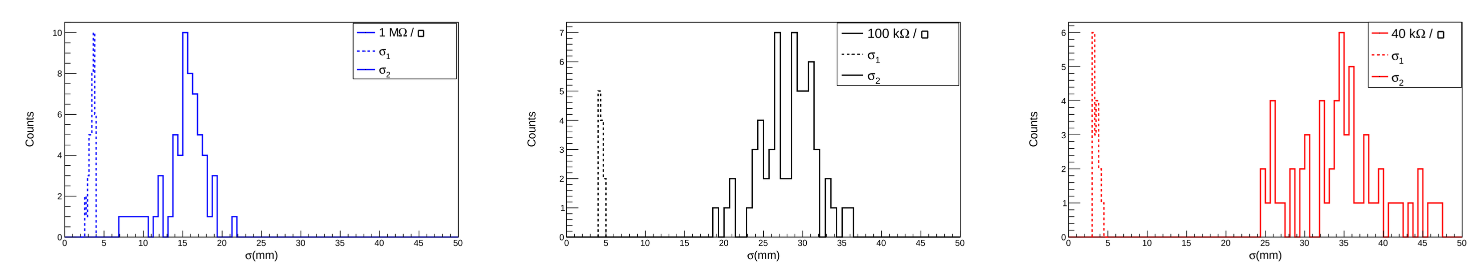


Figure 4: The distributions of σ_1 (dashed lines) and σ_2 (solid lines) obtained from double gaussian fits of events from the RPCs with surface resistivities (a) 1 M$\Omega/\Box$ (b) 100 k$\Omega/\Box$ and (c) 40 k$\Omega/\Box$.

• Charge Deposition at different integration time windows

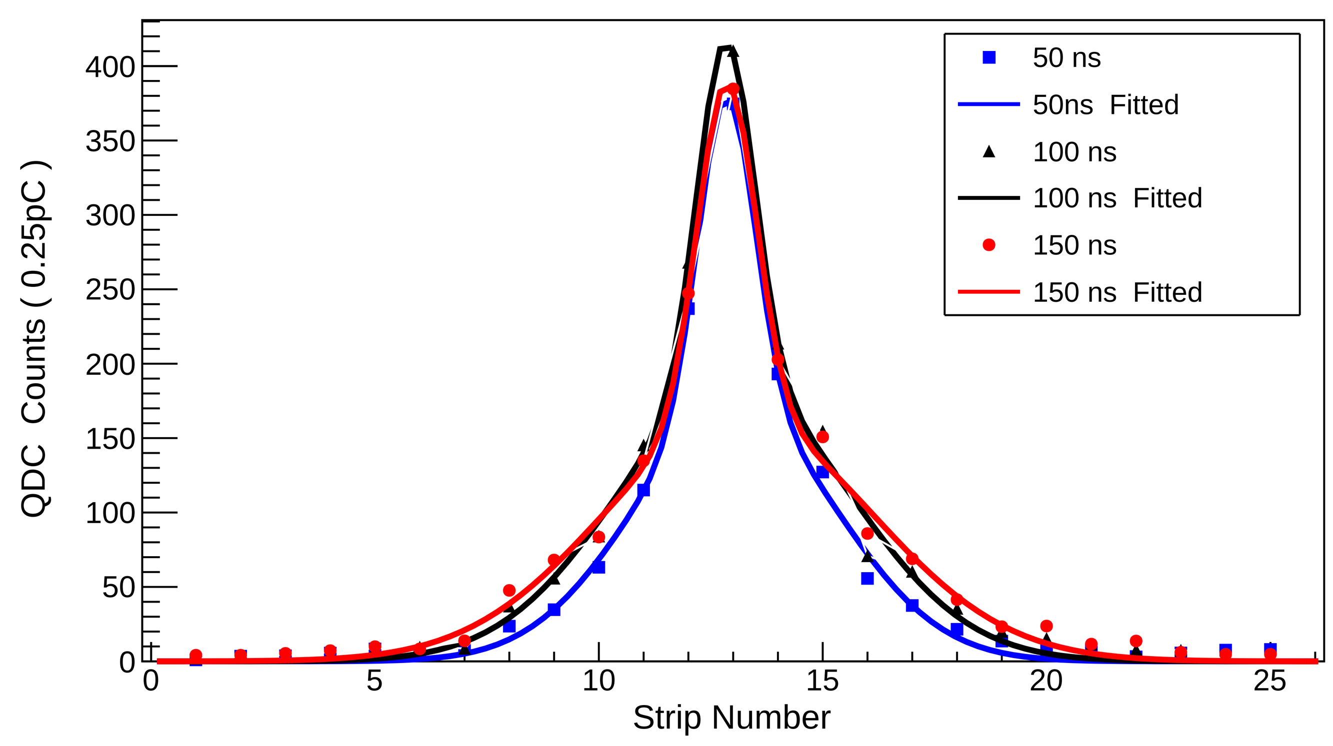


Figure 5: Distribution of induced charges and their double-Gaussian fits for three integration time windows (50 ns, 100 ns and 150 ns.

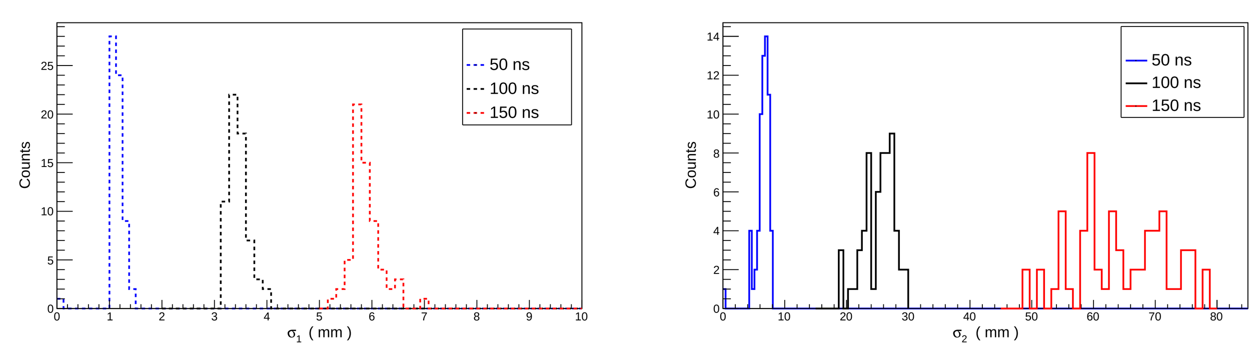


Figure 6: Distributions of σ_1 (b) σ_2 for all groups of events like those shown in figure 3, for 50 ns, 100 ns, 150 ns.

• Conclusions

- Tests carried with 30 mm as well as 5 mm wide readout strips show that the variation of surface resistivity of the electrode coat has a remarkable influence on the efficiency, strip rates and spatial dispersion of the induced charge by the RPC. Operating voltages of the RPC increase as their surface resistivity decrease.
- Also successfully fabricated RPC detectors with low surface resistivity and used G10 based pickup panels of narrower pitches and finally studied its charge deposition and position resolution at different integration time windows.

• Future work

To study charge deposition, position resolution with much finer strip pitches (1mm and 2mm) .

• References

1 . Satyanarayana Bheesette, *Design and Characterization Studies of Resistive Plate Chambers. PhD thesis, Department of Physics, IIT Bombay, India*, (2009).

2 . Y. Jin et al., *Studies on RPC position resolution with different surface resistivity of high voltage provider*, Nucl. Sci. Symp. Conf. Record 917 (2008).

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