

Fabrication and Characterization of Large Size Bakelite Resistive Plate Chamber

R. Ganai^{1,*}, A. Roy¹, K. Agarwal², Z. Ahammed¹, and S. Chattopadhyay¹

¹Variable Energy Cyclotron Centre, 1/AF Bidhan Nagar, Kolkata-700064, INDIA and

²Birla Institute of Technology and Science -Pilani, Pilani-333031, INDIA.

Introduction

Resistive Plate Chamber (RPC)[1] is one type of gas filled detector which utilizes a constant and uniform electric field maintained between two high resistive parallel electrode plates e.g. glass, bakelite. RPCs will be used as active detectors in the proposed India based Neutrino Observatory (INO) project [2] and Deep Underground Neutrino Experiment (DUNE)[3] at Fermilab in USA. VECC is involved in the R&D, indigenously on bakelite RPCs. Here we present the fabrication and test results of a large size oil free bakelite RPC with the cosmic rays.

Fabrication of (240cm × 120cm × 0.2cm) RPC

In order to fabricate the RPC we made a special platform with cardboard sheet, foam and a thick (2cm) glass plate of dimension ~240cm × 120cm each. These components ensure a well leveled surface for the RPC. First, all the edges of both the bakelite sheets were filed properly for smoothening. Then all the surfaces of both the sheets were properly cleaned with distilled water and alcohol. After cleaning the sheets, one surface of each sheet was painted with black conducting paint mixed with special dry thinner in the ratio 1:1 by volume. Enough time was given to the paint to dry up. The surface resistance of the painted surfaces were measured with the help of a zig of 9cm × 9cm. One copper tape of dimension (16cm × 2.5cm) was pasted on each painted surface at the edges to apply high voltage on the surface. Then the painted surfaces

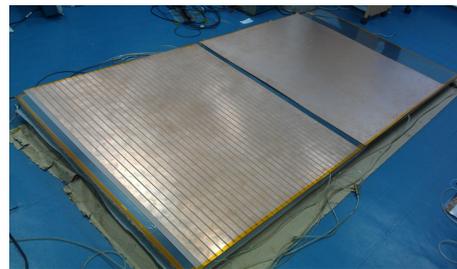


FIG. 1: Picture of the large bakelite RPC with pick up panel.

were isolated properly with mylar sheet and kapton tape. One of the sheets was placed on the platform. Then the side spacers, button spacers and the gas nozzles were glued properly and was given more then a day to settle. We used 128 button spacers (1.5cm × 1cm), 6 side spacers of ~80 cm each, 8 gas nozzles (4 for gas input and 4 for gas output) and 2 side spacers of ~120cm. Then we applied glue on the top surface of all the spacers and the second bakelite sheet was placed. Few weights were placed on the top electrode and was kept for one day to ensure better clinging. We reglued the top and bottom sides of the side spacers to ensure that the gas chamber is leak tight. Then all the gas connections and electrical connections were made and the chamber was tested. Figure 1 shows the picture of the complete RPC.

Test Results

A cosmic ray test set up was made with 3 scintillators and the RPC. The RPC was tested in streamer mode of operation with a gas mixture of Argon:Freon:Isobutane::34:57:9. The I-V characteristics of the fabricated bakelite RPC

*Electronic address: rajesh.ganai.physics@gmail.com

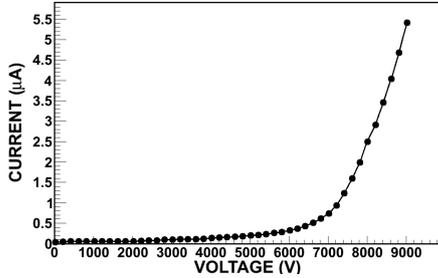


FIG. 2: I-V characteristic of the developed large oil-free bakelite RPC.

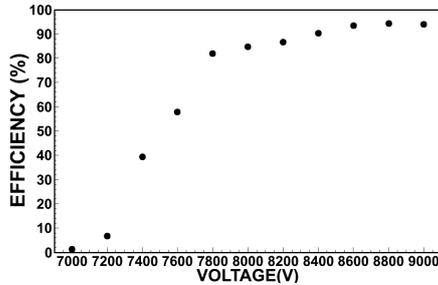


FIG. 3: Efficiency as a function of the applied voltage of the developed large oil-free bakelite RPC. The error bars are within the marker size.

has been studied and is shown in figure 2. Two distinct slopes in the I-V characteristics have been obtained with a breakdown voltage $\sim 7000V$.

The efficiency and noise rate of the RPC with cosmic rays was measured. An efficiency plateau was obtained for the RPC beyond

8400V. The efficiency, as shown in figure-3 was found to be $>95\%$. During this test, noise rate of the RPC was also calculated and was found to be $\sim 1.0 \text{ Hz/cm}^2$ at 9000V. A linearly varying behaviour of the noise rate with the applied voltage is shown in figure-4.

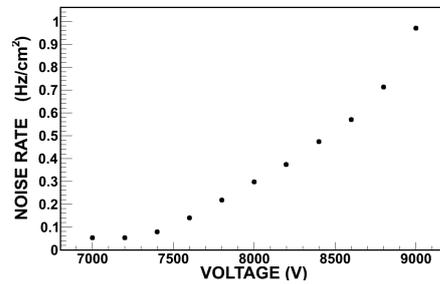


FIG. 4: Noise rate as a function of the applied voltage of the developed large oil-free bakelite RPC.

Conclusion

To conclude, we successfully fabricated and test a large oil free bakelite RPC of dimension $(240\text{cm} \times 120\text{cm} \times 0.2\text{cm})$.

References

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