# Development of 6-gap bakelite Multi-gap resistive plate chamber

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## 1.Introduction

The Multi-gap resistive plate chambers (MRPC)[1] are particle detectors with multiple gas subgaps separated by highly resistive electrodes. MRPCs work on operational principle based on ionization of gas atoms inside the detector by through going charged particles. A strong and uniform electric field is required for this purpose, which is produced by applying high electric voltage between two plates acting as electrodes made from highly resistive materials ($10^9$-$10^{12}$ Ωcm) like bakelite or glass.This type of detector has been used in many experiments of high energy physics like ALICE[2] in LHC and STAR experiment in BNL,USA[3]. MRPCs have excellent time resolution of the order of tens of ps[4] , high gain, and low cost. Hence choice of MRPC has many advantages over other detectors. Most experiments use glass based MRPCs. We have given an effort to develop bakelite based MRPCs because in the case of RPCs, bakelite based detectors has several advantages over glass based detectors. Bakelite has excellent mechanical strength hence transportaion and handling is much easier,good machinability and can withstand larger count rate compared to that of glass based detectors [5]. This is an effort to develop bakelite based MRPCs and we report the fabrication steps and initial test results in this document.

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## 2. Development of MRPCs

We have fabricated two 6-gap MRPCs using the method described in Fig.1 as flow chart The dimension and other parameters are described in TABLE 1.

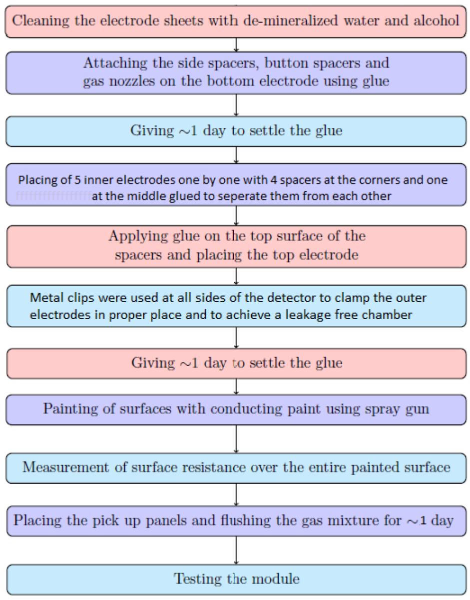


FIG. 1: Flow chart of fabrication of MRPC

## 3.Cosmic Ray test results

The MRPCs were tested with cosmic rays. The gas composition for the two detectors was Freon(R134a) : Iso-butane :: 85 : 15. The test result is discussed in the following sub-section.

| Name of component | No. of component used | Length (cm) | Breadth (cm) | Thickness (cm) |
|---|---|---|---|---|
| Outer Bakelite Electrode | 2 | 16.5 | 16.5 | 0.3 |
| Inner Bakelite Plate | 5 | 14 | 14 | 0.056 |
| Spacer | 30 | 0.8 | 0.8 | 0.024 |
| Gas nozzle | 2 | NA | NA | NA |

TABLE I: *Components used for making each MRPC*

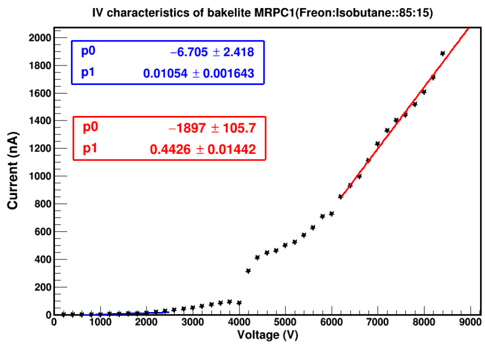


FIG. 2: IV characteristics of 6-gap Bakelite MRPC-1

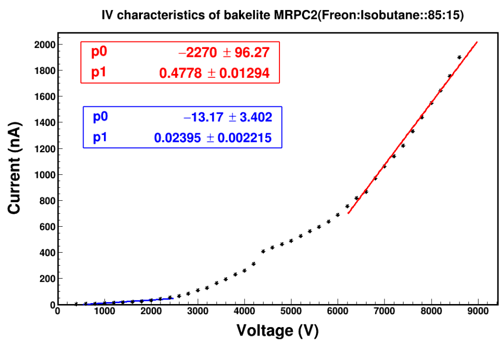


FIG. 3: IV characteristics of 6-gap Bakelite MRPC-2

### A. I-V characteristics:-

For our own convenience we have named the two MRPCs as MRPC-1 and MRPC-2 which will be mentioned throughout this document. Fig.2 and Fig.3 show the I-V characteristics of the MRPC-1 and MRPC-2 respectively. Two distinct slopes are clearly seen in each of the I-V characteristics curve of the MRPCs. The slopes are distinguished by the blue and red colour in the graph. The breakdown voltages of MRPC-1 and MRPC-2 are found at ∼4000V and ∼(3500-4000V) respectively.From the I-V curve the resistivity of the spacers have been calculated to be $3.461\times10^{8}$ Ωcm for MRPC-1 and $2.012\times10^{8}$ Ωcm for MRPC-2 and the resistivity of the bakelite plates were calculated to be $1.775\times10^{8}$Ωcm and $6.222\times10^{7}$ Ωcm for MRPC-1 and MRPC-2 respectively.

## 3. Conclusion and outlook

Two 6-gap bakelite MRPCs with each gas gap of 0.0240 cm thick have been developed.The MRPCs were tested for their IV characteristics with a gas mixture of Freon:Iso-butane::85:15.Both the MRPCs have shown good I-V curve with breakdown voltages at ∼4000 V and ∼(3500V-4000 V) respectively. The detectors are yet to be characterized for their efficiency, noise rate, time resolution, charge spectra measurements. The longterm performance of the same is also to be studied.

## Acknowledgments

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## References

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