Fabrication of Resistive Plate Chamber based on non-fragile material

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Introduction

India based Neutrino Observatory (INO) is going to use approximately 30,000 Resistive Plate Chamber detector having dimension 2m x 2m. Resistive Plate chambers are parallel plate fast gaseous detector made up of high resistivity (10^{12} ohm-cm^2) of glass or bakelite. Detail description about RPC detector's working is in Ref. [1,2]. Handling of glass of above dimension is very challenging due to its fragility.Disqualifying rate of such RPC is higher than the other material electrodes. To overcome the drawbacks of the above RPC detectors search of new material for the electrodes is required. The basic criteria for the selection of new material should be light weight, low cast, non-fragile and locally available.

Material Properties

At initial state, material is very flexible and can take any desired shape such as sheet, spherical, cylindrical etc. After a certain time interval shape get fixed and no further changes can be made. Due to its initial flexibility, material may be used in designing detectors for the medical purpose. Sheet of variable thickness starting from 0.1mm can be prepared for electrode purpose. Obtained material is non-fragile provide extra handle in fabrication of large area RPC detectors with least damage. Therefore, mounting of RPC chamber based on such material is very convenient. The material cost seems to be cheaper than the glass. Experimental setup for the study of present RPC detector is shown in the Fig.1. In present work we have fabricated small sized prototype RPC chambers based on the criteria mentioned above.

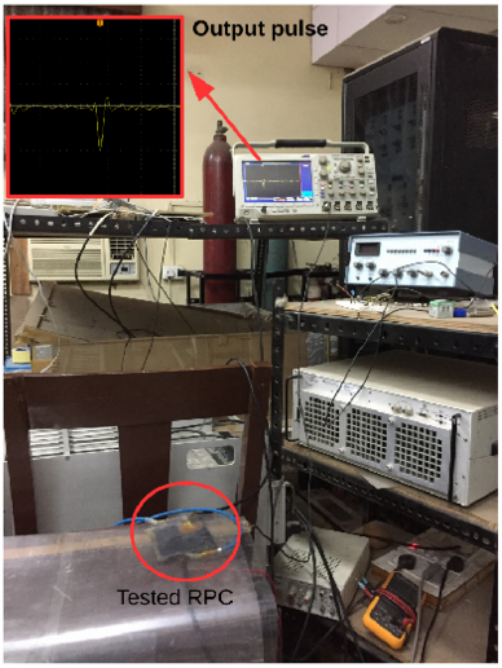

FIG. 1: Experimental setup for analyzing cosmic muon signal based on present RPC chamber using honeycomb pick-up panel.

Experimental setup

We obtained a pair of light weight, non-fragile sheet having dimension 9 cm x 9 cm x 2.5 mm from material science laboratory. We fabricated RPC detector having gas gap of 2mm using spacers, nozzles and buttons. We also coated the outer surface of the gas gap with conductive graphite paint whose resistivity range is (300-400) Ω cm^{-2}. To ap-

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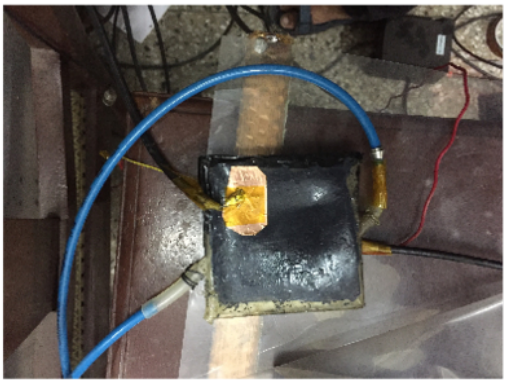

FIG. 2: Resistive Plate Gas gap based on non-fragile material.

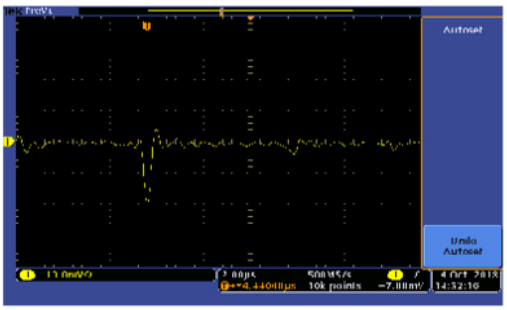

FIG. 3: Dispaly of cosmic muon pulse on oscilo-scope.

ply high voltage on the electrodes, a pair of temporary HV lugs are connected as shown in Fig.2. Physical and chemical properties of this material is under study. Single gas (freon R134a) has been used in the RPC detector with 4KV applied potential difference.

Results

Output pulse of cosmic muons has been shown in Fig.3. Honeycomb based pick-up panel has been used for picking the pulse from the RPC electrode surface.

Summary

We have succesfully obtained a material that are fulfilling above mentioned criteria for fabrication of large area RPC detector. We observed cosmic ray muon pulse successfully,

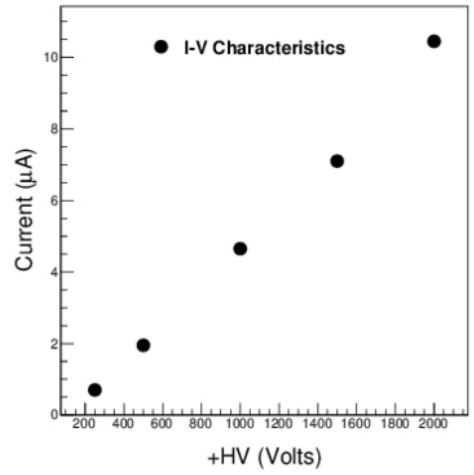

FIG. 4: I-V characteristics of RPC chamber.

which is similar in nature with glass and bake-lite based RPC detectors. I-V characteristics curve of newly fabricated gas gap is shown in Fig. 4. The applied voltage on each electrodes is 2KV. Out put pulse of the cosmic muons has been observed having amplitude 20mV with applied electric filed 20KV/cm and single gas (Freon) flow at very low rate. The FWHM of the pulse is 2micro second and rise time is around one micro second.Cosmic muons pulse has been succesfully observed. We will study the physical and chemical properties of the present material so that it can be optimized efficiently for neutrino detection similar to glass based RPC chambers.

Acknowledgments

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References

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[2] A. Kumar et al., Proc. DAE Symp. Nucl. Phys. 61, 1058 (2016).