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Development of Multi-Gap RPC for Medical Imaging

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All over the world, mainly scintillator-based detectors are being used for PET Imaging. Due to the high cost of the existing systems, extensive R&D is being performed to find an alternative detector. Multi-gap Resistive Plate Chamber (MRPC) with time resolution \sim tens of pico-seconds is considered to be a good alternative. In this work we present the development of Bakelite and glass-based MRPC systems for their applications in PET imaging.

MRPC is a gas filled detector made of highly resistive (bulk resistivity $\sim 10^{11} - 10^{12} \Omega \text{ cm}$, e.g. bakelite, glass) electrodes consisting of several small gas gaps (10 to 100 gaps of 0.2 mm to 1 mm width) and operates at atmospheric pressure. Smaller and larger number of gaps improves the time resolution. In MRPC, the total gas volume is divided into a number of small gaps with equal width by inserting intermediate resistive plates with bulk resistivity $\sim 10^{11} - 10^{12} \Omega \text{ cm}$ between the two outermost resistive plates.

A 20 cm \times 20 cm MRPC prototype with four 0.6 mm gap has been fabricated with 1.6 mm thick P-120 grade bakelite sheets and tested in a cosmic ray test bench in the streamer mode with a gas mixture of argon, iso-butane and tetra-fluoroethane (R-134a) in 55/7.5/37.5 volume mixing ratio. Silicone coating has been applied over all the inner surfaces to make the surface smooth.

Optional extended abstract

In this study the efficiency, counting rate, leakage current and time resolution of the module have been measured. The efficiency plateau above 95% has been obtained with the time resolution $\sim 2 \text{ ns}$.

One glass MRPCs of 20cm \times 14cm dimension, having six gaps each of 200 μm width has been fabricated and tested in avalanche mode with a gas mixture of Freon/iso-butane/SF₆ in 95/4.5/0.5 mixing ratio. The efficiency of $\sim 90\%$ and time resolution $\sim 450 \text{ ps}$ had been achieved.

Methods of fabrication of all the prototype MRPCs, mode of operation and the test results will be presented.

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