Title:	MODELING AN ULTRA-SENSITIVE DETECTOR FOR LARGE AREA EXPERIMENTS
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Abstract:	Cosmic ray particles which hit the Earth’s atmosphere, carrying information about the extra-terrestrial events are characterized by large flux and varying angular distribution which makes it necessary for detectors to have larger volumes for their detection. Same goes for detecting neutrinos, which are weakly interacting and have smaller interaction cross-section but carry useful physics. Charged particles with large flux produced in various ground- based particle accelerators (like in ALICE at LHC, CERN) also need to be detected pre- cisely with good time resolution to identify their various properties. Thus, a detector which can have better time resolution and is also economical for use in large numbers is needed for detecting such particles. One such detector is Multi-gap Resistive Plate Chamber (MRPC) which is a gas ionization detector with improved time resolution (in picoseconds). Cur- rent work involves modeling a five-gap MRPC detector using Garfield simulation package where geometry has been prepared by providing various dimensional parameters, in order to optimize this detector for the best possible time resolution. MRPC is a gas ionization detector with multiple gas gaps made up of highly resistive elec- trodes. MRPC was first conceptualized and developed in 1996. There is a single set of anode and cathode readout electrodes, placed at the outer surfaces of the two outermost resistive plates. The presence of multiple narrow sub-gaps with high electric fields re- sults in faster signals on the outer electrodes, thereby boosting the detector time resolution. Advantages of MRPC over conventional Resistive Plate Chamber include improved time resolution of less than 100 picoseconds, reduced time jitters of the signal, improved rate capability, and it is economical to be used in large area experiments. We have prepared a five-gap glass MRPC geometry of dimension 20 mm × 20 mm × 6.5 mm using Garfield simulation package. The geometry consists of 6 glass electrodes with dielectric constant 8. The width of outer two electrodes is 1 mm and that of inner four electrodes is 250 microns each separated by 200-micron gas-gap. Then above the outer electrodes, 50-micron conductive Graphite coat is present above which 200-micron insulat- ing Mylar sheet is kept. Finally on each side, 18 readout strips with thickness and width as 1 mm and pitch 0.1 mm are kept in the perpendicular orientation. Then we have optimized this MRPC by using various gas mixtures and electric fields to obtain time resolution in some 10’s of picoseconds. MRPCs are being used as Time-of-Flight (TOF) detectors devoted to charged hadron iden- tification in the mid-rapidity region of the ALICE experiment at Large Hadron Collider (LHC). It is also being used in medical imaging as an efficient detector for the TOF based Positron Emission Tomography (PET), and also in Muon tomography with cosmic ray muons which is a novel technology for high-Z material detection in security services. Thus, R & D for optimizing the time resolution of MRPC is indeed necessary for bringing break- throughs in detector technology which instead will help us not only for elementary particle identification but also for direct applications to various challenges which society faces in the sphere of science and technology.

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