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Development of a Multi-Grid-Type Gas Chamber

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MicroStrip Gas Chambers (MSGCs) [1] are new gas counters and based on very high precision photolithography technique. They have, in principle, two kinds of strips: the anode and the cathode closely placed on the same surface. As a result, very fine pitch position sensitive gas detectors are realized. They have shown their very high counting rate operation and good uniformity over entire sensitive area. However, MSGC suffers from discharges and poor gas gains. We have proposed a new patterning approach to this type of detector, which uses a complicated electrode geometry on the surface of the detector [2,3]. The multi-grid-type MSGC (M-MSGC) is equipped with intermediate grid electrodes between the anode and the cathode. The intermediate grid electrodes effectively isolate the anode and the cathode and realize a favorable bent electric field for high-counting-rate and high-gain applications [4] (see Fig.1).

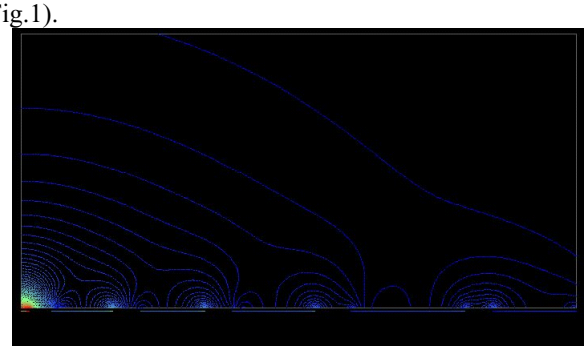

Fig. 1 Electric field of a multi-grid-type MSGC calculated by the ELFIN code.

M-MSGC with pad readout

To obtain the induced signals on the backside, it is possible to use a large gap between grid and cathode electrodes. In this kind of design, we can induce ~30% of the true signal charge on the backside electrode. However, this is obtained at the cost of surface charge accumulation. Thus, we investigated another readout method. In order to increase the induced signals observed at the backside electrode, an open cathode method was tried by the ILL group [5]. However, the results were unstable because the amount of the surface charge was not properly controlled. We reconsidered this method, covered the front surface with metal electrodes and designed floating metal pads for passing an induced charge through the substrate. In principle, if the metal electrode is floating, the induced charges stay on the electrode and this charge also induces additional charges on the rear surface. Fig. 2 shows a triple pinhole image obtained with this method. However, the induced charge is spread over several readout strips and we need to use a centroid calculation method. Now we are developing a dedicated ASIC electronics for this detector.

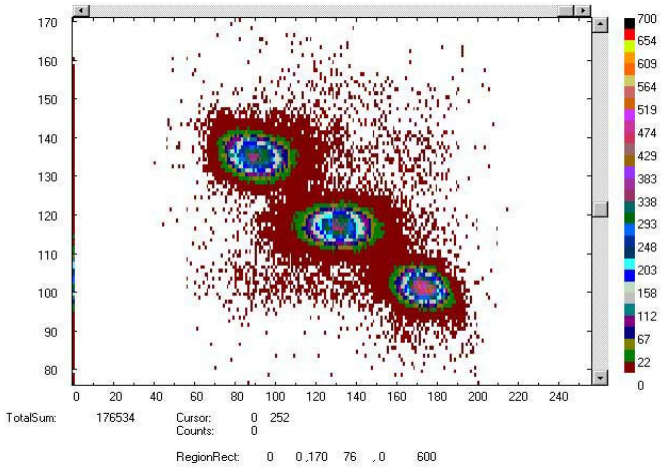

Fig. 2 Triple pinhole image obtained with the new two-dimensional readout method.

References

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