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A very large area Micro Pixel Chamber

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A Micro Pixel Chamber, called "µ-PIC", is a gaseous 2D imaging detector with a fine pixel electrode based on the Printed Circuit Board technology, and we developed it for the X/gamma-ray imaging and the tracking of the charged particles [1]. The previous µ-PIC has a fine position resolution (RMS $\sim 120\mu\text{m}$), a high gas gain (Max ~ 15000), good gas gain uniformity (4.5% RMS) and the stable operation (more than 1000 hour). But the detection area of the previous µ-PIC ($\sim 10 \times 10\text{ cm}^2$) is not large enough for a variety of the application, for example an MeV gamma-ray Compton camera [2] and dark matter search [3].

For these purpose, we developed a new µ-PIC having a $\sim 30 \times 30\text{ cm}^2$ detection area. The structure and the pitch of the electrode are same as those of the previous µ-PIC. There are 768×768 pixels in the whole area, and each pixel works as a proportional counter. The anodes and the cathodes of the pixels are formed on the 768 anode strips and the 768 cathode strips, which connect to the read-out board with the wire bonding, and the anode strips are orthogonal to the cathode strips. Therefore, this large µ-PIC is expected to have a fine 2 dimensional position resolution same as the previous µ-PIC, and the 9 times detection area. The yield of the first production was about 50%, and there is only $\sim 1\%$ dead pixels in the whole area. By these results, it is a prospect to the mass production of the µ-PIC.

We started the test operation of this large µ-PIC at the beginning of 2005, and we succeeded to detect the first signal with µ-ray of $^{90}\text{Sr}/\text{Y}$. This µ-PIC (SN041129-1) worked with a stable gas gain of ~ 3000 and a maximum gain of ~ 6000 at the center, and the ratio of the gain was 2.2 between the minimum and the maximum gain area. An X-ray image of $30 \times 30\text{ cm}^2$ was also taken by irradiating the X-rays from ^{109}Cd (22keV) to the whole detection area. And, for more applications, we are developing a time projection chamber with a large volume ($\sim 30 \times 30 \times 30\text{ cm}^3$).

In this presentation, we will report the manufacturing quality and performance of the first large area µ-PIC, and we also present the development of the readout system and a large size time projection chamber for an application of the new µ-PIC.

References

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