# Development of Gas Electron Multiplier (GEM) detector

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The Gas Electron Multiplier detector (GEM) is now developed for the measurement of Coherent Pion Production (CPP) at NTOF facility in RCNP. The GEM is used to detect charged pions produced in the final state with low energy. All physical observables in the CPP require very high intensity beam and high tracking resolution to reconstruct a missing mass accurately for the identification of the residual nucleus with ground state. This requires the use of detectors with very high rate and multi-track resolution capability combined with fast, dead-time free readout electronics. The GEM technology is suitable for this purpose [1].

The detector consists of the GEM electrode shown in Fig.1, cathode electrode, readout board, and readout electronics. The GEM electrodes consist of thin metal-coated polymer foils, pierced by a large number of holes. The unique point is that we have adopted the triple-GEM configuration, which permits to achieve an almost discharge-free operation with high gains. We used the 50 μ m kapton foils coated with 5μ m copper. The holes are arranged in a triangular pattern, and are 70μ m in diameter at 140μ m distance center to center. The readout board can detect the charged particles with two dimensional coordinates. It consists of two layers of perpendicular copper strips at 100μ m pitch, and the two layers are separated by 50μ m thick kapton ridges. The magnified view of the readout board is shown in Fig.2.
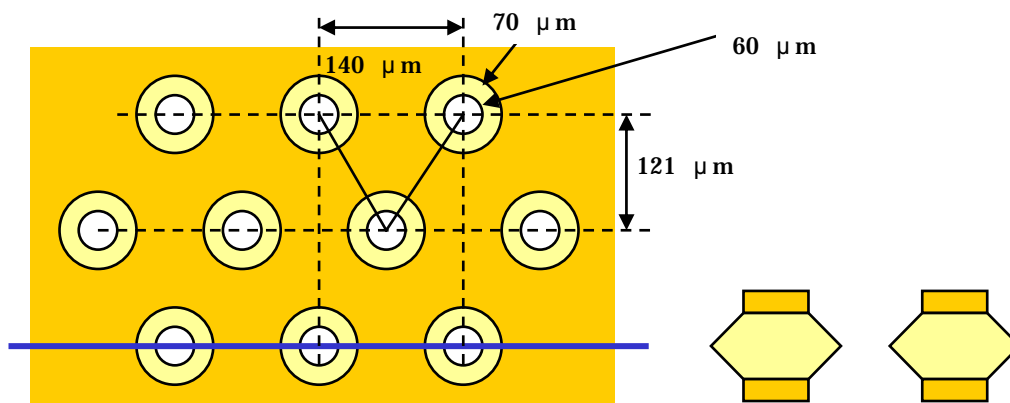


Figure 1. The structure of the GEM electrode. The left shows the
top view of the electrode and the right is its cross section view.
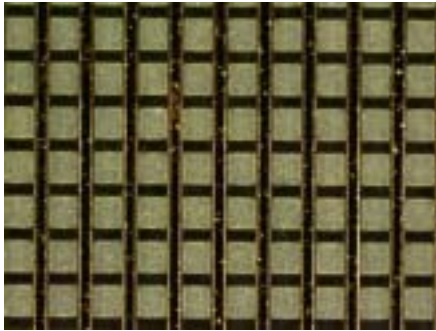
Figure 2. The picture of the readout board with the magnification 150.
Two layers can be seen, one is for the X coordinate detection and another is for Y coordinate.

As the readout system, HELIX128 card is used, which is originally developed for HERA-B experiment at DESY. One card has two chips and each chip contains 128 channels preamplifiers, buffer memory, and multiplexer. The 256 channel analogue signals received by a card are transferred with one serial line into flush ADC. The specification of the chip such as gain, shaping time, clock, and others can be programmed by loading the data into the registers integrated on HELIX128 card. The board to program the register was prepared with XilinX FPGA. Now the fabrication of each components is completed. The overview of the detector including the readout system can be seen in Fig.3. The operation test and basic measurement of the detector specification will be started soon.
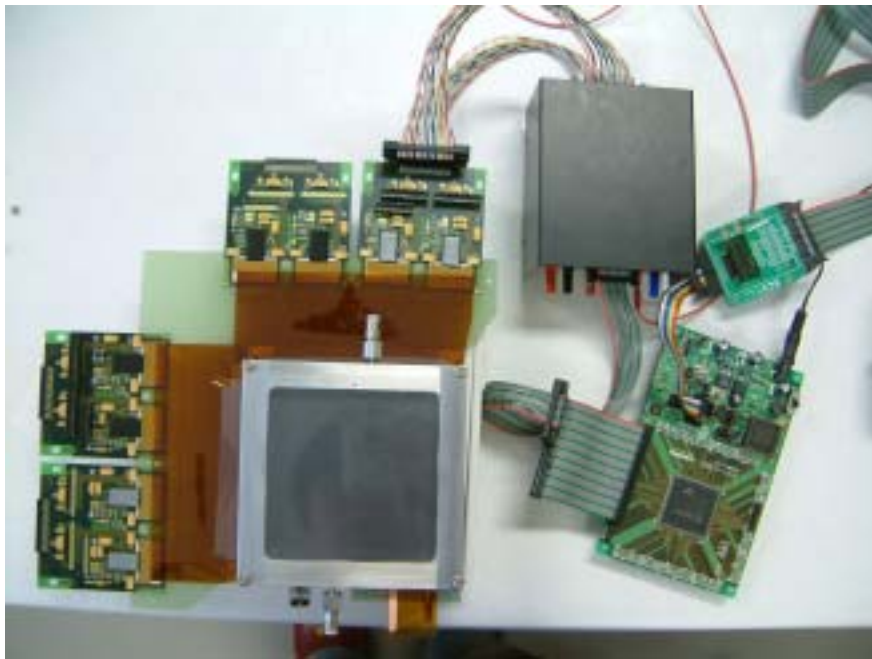


Figure 3. The overview of the GEM detector.

References
[1] F.Sauli, Nucl. Instr. And Meth. A386 (1997) 531.