Performance evaluation of GET readout electronics for heavy ion collision experiments at RIBF

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GET(Generic Electronics for TPCs)[1] will be used as the front-end readout electronics for the newly constructed SπRIT-TPC(SAMURAI pion Reconstruction Ion-Tracker Time Projection Chamber)[2]. The GET electronics has been recently developed by the GET collaboration for the particle and nuclear physics experiments and its performance is yet to be evaluated. We performed a test experiment at the Heavy Ion Medical Accelerator in Chiba(HIMAC) facility using the BRAHMS-TPC(TPM1)[3] to evaluate the performance of the GET electronics. The TPC has the multi-wire configuration similar to the SπRIT-TPC: anode wires for signal multiplication, gating grid wires to reduce the background noise.

We used 300 AMeV ^{132}Xe beam with 500 mg/cm^2 CsI target surrounded with the multiplicity trigger array of 60 scintillator plastics. To evaluate the resolution in both wire and drift directions, in the first setup the BRAHMS-TPC(TPM1) was placed at 60 degrees off the beam axis and we took data with different sampling rate of 5, 10, 25, 50, 100 and 200 MHz and shaping time of 70, 232, 502 and 1014 ns. Due to breakdown of the μ-TCA power supply, only one AsAd board(256 channels) is used in this configuration.

In the second setup the BRAHMS-TPC(TPM1) was located at 0 deg. We replaced the broken power supply and took data with three AsAd boards(768 channels) controlled by a full CoBo(Control Board for 4 AsAd boards). We tested the gating grid drivers with beam intensities varying from 10^2 to 10^5 pps. We placed five 3 mm thick Al plates in front of the TPC to stop the beam and heavy fragments so that only the light charged particles with $Z < 3$ can reach the TPC at the intensity 10^4 and 10^6 pps. Finally, with beam intensity 10^4 and 10^5 pps we took data under the SπRIT-TPC experimental condition: sampling rate of 25 MHz, shaping time of 232 ns, 256 time buckets(10.24 μs), and zero suppression mode.

Figure 1 shows the preliminary result in the first setup. The resolution is presented as a function of the layer numbers, where one layer means a row of 96 pads perpendicular to the beam axis and the BRAHMS-TPC has 12 layers. To obtain the resolution we selected three successive layers and calculated the difference between the hit position on the middle layer and the average position of hits on the first and the third layers assuming that the resolution of each pad is the same as δx. For example, $x = 0$ means the resolution is calculated with the layer number 0, 1, and 2 by accumulating $x_1 - (x_0 + x_2)/2$ values for all events. By the error propagation the RMS value of the distribution, σ, and the resolution, δx, have the relation: $\sigma = \sqrt{3/2}\delta x$.

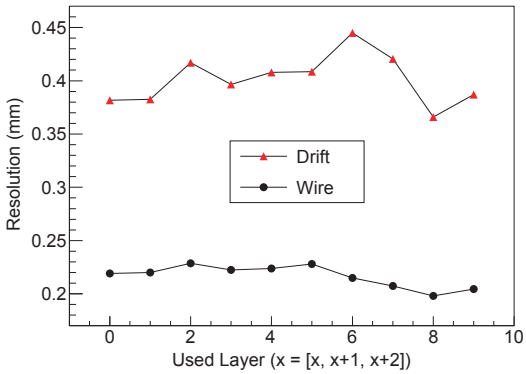

Fig. 1. Resolution of the wire and drift direction as a function of the layer number x, which is the first layer number among three layers.

Table 1. Resolution from two collaborations

Collaboration	Direction	
	wire (μm)	drift (μm)
BRAHMS	310	427
SπRIT	217±10	401±22

Comparison between the result from both collaborations is summarized in Table 1. Our result is better because the GET electronics is 12 bit ADC while the BRAHMS collaboration used 10 bit ADC.

Further analyses in the second setup are ongoing.

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