Operation of GET system as main readout device for SπRIT experiment at 2016 spring campaign

T. Isobe,[*1] M. Kurata-Nishimura,[*1] H. Baba,[*1] M. Kaneko,[*2] T. Murakami,[*2] W.G. Lynch,[*3] J. Barney,[*3] J. Estee,[*3] S. Tangwancharoen,[*3] G. Jhang,[*4] and J.W. Lee[*4] for the SπRIT Collaboration

The SπRIT time projection chamber (TPC) is one of the main devices for the SπRIT project at RIKEN-RIBF.[1] The SπRIT project aims to study the density-dependent term of the symmetry energy using heavy RI collision. General electronics for TPC (GET)[2] is a novel readout system employed for the SπRIT-TPC[3] to capture the signals produced by charged particles passing through TPC. By using the GET system, it is possible to realize a high resolution, wide dynamic range, and stable operation of data acquisition. The GET system for SπRIT-TPC is composed of 48 AsAd boards, 12 CoBo boards and 2 MuTANT boards. 12 CoBo boards and 2 MuTANT boards are mounted in 2 μ-TCA shelves so that the trigger signal and sampling clock are synchronized among different CoBo boards.

During the spring season of 2016, the first physics experiment campaign was performed as well as the commissioning of the SπRIT system in a SAMURAI magnet. All the readout electronics on TPC worked under a magnetic field of 0.5 T without any problem, and full operation of the GET system was successfully performed for a two-week physics run. The analog part of the system was configured to have a dynamic range of 120 fC, shaping time of 117 ns, and sampling rate of 25 MHz. The trigger rate was ∼60 Hz, and the total beam rate was ∼10 kHz. The SπRIT-DAQ system sustained a data rate of 300 MByte/s. The data were copied to RIKEN HPC storage through a 10-Gbps network for the 1st/offline data analysis. The trigger rate of 60 Hz was expected to be improved after the integration of a partial readout mode, where the channel was digitized and can be selected event by event to reduce the conversion time. Since this functionality was not fully tested as of spring 2016, only the fully digitized readout mode was used.

Figure 1 and Fig. 2 show the event display of heavy RI collision taken with SπRIT-TPC and the typical shape of electric signals detected with GET electronics, respectively.

As shown in Fig. 1, a large number of charged particle tracks pass through TPC. There are several pads which seem to be dead. However, the positions of the dead pads vary from event to event. The pads above the beam trajectory become dead.

The drift electrons produced by the beam is supposed to be blocked by the gating grid wire plane of TPC. An excessively large amount of δ-ray electrons produced by the beam which can penetrate the gating grid and is expected to affect the readout system.

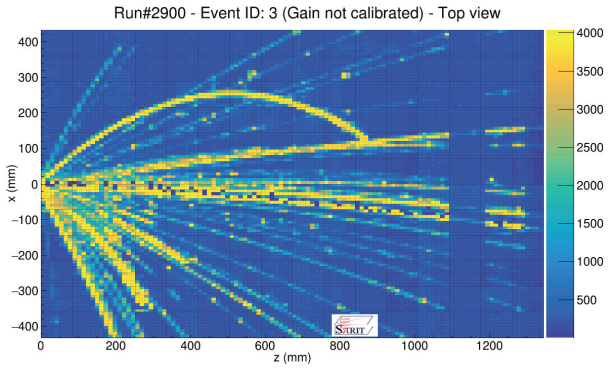

Fig. 1. Event display of heavy RI collision taken with SπRIT-TPC (top view). One dot corresponds to one of the channels. The color of each pad shows the maximum value of the signal. The Sn target is located at the left hand side of this display.

After a large effort to analyze TPC data, the ratio of charged pion production will be determined for setting the constraint on nuclear EoS.

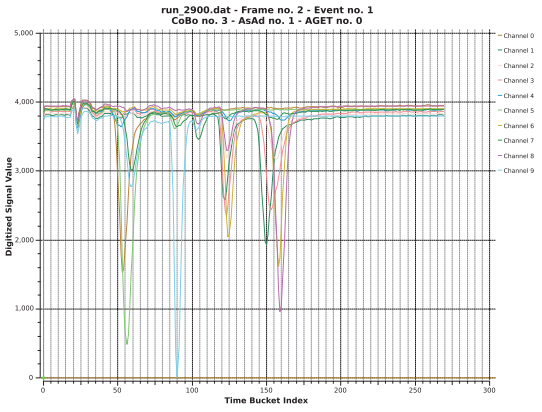

Fig. 2. Typical shape of electric signals produced by charged particles passing through TPC. Each color corresponds to each pad. Signals on 10 pads out of 12k pads are shown.

*1 RIKEN Nishina Center
*2 Department of Physics, Kyoto University
*3 National Superconducting Cyclotron Laboratory, Michigan State University
*4 Department of Physics, Korea University

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