Development of TPC readout system for SπRIT project

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For the measurement of multiple charged particle tracks in a heavy-ion collision experiment at RIBF, a time projection chamber (TPC) will be installed in the SAMURAI superconducting dipole magnet. The main aim of the experiment is to study the density dependence of symmetry energy defined in the nuclear equation of state. This project is carried out by an international collaboration, the "Sπ(PI)RIT collaboration"; SπRIT means Samurai PIon Reconstruction and Ion Tracker. As the readout electronics for more than 12k channels of TPC, a novel readout system, GET,[1] is employed. GET stands for General Electronics for TPC and has been developed mainly by a collaboration between French institutes and American institute. The details of the GET system for the SπRIT project have been reported by Isobe et al.[2].

For the first experiment at RIBF, we obtained the pre-production AsAd board, which is one of the important boards of the GET system and which was tested with SπRIT TPC at MSU. The pre-production AsAd board is controlled using the Xilinx evaluation board of ML507. ML507 can control only one board. For the massive readout of TPC, a dedicated concentration board, the CoBo board, which can control up to 4 boards, will be produced. Figure 1 shows the cosmic ray signal height of each channel as a function of the time bucket. There are 512 time buckets for one channel, and a sampling rate of up to 100 MHz is available. In the case of SπRIT TPC, a sampling rate of 50 MHz with 256 time buckets is planned to be used to cover the 10 μs drift time, which corresponds to a drift length of 50 cm with a 5 cm/μs drift velocity in P10 gas. Based on the information taken by the GET electronics, we succeeded to reconstruct the track as shown in Fig. 2. Now the analysis of the cosmic ray data is ongoing. It is planned that electron track data will eventually be taken with radioactive source.

As the data acquisition system, we plan to employ NARVAL,[2] which is used in the French nuclear physics laboratory, such as GANIL. The size of data produced by the SπRIT plus GET system is estimated to be more than 100 MByte per second. NARVAL is selected as it can handle data of such large size.

Finally, 48 electronic boards will be mounted on the TPC and will be tested with cosmic rays in 2014. After that, the TPC will be mounted on the SAMURAI magnet for the first heavy ion collision experiment.

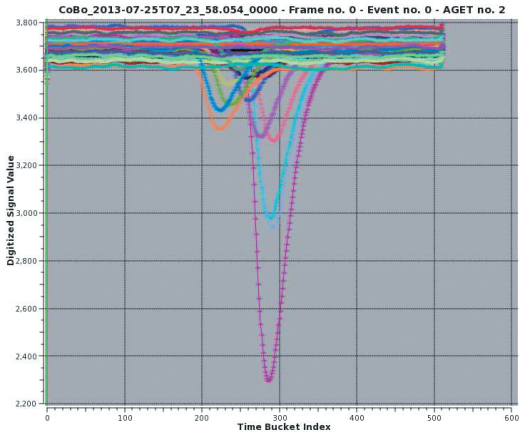

Fig. 1. Cosmic signal detected by SπRIT-TPC with GET electronics. Each line corresponds to one channel. One AsAd board contains four ASIC chips (AGET). One ASIC corresponds to 32 channels. The GET system employs SCA type flash ADC. Up to 512 time buckets can be used for analog data buffering. The pedestal is not suppressed in this figure.

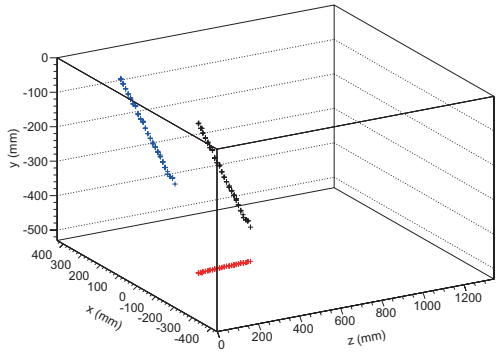

Fig. 2. Cosmic track reconstructed by SπRIT-TPC. The black line denotes the 3D track. The red and blue lines denote the projected track on each plane. A 100-MHz sampling rate is used.

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