Development of readout electronics for SAMURAI-TPC project

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Investigation of heavy-ion collision is one of the methods that can be used to study nuclear EoS. For performing a heavy-ion collision experiment at the Radioactive Ion Beam Facility (RIBF), a time projection chamber (TPC) will be installed in the SAMURAI superconducting dipole magnet. As the readout electronics for more than 12k channels in TPC, a novel readout system, GET[1)], is planned to be employed. GET stands for General Electronics for TPC, and has been developed mainly by France and USA collaboration. As shown in Figure 1, our GET system consists of ZAP, AsAd, CoBo, MUTANT and DAQ. The functionality of each component is summarized in Table 1. Although most components are provided by GET collaboration, each experimental group has to finalize their own system by developing some original components specialized for their experiment. In our case,we have developed the ZAP board, the updated DAQ, and an online software.

One of the main features of the SAMURAI-TPC readout system is the size of acquired data.

In spite of the data reduction and the limitation of the trigger rate, enormous amounts of data will be taken from the experiments using SAMURAI TPC because of the large number of readout channels. According to the simulation study, the most efficient way for the reduction is zero suppression, which will reduce the size by upto 90%. Drift time of an electron will limit the trigger to a rate between 200 and 500 Hz. In that case, the output data throughput is estimated to be 80∼300 MByte/sec, which corresponds to 100∼300 TByte per week. To handle such large amounts of data, the use of the RIKEN Integrated Computing Cluster (RICC) is considered for the data analysis.

The entire setup of the GET system for SAMURAI-TPC is supposed to be ready before the end of 2013. The SAMURAI-TPC is being constructed in the US and will be delivered to RIKEN at the end of 2013. The bunch of electronic boards will be mounted on the TPC and will be tested with cosmic rays. After that, the TPC will be mounted in SAMURAI magnet for the first experiment.

Table 1. Components of SAMURAI-TPC-GET readout system

TPC	Main detector. 108×112=12096 channels
ZAP	Adapter board to AsAd with protection from large signal. 1 ZAP for 1 AsAd.
AsAd	ASIC and ADC board. 4 AGET ASIC chips, FPGA and 4 ADCs (ADS6422) on 1 AsAd board. 64 channel readout with 1 ASIC (63 ch per AGET in our case). 512 samples at most. 1∼100 MHz sampling rate. Programmable gain. 192 AGET, 48 AsAd boards.
CoBo	Concentration board. DDRAM for event buffering. 4 AsAd per CoBo. Up to 10 CoBo can be mounted on 1 μ-TCA crate.
MUTANT	Trigger and time stamping module. 1 module per μ-TCA crate.
DAQ	Event building servers and computing farm for online/offline analysis.

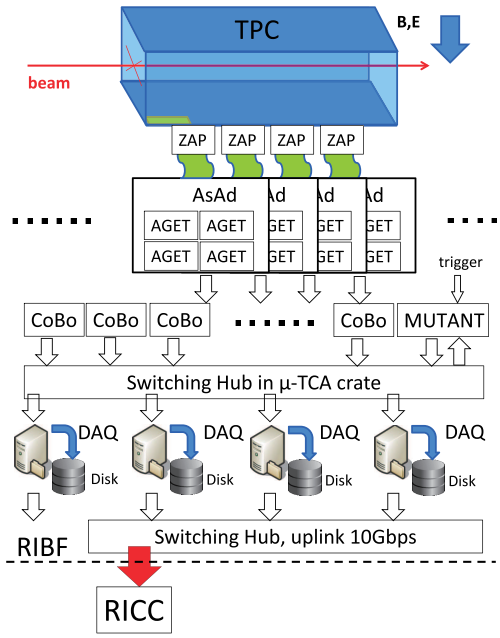

Fig. 1. Overview of readout system for SAMURAI-TPC

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References

1) E. Pollacco et al.: Physics Procedia **37**, 1799 (2012).