Development of the readout system for SCRIT WiSES

A. Enokizono,[*1,*2] H. Baba,[*2] Y. Haki,[*3] K. Kurita,[*1,*2] S. Matsuo,[*1,*2] Y. Moriya,[*2,*4] T. Suda,[*2,*4] T. Tamae,[*2,*4] K. Tsukada,[*2,*4] T. Tsuru[*2,*4] and S. Yoneyama[*2,*4]

WiSES (Window-frame Spectrometer for Electron Scattering) has been developed for SCRIT experiments in order to achieve the world's first measurement of the detailed structures of unstable nuclei using electron elastic scattering[1]. A detailed description of the WiSES apparatus is reported elsewhere[2]. One of the key components of WiSES is the Rear Drift Chamber (RDC) and the readout module (RAINER). In December 2014, all WiSES components including RDC and RAINERs have been installed for a wire target experiment, and the performance has been measured[3)4)]. In this report, the setup of RDC and the WiSES readout system for the wire target experiment is described.

RDC has a volume of 274 cm x 36 cm x 78 cm and consists of 10 layers as UU′VV′XX′UU′VV′ made out of 1002 sense wires (20 μm Au-W) and 3026 field wires (80 μm Au-Al). Each drift cell has a hexagonal shape with each side measuring 1 cm, and He + CH_4 (50:50) gas is used with an operation voltage of 2.95 kV. During the performance measurement and burn-in test for a year, 2 field wires of the U and V layers had a high current problem and have been replaced. We have found no hot/dead channel and experienced no HV trip throughout the wire target experiment.

Figure 1 shows RAINER which is a general multipurpose readout card (15 cm x 20 cm) manufactured by REPIC and is capable of processing ADC and TDC for 64 independent channels. TDC is counted by FPGA with the timing resolution of ∼1 ns with an 8 μs ring buffer. One of the advantages of using RAINER is the reduction of analog background noises by digitizing the signal at FPGA and the data is sent on TCP. This is beneficial for RDC which is installed near SCRIT SR2's RF power source. An RF noise test has been performed and reported elsewhere[4]. 16 cards are mounted on RDC to read all 1002 channels and the data is sent to a DAQ PC via Ethernet cables with a Gigabit switching hub. It has two data write modes, i.e. RAW mode and zero suppression mode to help in speeding up the DAQ rate.

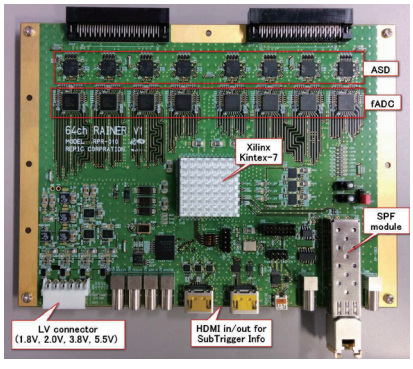

Fig. 1. RAINER card

As shown in Figure 2, two plastic scintillators are installed for triggering events and veto scintillators are also placed to remove cosmic events and background from the SR2 ring. TDC data for FDC are obtained with AMT-VME and the data is sent to the same DAQ PC as one for RAINERs. RIBFDAQ[5] (Babirl and ANAROOT) are used as the DAQ and online monitoring softwares. 16 RAINER data and VME data are taken by independent 17 processes using only one DAQ PC including the event builder. The DAQ performance test shows that there is no event loss up to a few kHz in the zero suppression mode. This is sufficient considering our trigger rate which is typically a few hundreds Hz including backgrounds.

In summary, SCRIT WiSES and the readout system have been developed and operated smoothly for the wire target experiment, except for a few minor issues. More studies and improvements of the DAQ system are underway toward the first electron-^{132}Sn scattering experiment at SCRIT in 2015.

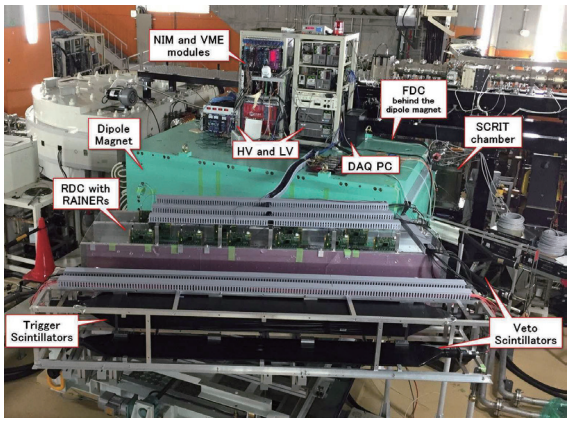

Fig. 2. Appearance of WiSES setup at SCRIT experiment.

*1 Department of Physics, Rikkyo University
*2 RIKEN Nishina Center
*3 REPIC Corporation
*4 Research Center for Electron-Photon Science, Tohoku University

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