Integration of VX2740B digitizer into babirl DAQ

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We investigate cluster formation mechanism dependent on isotope and the kind of clusters by (p, pX) cluster knock-out experiments and inverse kinematics reconstruction with TOGAXSI array,[1] which named ONOKORO project.[2] It is difficult that approximately 100 ch signals from TOGAXSI array are processed in a conventional analog circuit and combined into output triggers based (p, pX) kinematics. CAEN digitizer VX2740B is a promising candidate to obtain data from GAGG scintillators of TOGAXSI array, process complex logic signals, and generate triggers.

VX2740B digitizer is an 125 MS/s ADC having 64 analog inputs, compliant with VME64X standard which has a 62.5 MHz internal clock. Pulse height is sampled by the 16-bit ADC in full-scale range of 2 Vpp. The VME crate is used only as a power supplier. Data is obtained via USB-3.0, 1/10 Gigabit Ethernet, or optical link cables attached to the front panel. Digitized signal, which is temporarily stored in 2.5 GB memory, is processed in FPGA Xilinx Zynq UltraScale+ implemented on VX2740B board. If the data rate is too high, the memory becomes full, VX2740B outputs intrinsic busy signals and the efficiency is significantly suppressed. CAEN provides firmware and C libraries named "FELib" for the basic waveform processing. Here we have developed a new program to integrate VX2740B into babirl DAQ.[3] It is called as babies for VX2740B and it utilizes FELib.

The H424 experiment[4] was carried out in PH2 course at QST, HIMAC and we confirmed that VX2740B can work properly under the experiment condition as a first development. Beam nuclide is ^{4}He, ^{16}O, ^{40}Ar and all of their energy were set to 230 MeV/nucleon. ESPRI chamber, drift chambers and ONOKORO chamber were aligned from the beam upstream to the downstream. The detector data except those of VX2740B were obtained by MPV[5] which is a VME-based DAQ system. 24 signals from GAGG in the ONOKORO chamber and 2 signals from GAGG read out with photodiodes in the ESPRI chamber were divided and entered into VX2740B and conventional CAEN ADC V785 installed in MPV. In this experiment, "scope" firmware was used to acquire waveforms by VX2740B. VX2740B was driven by a common external trigger from the babirl DAQ while data from VX2740B and the babirl DAQ were saved in separate ridf files. To synchronize the timestamp information, which eanbles merging separately stored data, a 62.5 MHz internal clock of VX2740B was distributed to MPV.

As a result, we have found that VX2740B did not output busy and then VX2740B event counts are almost the same as babirl DAQ when input channels were 26 and trigger rate was approximately 1 kHz. As shown in Fig. 1, waveforms are correctly obtained. We analyzed the ridf files unified with timestamps in order to compare the ADC values of V785 obtained by existing DAQ with the PHA values calculated from waveforms acquired by VX2740B, resulting the linear correlation event by event (Fig. 2).

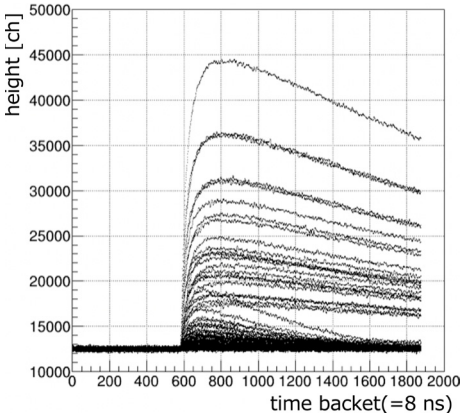

Fig. 1. Waveforms obtained by VX2470B.

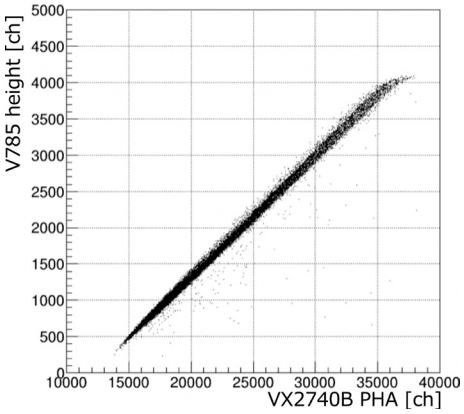

Fig. 2. Pulse height correlation.

In summary, we have developed the babies for VX2740B and succeeded in integrating it into babirl DAQ. In the HIMAC experiment, we operated it simultaneously with conventional ADC V785 and confirmed that the data was obtained correctly. In future studies, we plan to test the triggering function of VX2740B with "DPP-PHA" firmware provided by CAEN.

References

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