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Universal Readout Method for GAEA Gamma Spectrometer at CSNS Back-n White Neutron Source

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The back-streaming neutrons (Back-n) facility at China Spallation Neutron Source provides an excellent white neutron source for accurate measurements of nuclear data. At Back-n, the GAEA (gamma spectrometer with germanium array) spectrometer in planning is designed for neutron-induced cross-sections measurements with high accuracy and efficiency. As six kinds of detectors are used in GAEA, it is hard to design and maintain different readout electronics for each type of detector separately. Therefore, a universal readout method is proposed in this paper, which mainly consists of readout modules and the PXIe readout platform. To accommodate different characteristics of signals from various detectors, each of the readout module is composed of a dedicated mezzanine board for digitization and a universal carrier board for data processing and readout. The signal from detector is digitized directly on the mezzanine board with a dedicated analog gain. By changing the value of the feedback resistance, the gain of the conditioning circuit can be adapted for each detector. The digitized data is transmitted to the field programmable gate array (FPGA) in the 3U carrier board for data processing with real-time algorithms. Finally, the triggered data will be transmitted to the chassis controller via the PCIe bus. Besides high-speed data transmission, the PXIe chassis provides an excellent platform for digital trigger system. With full waveform digitization technology, the readout method in this paper provides a concise and high-performance readout electronics for GAEA.

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