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Evaluation Software for BaF2 Detector Array Electronics at CSNS-WNS

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Barium fluoride (BaF₂) detector array is one of the main experiment facilities at CSNS-WNS (white neutron sources at China Spallation Neutron Source). It is designed for the high precise measurement of neutron capture cross-section. The BaF₂ detector array consists of 92 crystal elements with completely 4π solid-angle coverage, which leads to 92 analog channels each of which need to be digitized for acquisition. Accordingly, the readout electronics system for the BaF₂ detector array is designed to be a distributed system with 4 readout PXIe crates, which contains 46 field digitization modules (FDMs). Each FDM supports two valid channels for signal digitizing. In this paper, the evaluation software is designed for evaluating the performance of the BaF₂ readout electronics system. It focuses on evaluating the performance for data transmission, ADC digitizing in FDM, and the detector array status monitoring. This evaluation software consists of three parts. The first part is data aggregation and distribution network (ADN) with star topology. In this topology, the central node, to which all other nodes are connected, is assigned as the master node responsible for bridging data between nodes on ADN and the backend data acquisition system. It runs on the acquisition computer. Each slave node represents a PXIe crate system containing crate controller, digitizing, timing and trigger modules. The number of slave nodes on ADN can be configured according to the requirement of experiment, which makes the system has an extensible and distributed architecture. The second part is the event-building center (EBC). EBC is mainly responsible for event building and data analyzing. With the first two parts in the software system, valid raw scientific data transmitted from FDM to back-end computer can be acquired and be ready for being analyzed. To better evaluate the readout electronics, control and monitor are required. So the third part of the software system is graphical user interface (GUI), which aims at controlling and monitoring the readout modules running on distributed PXIe crates and data visualization. The GUI viewer can be customized flexibly according to system requirement without any code modification or re-compiling. This makes the software system has good scalability. To communicate with ADN correctly, a unified interface module is realized in the EBC and GUI node respectively. Preliminary test shows that the evaluation software system can correctly acquire data from the BaF₂ readout system and evaluate the ADC performance under ADC test mode. FDMs in the readout system can also be monitored and controlled by this evaluation software in real-time.

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