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SAMPA Based Streaming Readout Data Acquisition Prototype

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We have assembled a small-scale streaming data acquisition system based on the SAMPA front-end ASIC. The 32-channel SAMPA chip was designed for the high-luminosity upgrade of the ALICE Time Projection Chamber (TPC) detector at the CERN Large Hadron Collider. The goals of the prototype system are to determine if the SAMPA chip is appropriate for use in detector systems at Jefferson Lab, and to gain experience with the hardware and software required to deploy streaming data acquisition systems in nuclear physics experiments. The 800 channel system is composed of components used in the ALICE TPC data acquisition upgrade. Five front-end cards (FEC) support five SAMPA chips each. SAMPA data streams on an FEC are concentrated into two high-speed (4.48 Gb/s) serial data streams by a pair Gigabit Transceiver ASICs (GBTx). These ten streams (44.8 Gb/s) are transmitted from the FECs over fibers to a PCIe based readout unit. The FPGA engine on the readout unit compresses data for transmission to a server via 100 Gb ethernet. Components on the FECs are radiation tolerant. High data rates can be handled. The system is by design scalable and thus provides a functional prototype for high-rate streaming readout at Jefferson Lab and the future Electron Ion Collider. We have made fundamental measurements (noise, linearity, time resolution) on the SAMPA ASIC. We have also coupled the readout system to a small Gas Electron Multiplier (GEM) detector and have studied its response to cosmic rays. A beam test of the system is planned.

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