Multichannel Data Acquisition System for GEM Detectors

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This paper presents the data acquisition system for GEM-detector [1] based cameras and spectrometers [2]. The system is modular [3] and supports 1D and 2D GEM arrays with software-defined readout modes. Channel count can vary from 8 up to hundreds. The readout electronics consists of two units - radiation tolerant Analog Front End and rack-mount data processing unit. Data processing is split into two parts - real time hardware, based on FPGA and software, based on embedded multicore CPUs and hardware accelerators.
The FPGA subsystem together with PCIe interface and multi-core Xeon processors forms low latency, high-performance processing chain suitable for applications requiring feedback.
The detectors in tokamaks operate in the high magnetic field, so the system was equipped with multipoint magnetic field measurement synchronized with detector readout. The system also includes custom HV supply, developed for triple GEM detectors operating in the high-rate mode. Dedicated protection and diagnostic subsystems were developed as well to ensure safe and reliable operation of the detector in harsh conditions. To support the operation of the detector in the high-temperature surrounding, liquid cooling subsystem was developed.

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