

Design of the FPGA-based Gigabit Serial Link for PandaX-III Experiment

PandaX-III (Particle And Astrophysical Xenon Experiment III) is aimed to search for NLDBD (Neutrinoless Double Beta Decay) of ^{136}Xe at China Jin Ping underground Laboratory (CJPL). For first phase of this experiment, a high pressure gas Time Projection Chamber (TPC) containing 200 kg, 90% ^{136}Xe enriched gas at 10 bar operates as detector. In the current baseline design, each TPC end-plate composes of 41 Microbulk Micromegas detectors, each read out in 64 X and 64 Y strips, the total number of channels whole TPC is 10496. Readout electronics for this experiment must provide low noise, high energy resolution, capability to process tens of thousands of channels and transfer their effective data, and low level of radioactivity.

In order to satisfy the requirement of high data throughput and low radioactivity, we use optical fiber links to communicate between front-end board and back-end board. Front-end board installed inside the water-proof vessel integrates charge of micromegas signals, digitize the waveform and send the data packet to back-end Data Acquisition (DAQ) board. Front-end board needs synchronous information (global clock, global trigger, global reset, etc.), as well as command messages from DAQ board. To accommodate the various types of signals, we propose a user-defined protocol with optical links. Communication of serial transmission is performed using Xilinx FPGA based Gigabit Transceiver (GTP and GTX) with a 1 Gbit/s point-to-point speed. The FPGA on DAQ board also processes event data and realizes 1 Gbit/s Ethernet interface to control PC. Finally, preliminary joint test with detectors is conducted in Shanghai, shows this system good performance and sufficient data bandwidth.

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