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Design and Implementation of a screening platform for SAMPA ASIC in front-end electronics of HERD-TRD

The High Energy Cosmic Radiation Detection (HERD) facility is one of several planned space astronomy payloads to be deployed onboard the upcoming China Space Station (CSS). HERD is expected to begin operation around 2027 and continue for approximately ten years. Among its key subsystems, the Transition Radiation Detector (TRD) is designed to calibrate the TeV energy spectrum of the Calorimeter (CALO) and assist in X-ray observations. The TRD will be mounted on one side of HERD and primarily consists of detection units, front-end electronics (FEE), back-end electronics (BEE), and a one-dimensional turntable. The FEE architecture employs a combination of SAMPA application specific integrated circuit (ASIC) chips and a field-programmable gate array (FPGA). Developed by CERN, the SAMPA ASIC demonstrates strong radiation tolerance, making it suitable for use in high-radiation environments. However, as it is an industrial-grade chip, its ability to meet aerospace-grade requirements—particularly in terms of long-term stability and low-noise performance under space conditions—remains uncertain. To address this challenge, a dedicated SAMPA chip screening system has been developed. This system comprises a SAMPA chip screening board and corresponding host computer software. The screening board integrates two SAMPA test sockets, a Xilinx Kintex-7 XC7K325TFFG900 FPGA, level shifters, quad serial peripheral interface (QSPI) flash memory, two oscillators, gigabit ethernet, and various other serial peripheral interfaces. The FPGA receives serial scientific data from the SAMPA chips via scalable low voltage signaling (SLVS) and performs data parsing, checksum verification, and data packaging. The processed data is transmitted to the host computer over gigabit ethernet for acquisition. The host software enables comprehensive control of the system by issuing configuration commands and managing data flow. In addition to command transmission and data reception, the software supports both real-time and online data analysis. It facilitates the evaluation of key performance indicators such as noise, linearity, and gain. The SAMPA screening system has been fully designed and implemented, and is currently undergoing a comprehensive electrical performance evaluation. The results of these tests will be reported at the conference.

Workshop topics

Front-end electronics and readout

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