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P1.2: Prototype design of readout electronics for Transition Radiation Detector in High Energy cosmic-Radiation Detection

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The High Energy cosmic-Radiation Detection facility (HERD) is a module being built with a planned launch in 2027. It will be installed on China's Space Station as part of the Chinese Cosmic Lighthouse Program. An additional Transition Radiation Detector (TRD) will be placed on one of the lateral sides. It will calibrate Calorimeter (CALO) in the TeV energy range with cosmic rays. We have designed a readout electronics prototype system for TRD based on the SAMPA chip. The readout electronics board includes two SAMPA chips and has 64 channels. In addition, it has a DP78 interface to receive the negative charge pulse signal from the detector, and an optical interface communicates with the computer. The readout electronics uses a Xilinx Kintex7 XC7K70T-2FBG676I FPGA to analyze packets from SAMPA, and the valid events data is packed and transmitted to the computer by SiTCP. SAMPA internal registers are also configured within FPAG by the I2C bus. The event rate can be up to 10 kHz in the external trigger mode, and there is no dead time in the self-trigger mode. This system's Integral Nonlinearity (INL) can reach 0.36%. Fe55 source testing results demonstrate that the readout system can perform well. The whole detect system's resolution can reach 27%. Then we will go to CERN for a beam test in September 2023.

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