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Readout Electronics for a Prototype TPC-based MeV Gamma-ray Telescope

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A design of readout electronics for a prototype electron-tracking Compton camera has been developed recently. The Compton camera will be a high-resolution MeV gamma-ray telescope in space. The telescope comprises a 30 cm cubic gaseous time-projection chamber (TPC) for electron tracking and energy measurement, with a $40\ \mathrm{mm} \times 40\ \mathrm{mm} \times 10\ \mathrm{mm}$ spatial-sensitive, high-resolution cadmium zinc telluride (CZT) detector array at the bottom of the TPC for scattering gamma-ray detection. To improve the spatial and energy resolution of electrons, a $30\ \mathrm{cm} \times 30\ \mathrm{cm}$ Micromegas detector with two-dimensional 0.65 mm pitch strip anodes has been used as the anode plane of TPC. The CZT detectors have pixelated anodes for the same purpose. Each CZT detector has 11×11 pixelated anodes with a 1.72 mm pitch. Four detectors have been used in total. Therefore, two kinds of different front-end electronics with different ASICs are used to process signals from TPC and CZT detectors separately and finally collected by the data acquisition system. We have conducted the performance test of a single CZT detector. The results show that the energy resolution of most pixels is better than 2% at 662 keV, which can satisfy the demand for resolution of the angular resolution measure (ARM) of incident gamma rays.

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