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Design of electronics readout system based on zero compression and threshold comparison algorithm

This paper presents Cosmic X-ray Polarization Detection-Topmetal-M2 (CXPD-M2), a CubeSat electronic system based on the Topmetal-M2 pixel chip, specifically designed for X-ray polarization detection in the 2–10 keV energy range. The CXPD-M2 system comprises both hardware and firmware. The hardware, developed under stringent power and space constraints, adopts a three layer electronic board architecture consisting of a chip bonding board, a front-end signal processing board, and a back-end control board. The firmware not only provides essential communication, device control, and data transmission functionalities but also integrates zero-suppression and threshold comparison algorithms within a rolling shutter readout mode for large area pixel arrays, effectively reducing noise while preserving valid particle signals. Experimental validation using alpha-particle and neutron-source demonstrated that, with a 400×512 pixel Topmetal-M2 operating at a 20M readout rate, the system achieves a 99% reduction in redundant data, confirming its feasibility. This compact and efficient CubeSat based solution for X-ray polarimetry establishes a promising platform for future spaceborne detection applications and offers opportunities for further advancements in pixel chip algorithm integration and optimization.

Workshop topics

Detector systems

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