

Performance evaluation of the high-voltage CMOS active pixel sensor AstroPix for gamma-ray space telescopes

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We have been developing the high-voltage CMOS active pixel sensor, AstroPix, mainly for the future gamma-ray space telescope, AMEGO-X. The gamma-ray detector of AMEGO-X consists of four identical stacked silicon tracker towers and requires $\sim 6 \times 10^4$ cm² silicon area. The scientific purpose of the AMEGO-X mission dictates a number of requirements on the performances of the instrument, such as the energy range (25 keV - 1 GeV) and resolution, which affects the design of the detector. AstroPix has to be 500 μ m thick and to be fully depleted by supplying bias voltage. Also the energy resolution must be $< 10\%$ (FWHM) at 60 keV and the pixel pitch should be 500×500 μ m² in order to achieve the desired angular resolution of the gamma-ray detector. Furthermore, given the space-based nature of AMEGO-X, the power consumption of AstroPix needs to be limited (< 1 mW/cm²). The first version of AstroPix was developed based on the experience of the developments of both ATLASPix and MuPix. Our development strategy is to incrementally upgrade the chip design towards fulfilling the requirements for AMEGO-X. While the development is under way, the latest version of AstroPix already reached the target pixel pitch. In this contribution, we report about the AstroPix developments and performance, such as I-V, noise, energy calibration/resolution/threshold, depletion depth, and their radiation tolerance.

Submission declaration

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