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Evaluation of SOI Pixel Detector with Charge Sensitive Amplifier Circuit for Event-Driven X-ray Readout

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We have been developing monolithic active pixel detectors, "XRPIX", with the silicon-on-insulator (SOI) technology for future X-ray astronomical satellite missions. XRPIX is wide-band (0.3 –40 keV) fine imaging spectrometer and the advantage is low background. Our objective performance are high coincidence time resolution (~ 1 μs), superior hit-position readout time (~ 10 μs) in order to reduce the non-X-ray background by cosmic rays. XRPIX contains comparator circuit in each pixel to detect an X-ray photon injection; it offers intra-pixel hit trigger (timing) and two-dimensional hit-pattern (position) outputs.
Therefore, it is capable of direct access to selected pixels to read out the signal amplitude. X-ray readout by this function is called ''Event-Driven readout". By introducing an anti-coincidence method between the hit signal and the external active shield detector, the back ground can be greatly reduced. It realizes about 1 % of low background of CCD at 20 keV.

In our previous study, we developed prototype of XRPIX and demonstrated the acquisition of X-ray spectra in Event-Driven readout. The energy resolution are 900 eV (FWHM) for Frame mode and 1.2 keV (FWHM) for Event-Driven mode at 22.2 keV. And the readout noise is 68 e- (rms) for Frame mode.

Recently, we designed a new prototype which has charge sensitive amplifier (CSA) in each pixel in order to increase the gain and improve energy resolution. Then, the readout noise reached 33 e- (rms) and the energy resolution is about 300 eV (FWHM) at 5.9 keV. The Event-Driven X-ray readout by CSA circuit is under evaluation now. In this presentation, we report the present status of development focusing on spectrum performance.

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