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Development and Evaluation of Event-Driven SOI Pixel Detector for X-ray Astronomy

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We have been developing a monolithic active pixel sensor with the silicon-on-insulator (SOI) CMOS technology for use in future X-ray astronomical satellite mission. Our objective is to replace the X-ray Charge Coupled Device, which is the standard detector in the field, by offering high coincidence time resolution (~ 50 ns), superior hit-position readout time (~ 10 μs), and wider bandpass (0.3 –40 keV) in addition to having comparable performances in imaging spectroscopy. In order to realize this detector, we have developed prototype detectors, called "XRPIX"series. 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, XRPIX 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".

In our previous study, we successfully demonstrated the acquisition of X-ray spectra in Event-Driven readout. Although some problems still remain in operation of the circuit, a detailed investigating operation of XRPIX revealed their cause recently. Moreover, we designed a new prototype which has charge sensitive amplifier in each pixel in order to increase the gain and improve energy resolution. Then, the readout noise is 33 e- rms and the energy resolution is about 300 eV FWHM at 5.9 keV. In this presentation, we report on the development and evaluation of XRPIX about Event-Driven readout.

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