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Soft X-ray Trigger Performance of X-ray Astronomy SOI Pixel Sensors, "XRPIX"

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We have been developing X-ray Silicon-On-Insulator (SOI) pixel sensors, called "XRPIX" for the next generation X-ray astronomy satellite "FORCE" (Tsuru et al. 2018, Proc. of SPIE 10709, 107090H). XRPIX has the event trigger output function which achieves a time resolution of 10 μ s. This time resolution is higher by an order of five than that of X-ray CCDs, used as the main detectors in the current X-ray astronomy satellites. In this presentation, we report results on the evaluation of the trigger function. (1) We show the linearity between the X-ray energy and the threshold voltage of the trigger circuit using monochromatic X-rays such as Fe-K α (6.4 keV), Al-K α (1.5 keV), and F-K α (0.68 keV). Although overall linearity is good enough, there is an offset equivalent to 1.4 keV. (2) We report the lower X-ray energy threshold. It is determined by the circuit noises of the charge sensitive amplifier and the comparator for the trigger output function. The noise of the comparator circuit is equivalent to 70 ~ 80 e (rms), which is significantly higher than that of the charge sensitive amplifier of ~ 10 e (rms). The lower threshold X-ray energy that can be detected with the trigger output function is 1.5 keV, which is determined by the lowest threshold voltage at which the comparator circuit noise is not triggered. The target lower threshold is 1.0 keV, so further noise reduction is necessary. (3) In addition, we report the spectral performance for low energy X-rays such as energy resolution and the tail structure in the spectrum.

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