SOIPX for X-ray Astronomy

We have been developing monolithic active pixel detectors based on the SOIPX for future X-ray astronomical satellite missions (e.g. FORCE).

The performance is required …
- FWHM ≤ 140 eV @ 6 keV (Readout Noise ≤ 10 e– (rms))
- Spatial resolution : ≤ 100 µm pitch pixel
- Coincidence time resolution : ~10 µs per event readout
- Wide energy range : 0.5 ~ 40 keV

→ We have been developing “XRPIX device.”

Event-driven Readout Mode

We realize the spectroscopic system on the right figure.

(anti-coincidence method between hit signals and external active shield detectors)

Our Works with XRPIX

We have designed 13 devices and shown some basic performances.
- X-ray response of XRPIX (SOIPX) -> XRPIX1/1b [1], [2]
- Event-driven readout mode -> XRPIX1b [3], XRPIX2b [4]
- Improvement of spectroscopic performance -> XRPIX3b [5], XRPIX6E [6]
- Large-area device -> XRPIX5 (Single-SOI) [7] / XRPIX7 (Double-SOI)

The basic function of XRPIX has been already realized. We have improved spectroscopic performance by developing circuit and sensor structure.

This work

XRPIX has a pattern processing circuit for efficient X-ray event determination in event-driven mode.

→ We evaluate the pattern processing function of the designed circuit.

Pattern Processing Circuit for Event-driven mode

- XRPIX has a pattern processing circuit for efficient event determination.
- XRPIX outputs the address of the place where the event is detected through the encoder circuit.
→ Independent of Row Address (RA) and Column Address (CA) side
- By switching between “Low Edge” and “High Edge” addresses, we can know the position and size of events detected by only two addresses (Low / High) conversions.
- The output address is shifted by the input of the scan clock signal.
→ Pattern scan function

Test Results of Pattern Classification

- The difference in classification by radioactive source was tested using the pattern information of XRPIX6E.
→ Front illumination (affects the size of the charge cloud) / 100k events
- Under the condition that the firing pixel by event detection is two or less, we can use pattern information to help determine X-ray events.

Summary

- We have been developing the event-driven SOIPX, “XRPIX”, for future X-ray astronomical satellite missions (e.g. FORCE).
- We designed the pattern processing circuit for efficient X-ray event determination.
- We evaluated the pattern processing circuit according to the types of radioactive sources.
- This function of XRPIX improves the X-ray determination efficiency.
- We will optimize these functions to help determine X-ray events.

Reference


Please contact us if you are interested. -> http://rd.kek.jp/project/soi/
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