13th International "Hiroshima" Symposium on the Development and Application of Semiconductor Tracking Detectors (HSTD13), Vancouver, Canada

Contribution ID: **78** Type: **Oral**

Evaluation of the X-ray SOI pixel detector with on-chip ADC

Thursday 7 December 2023 12:20 (20 minutes)

The monolithic X-ray SOI-CMOS detector "XRPIX" integrates a sensor layer and a CMOS layer by sandwiching an insulating layer made of SiO2 using SOI technology. This detector is planned to be installed in future X-ray satellites. SOI technology allows us to implement complex CMOS readout circuits. The detection efficiency is high even for X-rays above 10 keV due to the thick depletion layer of several hundred μm. Therefore, by implementing the self-trigger function in pixel circuits, the time resolution of XRPIX is less than 10 μs, which is excellent for observing time-varying celestial objects. In order to achieve a large imaging area in the limited space of the satellite, it is essential that the ADC (analog-to-digital converter) be mounted on the detector (on-chip).
We developed XRPIX9 with on-chip ADC and evaluated the performance of the ADC. The XRPIX9 is equipped with 16 units of 14-bit cyclic ADCs to read out 8 columns. And their convert speed is 5.96 μs. Cyclic ADC performs binary search by repeatedly using a common amplifier and comparator for the number of bits, thus enabling high-precision AD conversion in a small footprint. To evaluate the cyclic ADC, at first, external signals were input to the ADCs by connecting with the function generator. We evaluated the integral nonlinearity, differential nonlinearity, and input noise of the ADC, which were found to be 0.06%, 0.5 LSB, and 3 LSB respectively. We also irradiated XRPIX9 with 5.9 keV X-rays from 55Fe, then we successfully obtained X-ray signals via on-chip ADC. In this presentation, we will report these evaluations of the performance of on-chip ADC and their details.

Submission declaration

Original and unplublished

Author: MATSUHASHI, Hiroumi

Co-authors: BAMBA, Aya (The University of Tokyo); TAKEDA, Ayaki (University of Miyazaki); SUZUKI, Hiromasa (Konan University); KURACHI, Ikuo (D&S inc.); MORI, Koji (University of Miyazaki); HAGINO, Kouichi; MATSUDA, Masamune (Kyoto University); YUKUMOTO, Masataka; UENOMACHI, Mizuki (Kyoto University); TANAKA, Takaaki (Konan University); KOHMURA, Takayoshi (Tokyo University of Science); TSURU, Takeshi (Kyoto University); NARITA, Takuto; IKEDA, Tomonori (Kyoto University); Prof. ARAI, Yasuo (High Energy Accelerator Research Organization (JP)); NISHIOKA, Yusuke (University of Miyazaki); UCHIDA, Yusuke (Tokyo University of Science)

Presenter: MATSUHASHI, Hiroumi

Session Classification: Day 4 - Session 2

Track Classification: Applications in astrophysics