



SOIPIX
Silicon-On-Insulator Pixel Detector Project



IMSS
物質構造科学研究所

Development status of new readout system for SOI pixel detector using 10 Gb Ethernet SiTCP

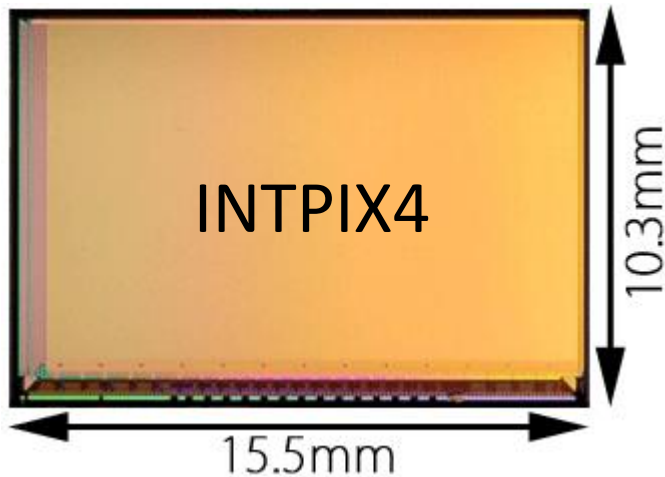
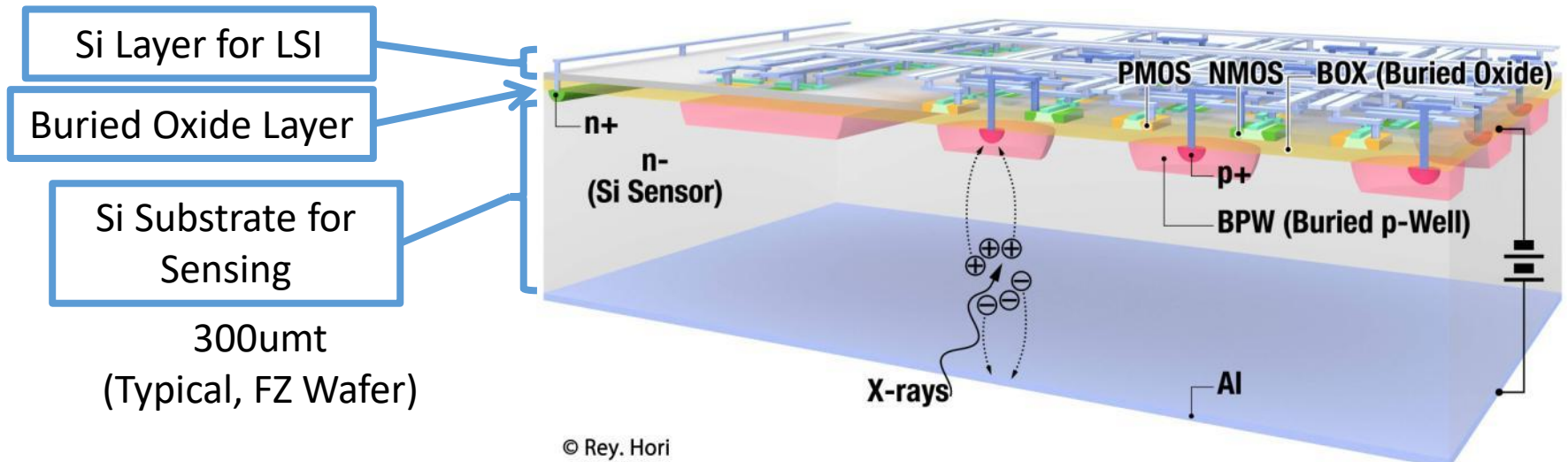
Ryutaro NISHIMURA^{1,*}, Shunji KISHIMOTO¹,
Yasuo ARAI², Toshinobu MIYOSHI²

¹ Institute of Materials Structure Science, High Energy Accelerator Research Organization

² Institute of Particle and Nuclear Studies, High Energy Accelerator Research Organization

*ryunishi@post.kek.jp

SOI pixel detector (SOIPIX)



Integration Type SOIPIX detector

- 17 um × 17 um square pixel
- Column 832 × Row 512 pixels array (425,984 pixels)
- Global shutter
- Designed Gain : -14uV/e⁻

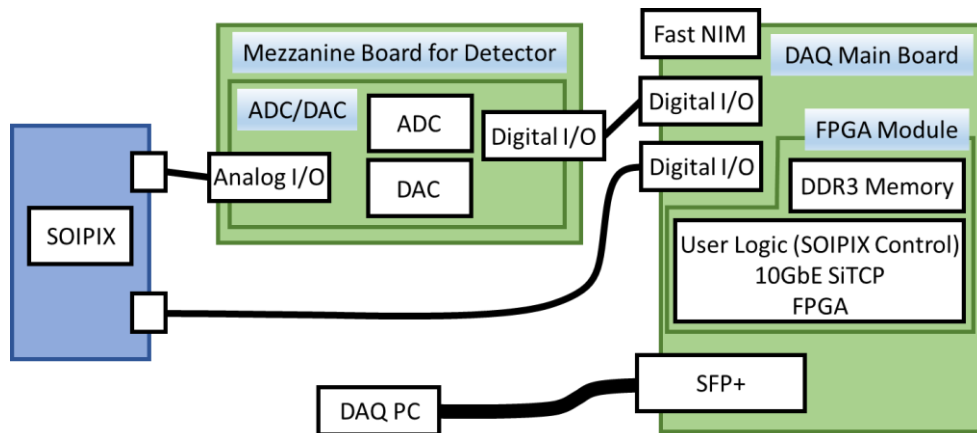
-> Available for X-ray Imaging.

-> Improved Version (INTPIX4NA) is under testing.

New readout system using 10GbE SiTCP

SiTCP is a network processor IP (Intellectual Property) core that can be implemented in an FPGA.

- Developed by Tomohisa Uchida (KEK ESYS), and currently developed and supported by Bee Beans Technologies.
 - Small circuit size (~3000 Slice), simple FIFO like I/F, close to specification maximum transfer speed caused by Hardware-based implementation and easy to customize.
 - Present system using 1GbE SiTCP, and it is not enough for advanced experiments. (high framerate, large area etc.)
- > **10GbE SiTCP (SiTCP-XG) is upgrade version of SiTCP and strong solution for our readout system.**



10GbE SiTCP readout system

- New readout boards (pilot production) were developed and now under testing.
 - 10GbE SiTCP was implemented to Kintex-7 FPGA, mixed implementation with SOIPIX control logic.
- Prototype of new system was developed on KC705 commercial FPGA evaluation board with Alpha release of 10GbE SiTCP. (Results were shown in next slides)

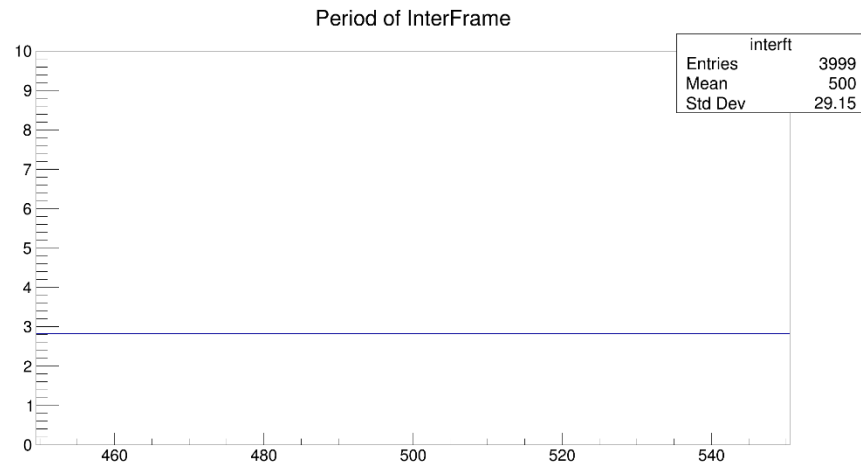
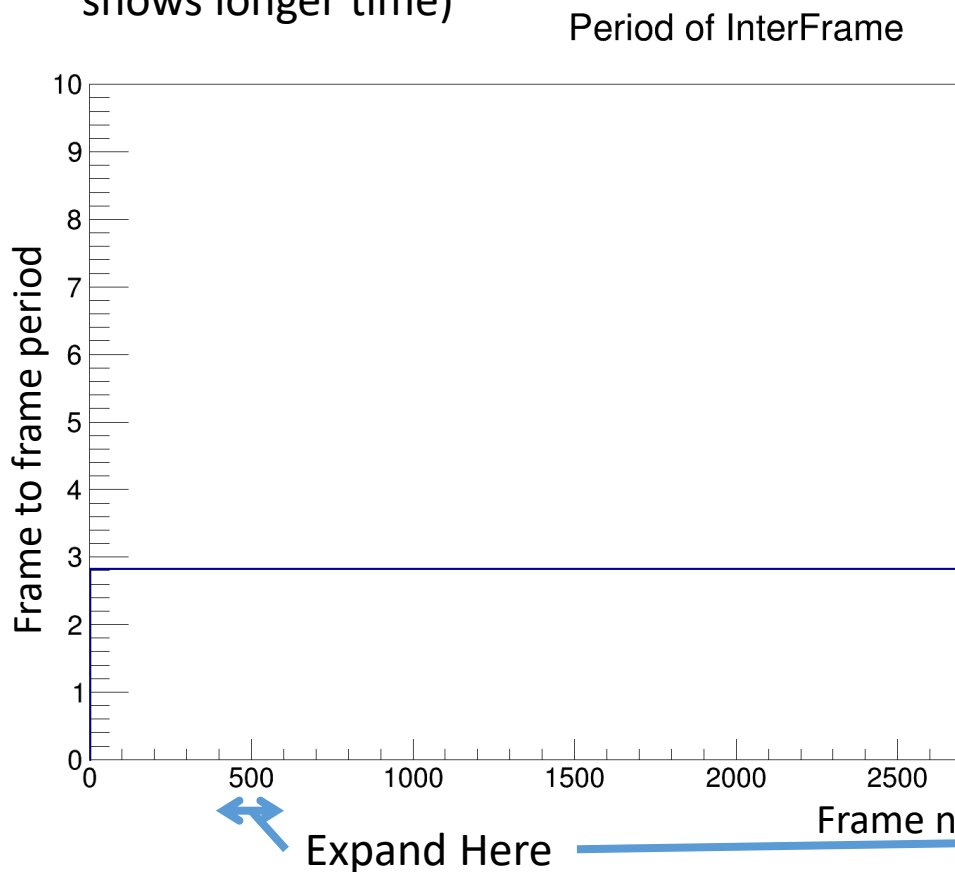
Full array (832 × 512) 350fps continuous imaging at PF BL-14A

Limitation of detector specification

Exposure time : 200 us/frames , Analog output settling wait time : 80ns/pix

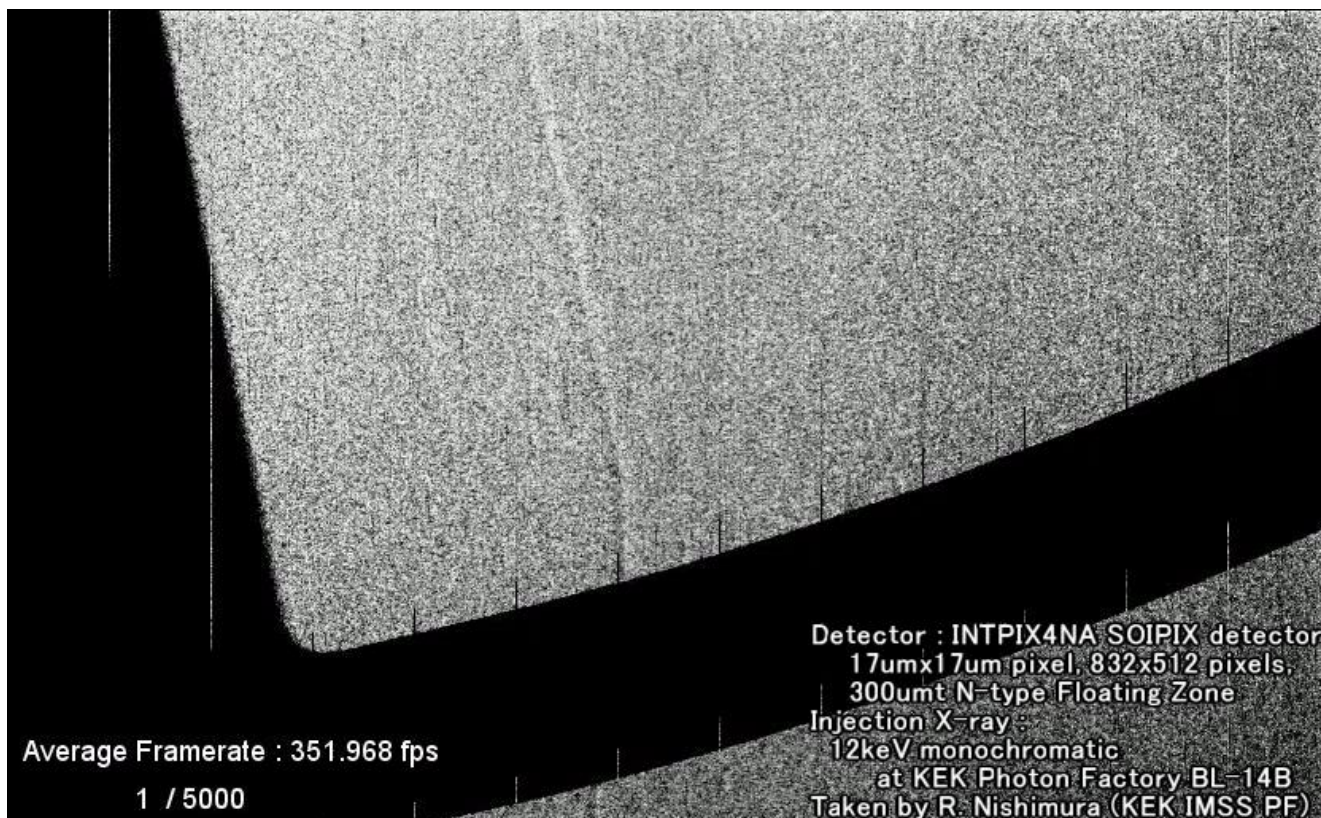
Frame to frame period (Starting edge-to-edge) : 2.828ms , Average data traffic : 2.4Gbps

(If one frame's data transfer wasn't completed in 2.828ms, next frames period will shows longer time)



10GbE SiTCP shows stable and higher(>1GbE) transfer rate.

Full array (832 × 512) 350fps continuous imaging at PF BL-14B



Sample : 12keV X-ray Profile with Optical Chopper

Exposure time : 200 us/frames , Analog output settling wait time : 80ns/pix.

(Same as previous BL-14A result slide)

This is the initial result of SOIPIX X-ray imaging data with 10GbE SiTCP.
10GbE SiTCP was advanced to Beta release and now you can try!
(https://github.com/BeeBeansTechnologies/SiTCPXG_Netlist_for_Kintex7)