Université de Strasbourg

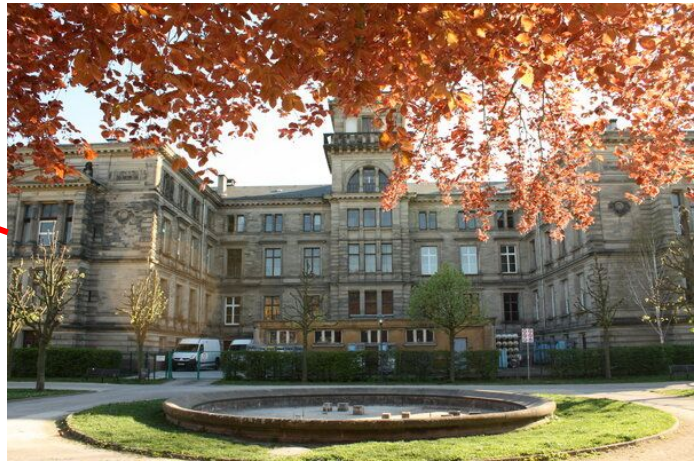
IPHC Institut Pluridisciplinaire Hubert CURIEN STRASBOURG

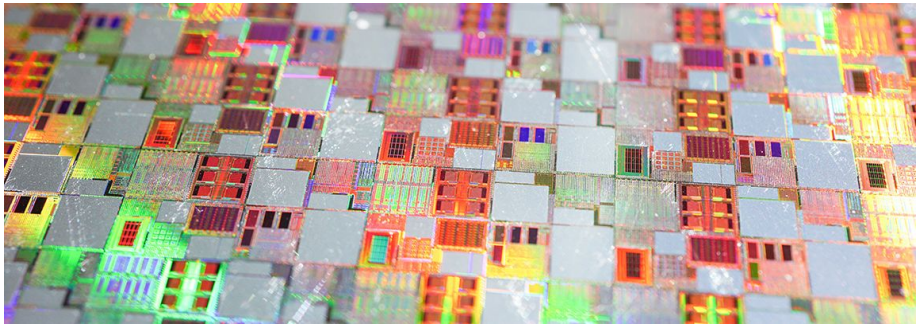
SOI INTPIX4 On-Board Zero-Suppression

Supervisor - Katsuro NAKAMURA

Thomas LAUBER

Master student in Microelectronics
from the
University of Physics and Engineering





Affiliated with IPHC laboratory

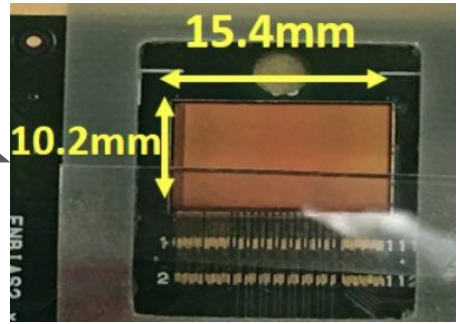
IPHC
Institut Pluridisciplinaire
Hubert CURIEN
STRASBOURG

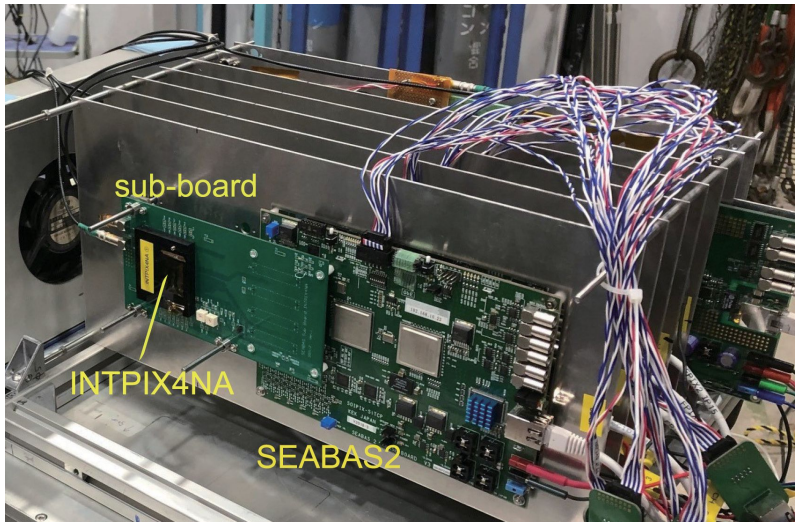
Intern From 16/07 to 30/08

KEK

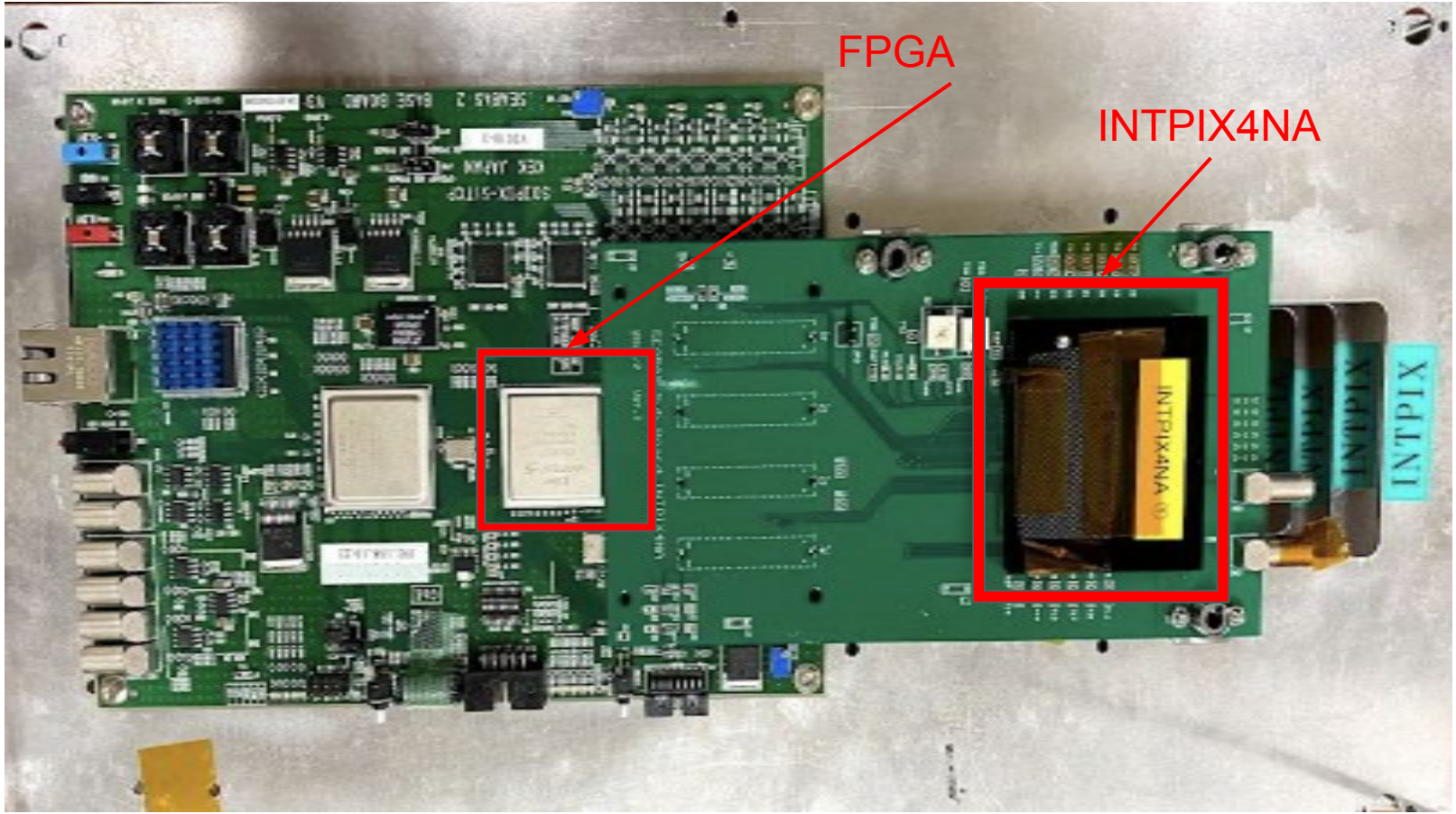
Project : Implementation of a zero suppression algorithm in the SOI telescope

INTPIX4NA sensor





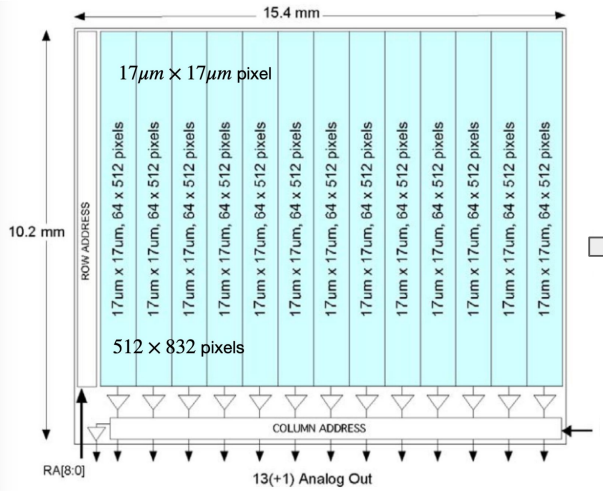
SEABAS2 board



Current flow

Detection

Pixel sensor

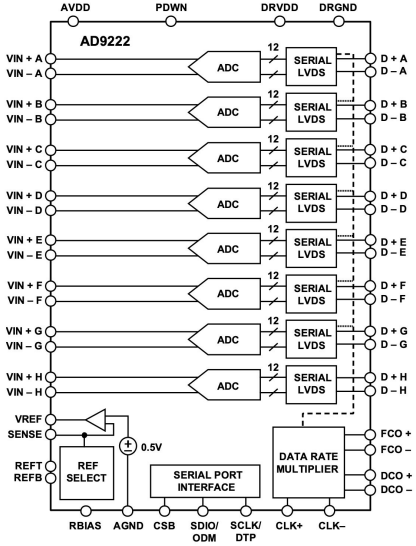


13 blocks

Analog

Digitization

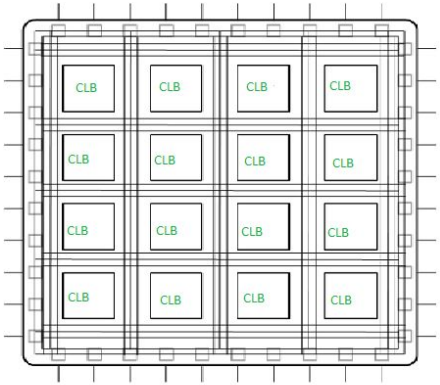
2x8 channels ADC



Digital

Processing

FPGA (XC5VLX50)



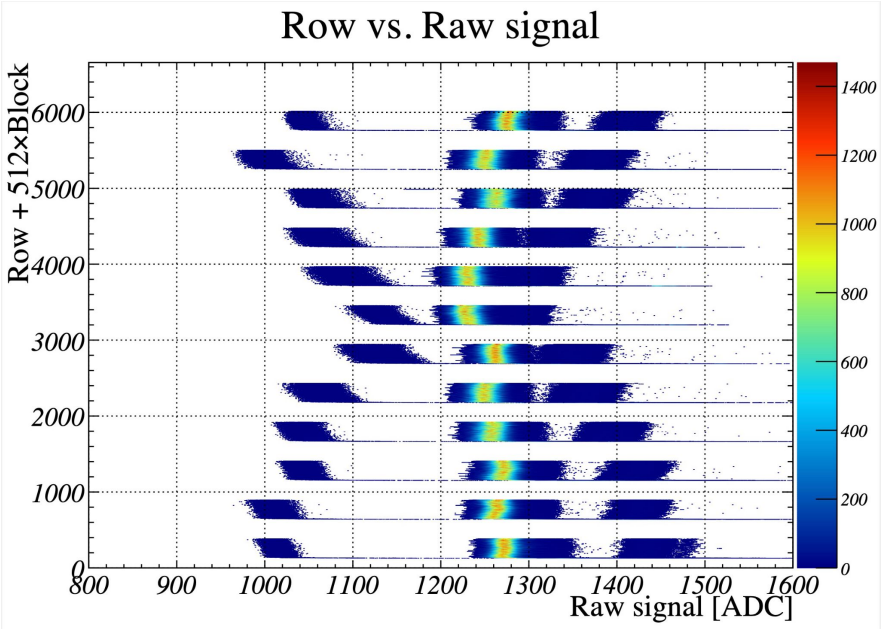
SiTCP

Problems with the current flow

1) No zero-suppression of the INTPIX4 data is performed
   ➔ 832x512 pixels for 1 event = 307 GB data just for a 1 hour x 100 Hz trigger run
2) Pixels common mode noise may induce false hits

➔ Noise is not constant, fixed threshold wouldn't work

zero-suppression with common-mode correction is necessary



Main objectives

send the ADC data only from pixels which have hit signals

Reduce as much as possible common mode noise

Verilog HDL (hardware description language)

FPGA

Global idea

$$\begin{array}{c} \\ k=0 \\ k=1 \\ \vdots \\ k \\ \vdots \\ k=511 \end{array} \begin{array}{c} \begin{array}{ccccccc} j=0 & j=1 & \cdots & j & \cdots & j=63 \end{array} \\ \begin{bmatrix} x_{0,0} & x_{0,1} & \cdots & x_{0,j} & \cdots & x_{0,63} \\ x_{1,0} & x_{1,1} & \cdots & x_{1,j} & \cdots & x_{1,63} \\ \vdots & \vdots & \ddots & \vdots & & \vdots \\ x_{k,0} & x_{k,1} & \cdots & x_{k,j} & \cdots & x_{k,63} \\ \vdots & \vdots & & \vdots & \ddots & \vdots \\ x_{511,0} & x_{511,1} & \cdots & x_{511,j} & \cdots & x_{511,63} \end{bmatrix} \end{array}$$

1 block

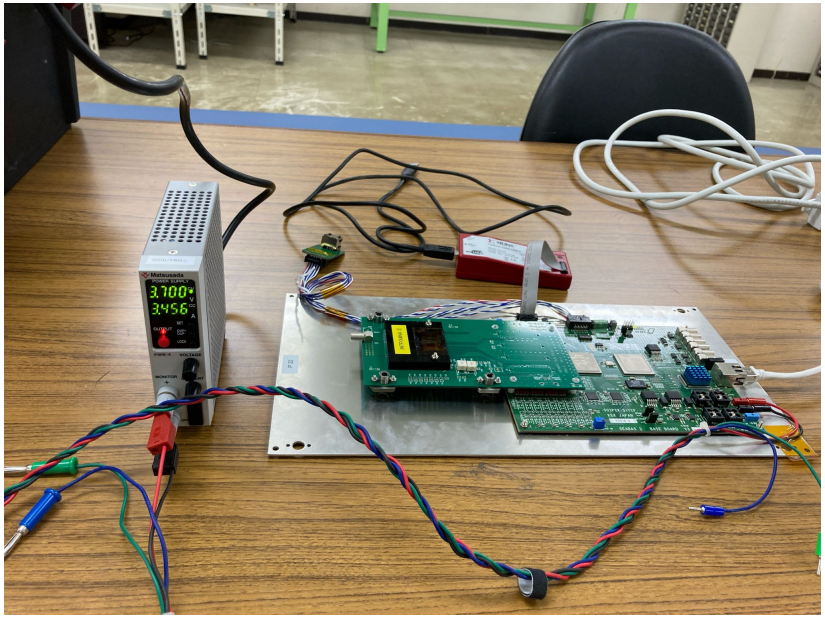
$$X = [x_{k,j}] \in \mathbb{R}^{512\times 64}$$

$$\mu_k = \frac{1}{64}\sum_{j=0}^{63} x_{k,j}$$

$$X^{(1)} = \left[x_{k,j}^{(1)}\right] = [x_{k,j} - \mu_k]$$

Threshold

Real testbench



INTPIX4NA setup in Fuji B1