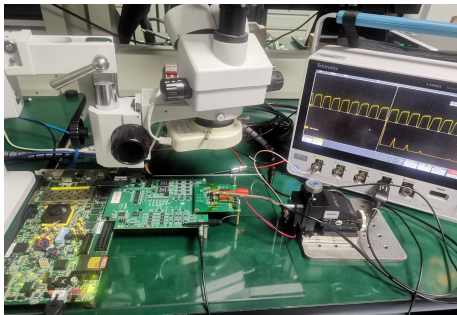


COFFEE2 Chip Test

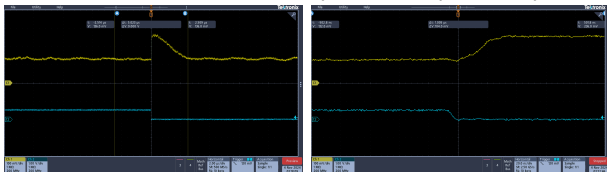
Dexing Miao, Leyi Li, Yiming Li, Weiguo Lu, Jianchun Wang,
Zhiyu Xiang, Zijun Xu, Cheng Zeng, Mei Zhao, Yang Zhou

November 8, 2024

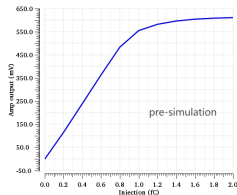
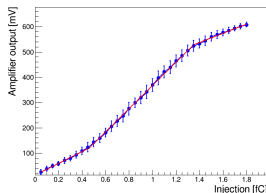
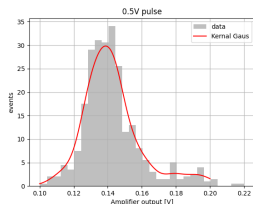


Active pixel test: Amplifier output

- Try to inject charge with $\sim 0.5V@10ns$ pulse from wave generator, clear response appears. Amplifier (last 8 columns pixels, Pin62) rising time $\sim 25ns$. Define: $Output = \text{Max}(\text{Response}) - \text{Mean}(\text{Baseline})$.

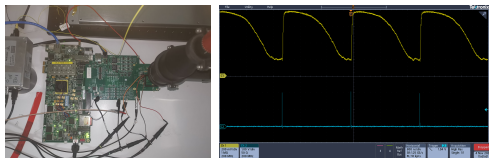


- 500 injections per voltage point to determine the mean and σ of output. The calibrated response curve shows good linearity and then tends to be saturated, similar as pre-simulation.

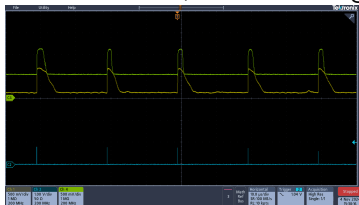


Active pixel test: laser

- Only 1 single pixel can be readout, which controlled by row-column gating, testing with laser is more efficient than radioactive source.
- Test with red laser ($\lambda \sim 650\text{nm}$). Clear amplifier response follows laser trigger even for sensor bias of -1.2V .

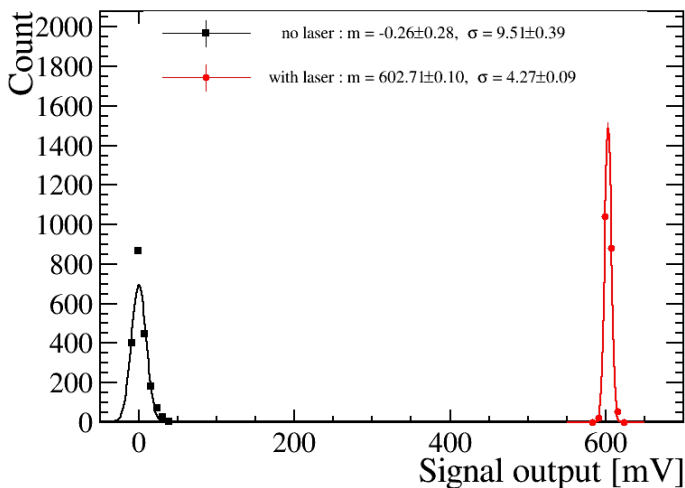


- . The discriminator also works well, as shown in green.



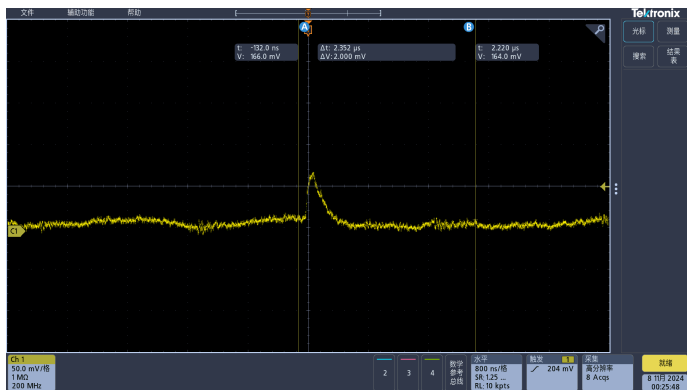
Active pixel test: Laser

- Under sensor bias of 70V, 2000 injections with laser irradiation shows the high energy resolution of COFFEE2 pixel (sensor + amplifier).



Active pixel test: Fe55 X-ray (preliminary)

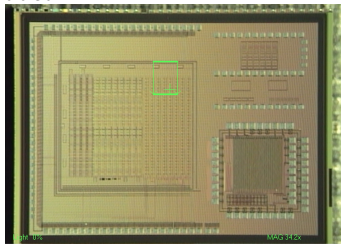
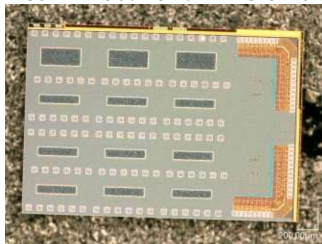
- Clear response to Fe55 source observed. Charge deposit estimated 1000-2000e- consistent with expectation (1620 e-)



Backup

CMOS sensor in Fifty-Five nm process (COFFEE)

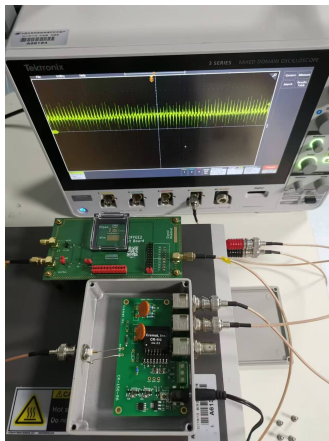
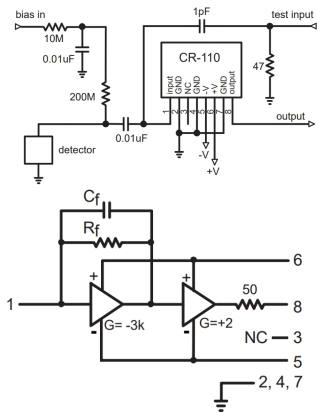
- COFFEE designed by IHEP&ITK, MPW with domestic foundry
- COFFEE1 chip ($3 \times 2\text{mm}^2$):
 - No HV application, has similar deep N well separating the transistors and the sensor part
 - pixel size: $25 \times 150\mu\text{m}^2$
 - Variation of passive diode arrays
 - Simple amplifiers added
- COFFEE2 chip ($4 \times 3\text{mm}^2$): (test results shown today)
 - Real validation of the sensor structures with electronics included
 - Variation of passive diode arrays
 - Integral analog amplifier and switch circuit to select certain pixel
 - Discriminator and DAC unit added



Passive diode test: Schematic & CSA

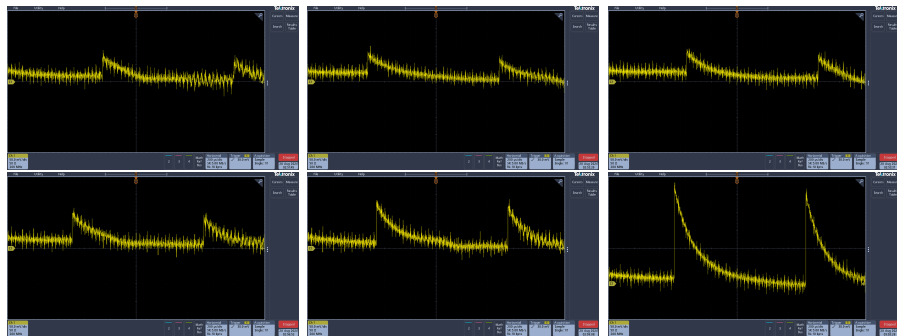
Sensor signal is delivered to the oscilloscope via AC coupling.
A charge sensitive preamplifier ([link](#)) used in the COFFEE2 signal test.

- Gain: 1mV/fC ; Decay time constant: $140\mu\text{s}$; ENC RMS: 200 e



Passive diode test: single pulse

- 54 pixels read out
- CSA bandwidth $\sim 10\text{kHz}$. Test with 1KHz .
- 1kHz laser pulse @ 20V , 30V , 40V , 50V , 60V , 70V
- Under 70V , $250\text{mV} \sim 250\text{fC}$, $5\text{fC}/\text{pixel}$



Passive diode test: α source

- Clear α signal appears
- low event rate $\sim 1\text{Hz}$, around 50fC/100fC level under 40V/70V

