

First evaluation of ColorPix-3 ASIC

J. Broulím^{1,2,*}, Z. Janoška¹, M. Kuncová¹, K. Lavičková¹, M. Marčišovská¹,
M. Marčišovský¹, R. Novotný¹, P. Švihra^{1,3}, L. Tomášek¹

PSD14

¹ Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague

² Faculty of Biomedical Engineering, Czech Technical University in Prague

³ Institute of Physics of the Czech Academy of Sciences, Prague

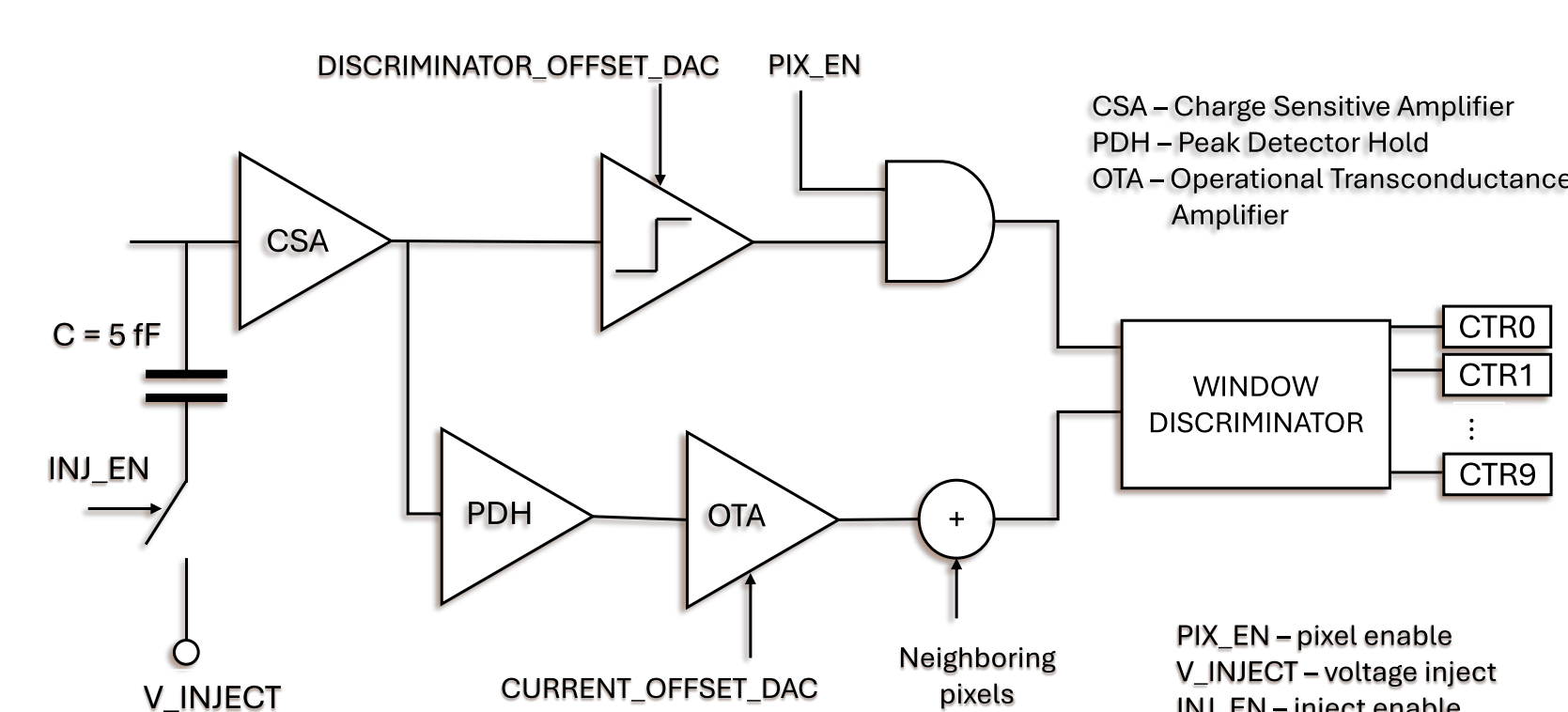
* jan.broulim@cvut.cz, On behalf of the CAPADS group

INTRODUCTION

- We present the characterization of the ColorPix-3 ASIC **65 nm CMOS TSMC technology**.
- ColorPix-3 is the ASIC designed for high-resolution, position and color **spectral X-ray imaging**, measured in terms of hit counting across 10 settable **equidistant energy levels**.
- Each energy bin is equipped with **12-bit counter**.
- Up to 3.2 Gbit/s readout speed.
- Input signal in the range from **1 ke⁻** to **18 ke⁻**.
- A 2mm CZT sensor bump-bonded to the chip was used for initial measurements.
- The matrix consists of **32 × 32** pixels with a pitch of **70 μm**.
- Measurement can be performed in the MONOCHROMATIC and COLOR modes.

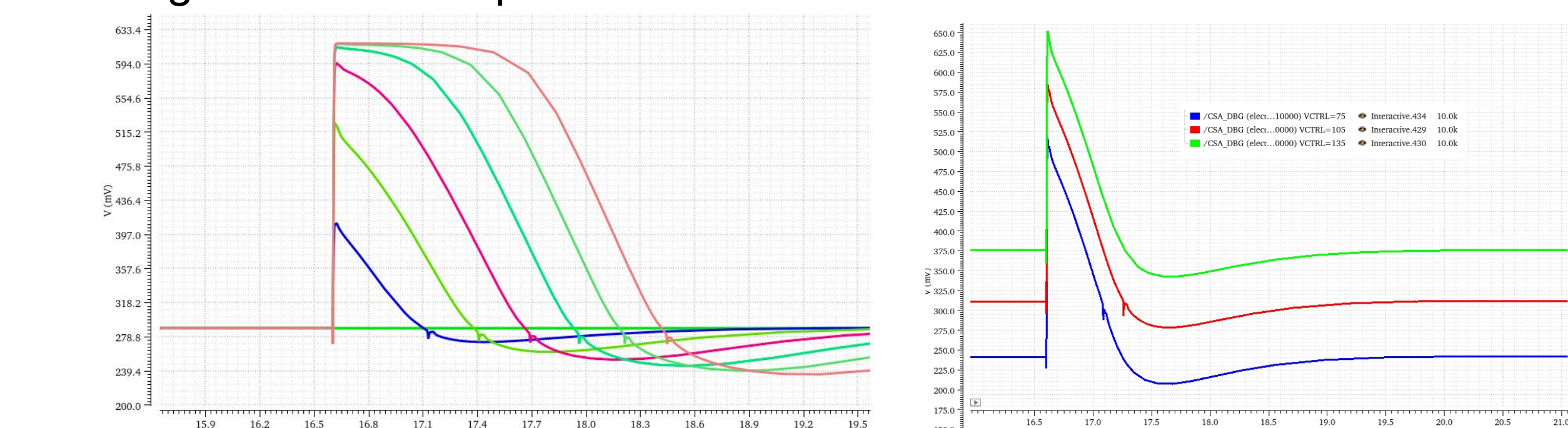
ELECTRICAL VERIFICATION

- The acquired signal is amplified in the charge sensitive amplifier, which and then processed in two branches.

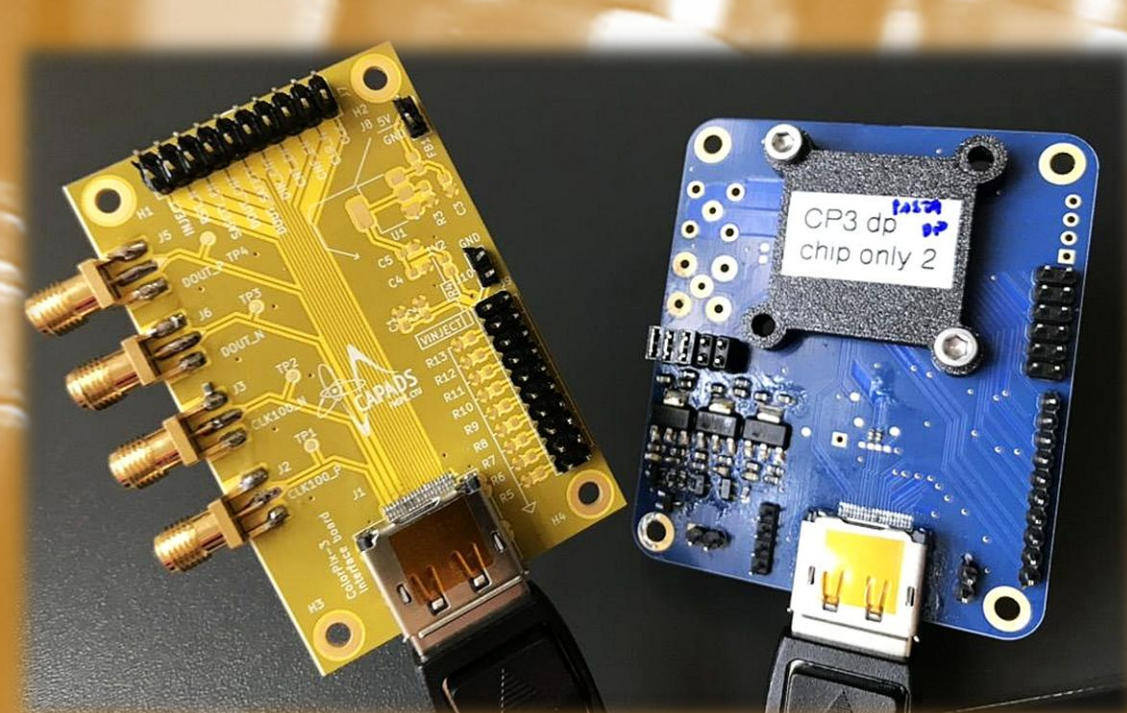
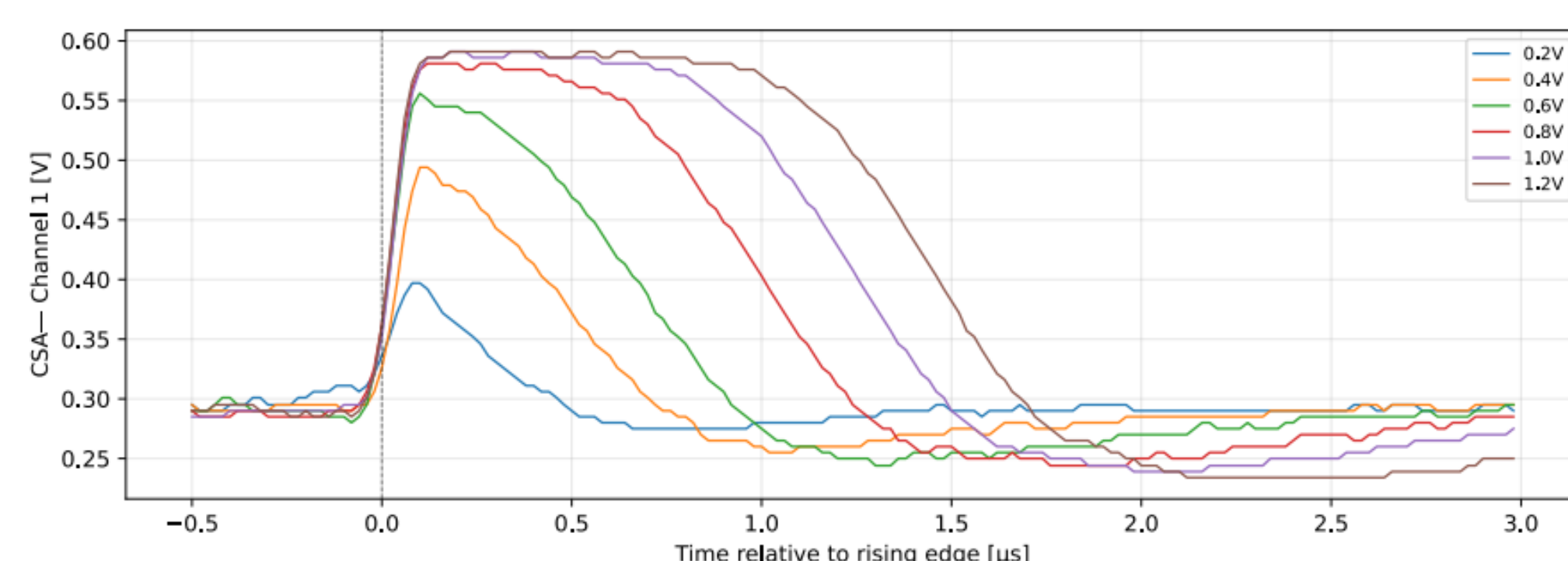


A simplified scheme of the pixel

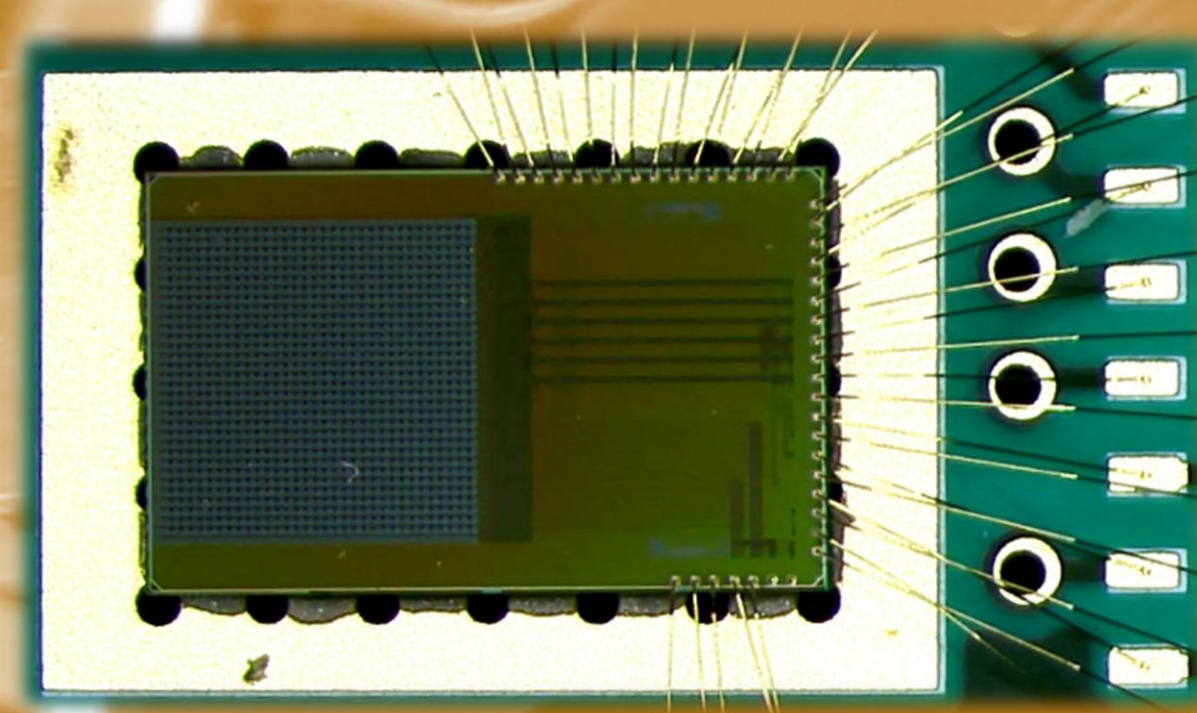
- The first branch generates a trigger for a window discriminator circuit
- The second branch converts voltage into a current signal that serves as the input to a window discriminator. Hardware summing with neighboring pixels is supported.



- The plot below shows the **measured** signal amplitude as a function of time following the arrival of the input signal for different injected charge values in the same range as those used in the figure above. The results were obtained **experimentally**.



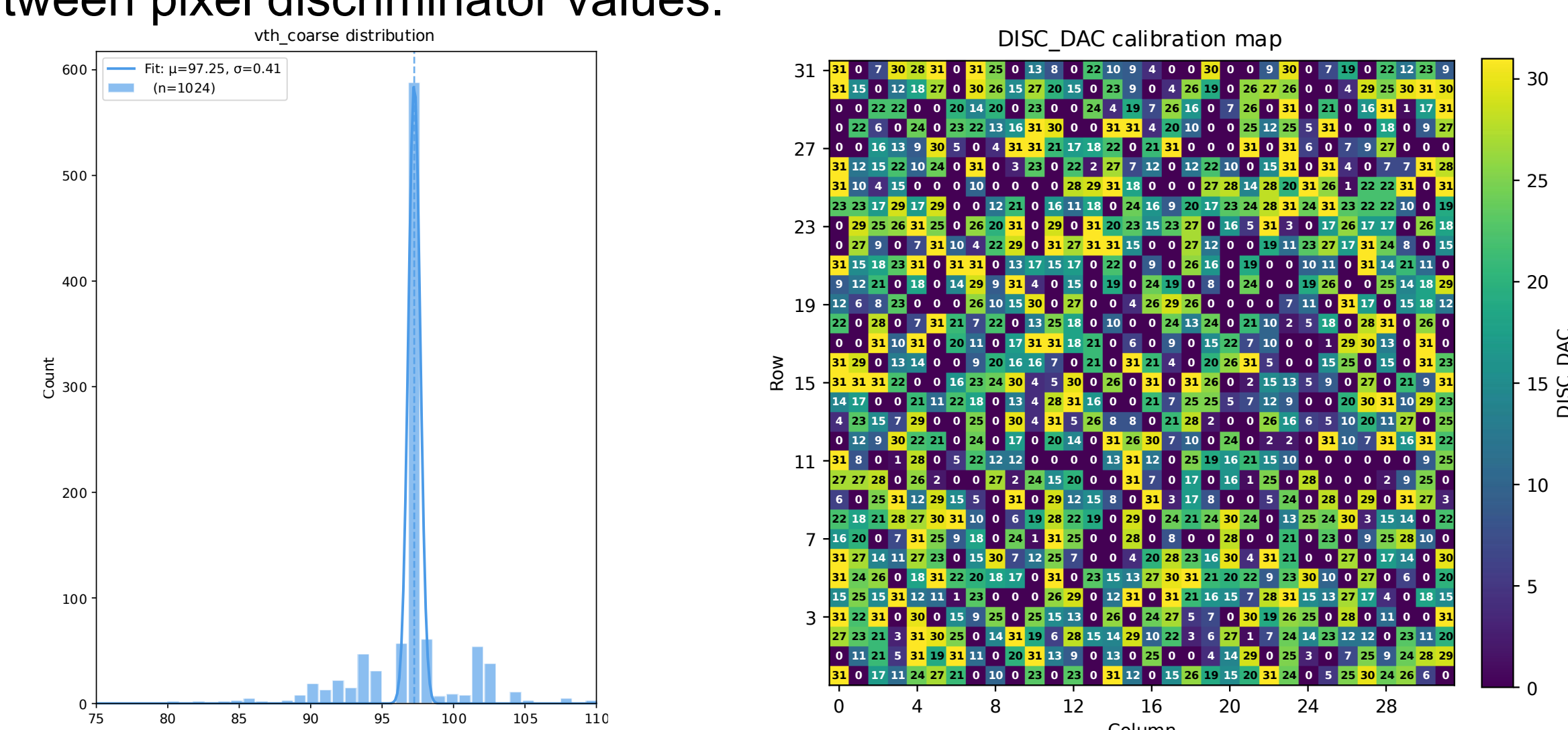
Motherboard with a DisplayPort connector



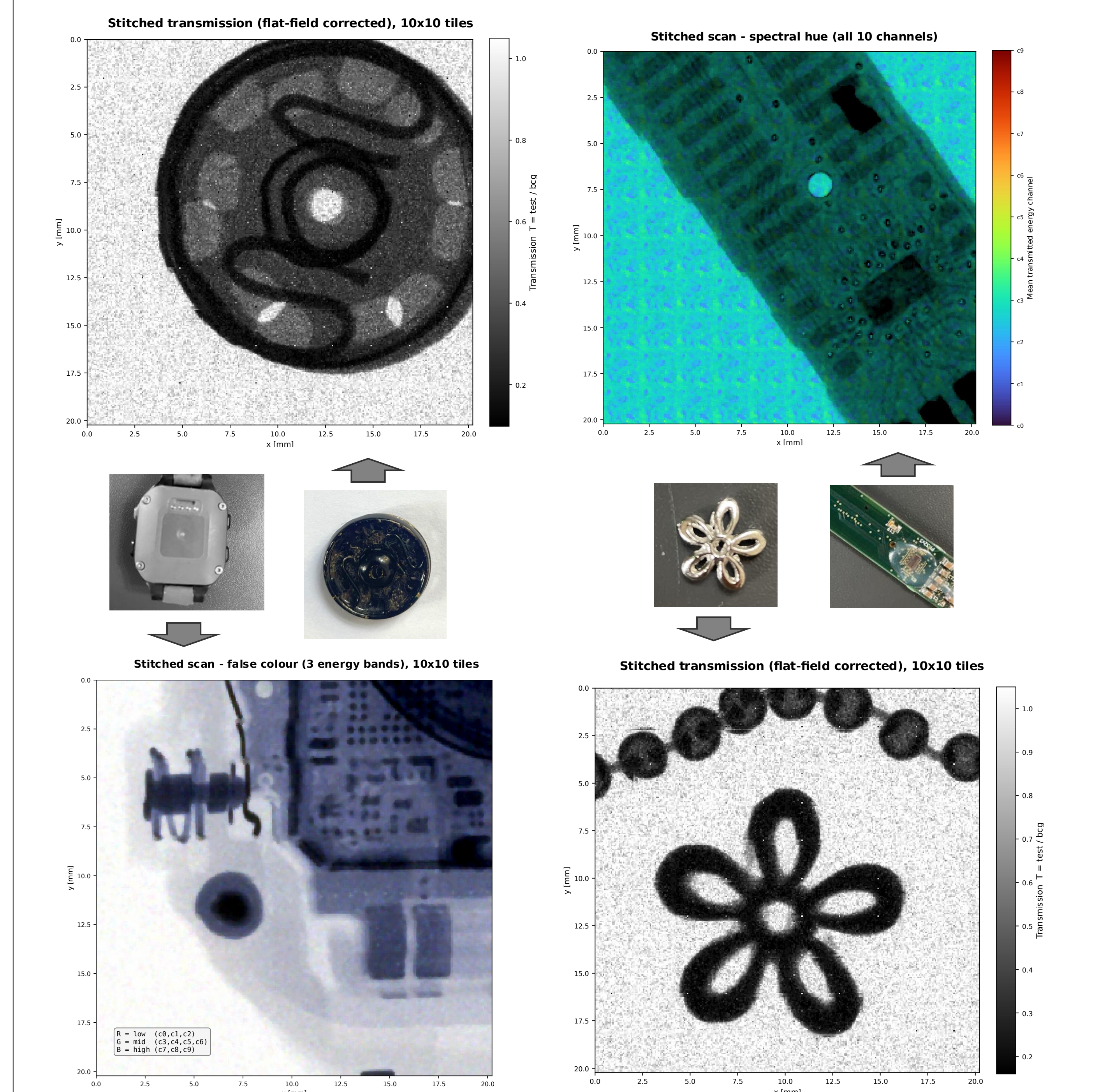
Wirebonded ASIC

MEASUREMENTS AND IMAGING

- The calibration procedure consists of determining a global threshold value pixel discriminator values used for trigger generation, and the pixel offset values used to compensate for gain variations between pixels. The standard threshold scan after the calibration is performed and shown. The matrix illustrates variation between pixel discriminator values.



- Imaging capabilities are illustrated in three experimental measurements
- Transmission through a metal clip in monochromatic mode illustrates the attenuation and corresponds to a standard radiographic image. Transmission through a metal charm is shown in spectral radiography as values within 10 energy bins.
- Imaging capabilities, in monochromatic and color modes, are shown below.



CONCLUSIONS

- ✓ We successfully validated the capability of the ColorPix ASIC to operate in spectral radiography and compared the simulated results with selected experimental measurements.
- ✓ The ColorPix architecture is prepared for a further extension to a 256×256 matrix.
- ✓ In addition to our Unicorn readout, we plan the integration with the Caribou ecosystem.

