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First characterization results of the MÖNCH hybrid pixel detector

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MÖNCH is a novel hybrid silicon pixel detector based on charge integration and analog readout, featuring a challengingly small pixel size of $25 \times 25 \mu\text{m}^2$. It is a research project which aims to push the development of hybrid pixel detectors to its limits in terms of photon flux, position resolution, energy information and low energy detection.

MOENCH02 is a fully functional, small scale prototype of $4 \times 4 \text{mm}^2$, containing an array of 160×160 pixels, designed in UMC 110nm technology [1]. This array is subdivided in five sub blocks, each featuring a different pixel architecture. The first block targets high resolution, low flux synchrotron applications, as RIXS (resonant inelastic X-ray scattering) or X-ray tomography with X-ray tubes. In this case the charge sharing effect between pixels, together with the signal analog readout, can be exploited to interpolate the hit position with a precision that could reach the sub- μm resolution.

The first characterization results of this sub block of MÖNCH02 in terms of bump-bonding yield, linearity, dynamic range and energy resolution will be shown. The noise performance will be presented in more detail, showing a total noise as low as $<40 \text{ e}^-$, as well as an overview of the noise contribution of the different blocks, from the amplifier to the off-chip buffer. The latest version of the interpolation algorithm and tests showing its effectiveness in obtaining sub-pixel resolution will also be shown.

The encouraging results obtained lead to the design of a bigger size prototype, MÖNCH03. MÖNCH03 has an active area of $5 \times 10 \text{mm}^2$ and it contains an array of 200×400 identical pixels, based on the first block of MÖNCH02. Several improvements are implemented in the chip periphery and in the readout system, which should result in a final frame rate of $\sim 8 \text{ kHz}$.

Summary

MÖNCH is a novel hybrid silicon pixel detector based on charge integration and analog readout, featuring a challengingly small pixel size of $25 \times 25 \mu\text{m}^2$. It is a research project which aims to push the development of hybrid pixel detectors to its limits in terms of photon flux, position resolution, energy information and low energy detection.

MOENCH02 is a fully functional, small scale prototype of $4 \times 4 \text{mm}^2$, containing an array of 160×160 pixels. The first characterization results of the main sub block of MÖNCH02 in terms of bump-bonding yield, linearity, dynamic range and energy resolution will be shown, as well as latest results on sub-micron resolution using interpolation algorithms.

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