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18k Pixel Readout IC for CdTe Detectors Operating in Single Photon Counting Mode with Interpixel Communication

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This paper presents a readout integrated circuit (IC) of pixel architecture called MPIX (Multithreshold Pixels), designed for CdTe pixel detectors used in X-ray imaging applications. The MPIX IC of the area of 9.6 mm x 20.3 mm is designed in a CMOS 130 nm process. The IC core is a matrix of 96 x 192 square-shaped pixels of 100 μm pitch. Each pixel contains a fast analog front-end followed by four independently working discriminators and four 12-bit ripple counters. Such pixel architecture allows photon processing one by one and selecting the X-ray photons according to their energy (X-ray color imaging). To fit the different range of applications the MPIX IC has 8 possible different gain settings, and the IC can process the X-ray photons of energy up to 154 keV. The MPIX chip is bump-bonded to the CdTe 1.5mm-thick pixel sensor with a pixel pitch of 100 um (see Fig.1) To deal with charge sharing effect coming from a thick semiconductor pixel sensor, Multithreshold Pattern Recognition Algorithm is implemented in the readout IC [1]. The implemented algorithm operates both in the analog domain (to recover the total charge spread between neighboring pixels, when a single X-ray photon hits the pixels border) and in the digital domain (to allocate a hit position to a single pixel). The example of the measured integral spectra with three different X-ray energies is shown in Fig. 2.

[1] P. Otfinowski, et al., 2019 JINST 14 C01017

Authors: GRYBOS, Pawel (AGH University of Science and Technology); Mr KLECZEK, Rafal (AGH University of Science and Technology);   KMON, Piotr (AGH University of Science and Technology);   KRZYŻANOWSKA, Aleksandra (AGH University of Science and Technology);   Dr OTFINOWSKI, Piotr (AGH University of Science and Technology);   SZCZYGIEL, Robert (AGH University of Science and Technology);   ZOLADZ, Miroslaw (AGH University of Science and Technology)

Presenter: GRYBOS, Pawel (AGH University of Science and Technology)

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