Contribution ID: **51** Type: **Oral**

Characterization results of the first small pixel high rate (SPHIRD) photon counting hybrid pixel detector prototypes

Tuesday, 27 June 2023 11:20 (20 minutes)

This work presents experimental performance results of a first set of p-type Si and CdTe SPHIRD (Small Pixel High Rate photon counting Detector) prototypes [1]. The SPHIRD project targets a new generation of photon counting hybrid pixel detectors for synchrotron radiation applications with small pixels and operating between 10 and 30 keV. The current prototypes are based on an MPW test readout ASIC in CMOS 40nm technology that features an active area of 64×32 pixels with a 50 µm pitch. The readout ASIC is designed to explore techniques that boost the count rate capabilities of the detector and methods to manage, or in some cases exploit, the effects of charge sharing that are unavoidable in this type of device with small pixels.

The management of high photon rates relies on the implementation of a fast charge-sensitive amplifier in the pixel together with time-based and amplitude-based pile-up compensation techniques. These techniques, which consist of the use of additional discriminators or time-over-threshold methods, have been compared experimentally. The results obtained show and quantify their effectiveness in increasing the count rate handled by the detector.

The readout chip also includes dedicated circuitry for the relocation of photon hits, something necessary to reduce the photon losses that are observed in photon counting detectors due to charge sharing when the discrimination threshold is set to 50% of the photon energy. The pixel relocation circuitry, based on an interpixel arbitration logic, allows the detector to operate with a threshold of 25% or less of the incident photon energy. The X-ray measurements, both with uniform illumination and with pencil beams, demonstrate how this relocation approach successfully recovers those undesired counting losses.

The relocation circuitry in the SPHIRD ASIC is not limited to full pixel relocation. It also implements resources to reassign X-ray hits within regions smaller than the physical pixel. This sub-pixel relocation capability is intended to increase the effective spatial resolution of the detectors and has also been experimentally evaluated with a pencil beam and with full field images.

Primary authors: MAGALHAES SUAREZ, Debora; FAJARDO, Pablo

Co-authors: Mrs RUAT, Marie (ESRF); GRYBOS, Pawel; KMON, Piotr (AGH UST Krakow); Dr OTFINOWSKI, Piotr; KLECZEK, Rafal (AGH)

Presenter: MAGALHAES SUAREZ, Debora

Session Classification: Detector Systems

Track Classification: Detector systems