Contribution ID: **138** Type: **Poster**

P2.5: Thickness-dependent characteristics of silicon-based Medipix3RX detectors at Sirius beamlines

Wednesday, 28 June 2023 16:44 (1 minute)

X-Ray imaging techniques at synchrotron facilities often rely on hybrid pixel detectors. They consist of photon-counting devices encompassing a photo-active semiconductor sensor integrated with a pulse processing Application Specific Integrated Circuit (ASIC) capable of performing input pulse counting along a pixelated array of discrete 55 x 55 μm counting units. Recently, our group published an initial set of characterization experiments on the PIMEGA detectors, which were developed and employed at the Brazilian Synchrotron Facility [1]. Our previous work focused on the physical responses of 300 μm thick silicon sensors integrated into Medipix3RX ASICs. In this report, we compare the physical responses of 300 and 675 μm thick silicon-based detectors. Among the experiments gathered within this contribution, we have performed the slanted edge technique for measuring the Modulation Transfer Function (MTF) [2,3]. This measurement was employed for assessing the thickness dependence of the detector's spatial resolution, and its results are depicted in Figure 1. This experiment was conducted under 5.9 keV incident energy (E0), for equivalent energy threshold values of 0.5 and 0.7 E0. Our work demonstrates that, even though thicker sensors present higher absorption efficiencies, their MTF values are lower along the entire spatial frequency domain. Moreover, higher threshold settings yield larger MTF values for both probed thicknesses. These observations are a consequence of the charge diffusion lengths within the thickness of the semiconductors, which lead to more pronounced charge-sharing effects on thicker sensors. Our results suggest a compromise between sensor absorption efficiency and spatial resolution. Future characterization experiments will also be employed to fully describe the thickness dependence of the detector's physical outputs.

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Session Classification: Poster (incl. coffee)