Contribution ID: **197** Type: **Invited talk**

XIDyn: A Charge Cancellation Detector for high Timing and Flux Measurements at 4th Generation Synchrotrons

Thursday 29 August 2024 11:20 (20 minutes)

XIDyn is a hard X-ray detector that will measure fluxes up to 10^{12} photons/mm^2/s with >100 kHz continuous frame rate and capture bursts of frames at up to 5.7 MHz. The detector will have 144 x 192 pixels on a 110 μm designed to operate with CdZnTe detector material and operate at energies of 10 - 100 keV.

The XIDyn ASIC is a two-stage charge cancellation and digitisation design. The first "coarse"stage integrates, cancels and counts integer numbers of photons at a time. The second "fine"stage is operated in a pipeline with the coarse stage and resolves single or fractions of a photon using the same charge cancellation method. The "sub-frames" measured on coarse and fine stage counters are merged and stored in the pixel RAM. The pixel RAM can be flexibly programmed so that the sub-frames can be summed, averaged, stored in a sequence, and vetoed before readout. The data is readout as 66b64b aurora encoded packets by serialisers operating at 14.1 Gbps. There are 6 serialisers along one edge of the chip and there is an option to operate all serialiser or one, depending on required frame rate.

The chip has two main modes of operation but retains functionality for other modes. In continuous mode the sub-frames are summed or averaged in the pixel RAM and readout a regular intervals. For example, with a sub-frame rate of 533 kHz to match the orbit of Diamond, and a pixel count of 16 bits, the ASIC could operate with a frame rate of 133.5 kHz. In burst mode, the RAM can be used to capture sequences of sub-frames at rates higher than the output rate of the chip. For example, a sub-frame rate of 5.7 MHz to match the 16-bunch mode of ESRF could be used with an 8 bit value per pixel. The RAM could capture a sequence of 256 sub-frames that are readout at the end of the collection.

In addition to progress in the design of the XIDyn ASIC, results will be presented from a 16x32 pixel MPW ASIC. The electrical performance and measurements made with HF-CdZnTe detectors will be discussed and how these findings may impact the design of the full-scale detector.

I plan to submit also conference proceedings

Yes

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Session Classification: Mikrosymposium 4/1: New Detector Developments

Track Classification: 4. New detector developments