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The AGIPD Detector for the European XFEL

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The AGIPD consortium consisting of Deutsches Elektronensynchrotron (DESY), Paul-Scherrer-Institut (PSI), University of Hamburg and University of Bonn is developing a pixel detector for the European Free Electron Laser (XFEL) [1]. The challenge is the temporal structure of the radiation pattern emitted by the European XFEL, which will provide fully coherent X-ray pulses with a length of less than 100 fs and an intensity of up to 1012 photons at a photon energy of 12 keV. The pulses will be delivered in bunch trains with a repetition rate of 10 Hz, where each train consists of 2700 bunches with a spacing of 220 ns.

The task of creating a detector suitable for the beam characteristics is difficult, as there will be a high number of photons simultaneously impinging the pixels. Thus, as it is not possible to use the photon counting technique, an integration system has been developed. Due to the required high dynamic range of >104 photons, multiple gain stages with an automatic internal switching will be used. Therefore, the AGIPD collaboration developed such a charge integrating hybrid pixel detector with dynamic gain switching and an analogue on-pixel storage chain, which will allow temporal storage of images (˜200) during the train, which will be read out in the gap between the trains.

The readout chip will consist of 64 x 64 pixels, each pixel having a pixel size of 200 x 200 μm2. The detector will be built out of 8 x 2 modules each containing a silicon sensor bump bonded to an array of 8 x 2 CMOS readout chips.

Up to now, several prototype chips have been produced. The AGIPD01 prototype is not pixelated and was used to investigate the different parameters of the electronics like the linearity of the readout chain consisting of a Preamp and a Correlated Double Sampling Stage (CDS) or the gain switching. AGIPD02 includes 16 x 16 pixels with 100 storage cells and bump bonded silicon sensor. Different combination of Preamp and storage cell architecture were employed. AGIPD03 is the latest prototype with a high speed serial control logic and a radiation hard storage cell design.

This talk will give an overview of the AGIPD project, focusing on the results of the characterization of the AGIPD01 and AGIPD02 prototypes.

[1] European XFEL: http://www.xfel.eu/en/index.php

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