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AGIPD detectors - fast cameras for the experimental stations of the European XFEL

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AGIPD is an Adaptive Gain Integrating Pixel Detector designed in a collaboration between Deutsches Elektronen-Synchrotron (DESY), Paul-Scherrer-Institut (PSI) and the Universities of Hamburg and Bonn. It is a hybrid pixel X-ray detector developed for the European XFEL, whose key features will be the high brilliance coherent pulses with a specific bunch structure. 2700 pulses in a bunch-train will be separated by 220 ns from each other with a 99.4 ms between the bunch-trains. One of the aims of the detector is to catch as many consecutive pulses out of the bunch-train as possible. The other important requirement is the dynamic range, starting from single photon sensitivity up to 10^4 12.5 keV photons. In order to fulfill mentioned requirements a radiation tolerant Application Specific Integrated Circuit (ASIC) is designed. Each pixel has a fast charge-sensitive preamplifier, providing the possibility to write the image data into one of 352 random-access analogue memory cells at a 4.5 MHz frequency. The preamplifier uses an adaptive gain technique allowing a reduction of the gain with respect to the input charge and thus extending the dynamic range. Some additional techniques like correlated double-sampling and double-column readout are also used. Over about 10 years of the project more than 5 multi-project wafer and 2 engineering runs were made in order to characterize and improve the ASIC performance and calibration possibilities.

A hybrid module, consisting of a silicon sensor bump bonded to 16 ASICs, has 128×512 pixels $200 \times 200 \mu\text{m}^2$ each, and is served by back-end electronics. The 1M pixel detector incorporates four quadrants of 4 modules each, operating in vacuum. Two systems will be installed at the SPB and MID experimental stations of the European XFEL. A 4M version for the SFX experimental station is now under development. Assembly, calibration and integration efforts will be presented.

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