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AGIPD, the electronics for a high speed X-ray imager at the Eu-XFEL

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The AGIPD (Adaptive Gain Integrated Pixel Detector) X-ray imaging camera will operate at the X-ray Free Electron Laser, Eu-XFEL, under construction in Hamburg, Germany. Key parameters are 1Mega 200 μ m square pixels, single 12.4 keV photon detection and a dynamic range to 10000/pixel/image. The developed sensors, ASICs, PCB-electronics and FPGA-firmware acquire individual images per bunch at 27000 bunches/s, packed into 10 bunch-trains/s with a bunch separation of 220 ns. Bunch-trains are handled by 352 analogue storage cells within each pixel of the ASIC and written to written during the 0.6msec train delivery. Random addressing provides reusability of each cell after an image has been declared as low-quality. Digitization is performed between trains (99.4 msec).

The talk will introduce all functional blocks, concentrating on the DAQ-chain PCB-electronics: a dense area of 1024 ADC-channels, each with a pickup-noise filtering and sampling of up to 50 MS/s/ADC and a serial output of 700 Mbit/s/ADC. FPGAs operate the ASICs synchronized to the bunch structure and collect the bit streams from 64 ADCs/FPGA. Pre-sorted data is transmitted on 10 GbE links out of the camera head using the time between trains. The control and monitoring of the camera with 700 A current consumption is based on a micro-controller and I2C bus with an addressing architecture allowing many devices and identical modules. The high currents require planned return paths at the system level. First experimental experience of the constructed components will be presented.

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