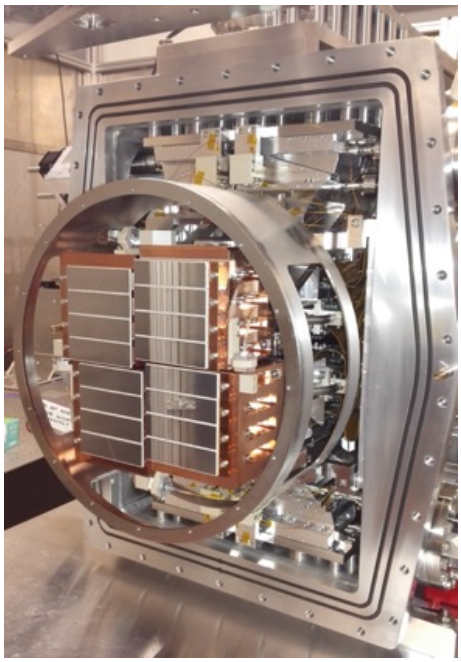
New Detectors for New Photon Sources

Heinz Graafsma

Deutsches Elektronen-Synchrotron (DESY), 22607 Hamburg, Germany

heinz.graafsma@desy.de

The European X-ray Free-Electron Laser (Eu.XFEL), with its extreme peak intensity and 4.5 MHz repetition rate posed extraordinary challenges for the detector community. From the beginning it was clear that only custom designed systems would be able to meet those challenges. The Adaptive Gain Integrating Detector (AGIPD) system (Figure below) is one of three projects for the Eu.XFEL. In this system each pixel individually and fully automatically adapts its gain to the incoming signal strength during the pulse, and with that provides at the same time low-noise performance for weak signals, allowing distinguishing between single photons, and high dynamic range for strong signals. In addition to the large dynamic range the AGIPD system also provides high speed imaging up to 6.5 MHz. The first system was deliver and installed at the Eu.XFEL, and successfully used for the very first user experiments in fall 2017. The system will be described, and the performance at the experimental station presented. Another challenge is presented by the low-energy FELs like FLASH. In order to be able to reliably detect photons down to 250 eV a system based on back-illuminated CMOS imagers is developed. This system, PERCIVAL, has a different adaptive gain structure providing single photon sensitivity as well as a large dynamic range. The results obtained with the first 2-million pixels monolithic sensors will be presented. Finally results with GaAs, CdTe and Ge as sensor material, needed for higher photon energies will be presented



The AGIPD system developed for the European XFEL