

Poster Presentation

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Hybrid photon-counting detectors accelerating synchrotron and laboratory science

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Since their introduction in 2007, single-photon-counting PILATUS hybrid pixel detectors and MYTHEN micro-strip detectors have transformed synchrotron research by enabling new data acquisition modes and even novel experiments. At the same time data quality has improved due to the noise-free operation and the direct conversion of the X-rays, while millisecond readout time and high-frame rates allow for hitherto unknown data acquisition speed and efficiency. Instant retrigger technology, introduced in 2012 with the PILATUS3 further improves the count-rate capabilities to 107 photons/sec/pixel, allowing single photon counting at brightest synchrotron beamlines. On the other hand, the unique properties of these detectors have also been explored to improve and accelerate diffraction and scattering experiments in the laboratory. The noise-free operation is a key advantage in combination with the low-flux laboratory sources, allowing for high-throughput and optimal data quality. The modular architecture of the detectors and the vacuum-compatibility of the PILATUS detector modules are ideal prerequisites to design specific detector solutions. In-vacuum operation is ideally suited to eliminate all background arising from windows and air, resulting in optimal signal-to-noise ratio. Furthermore, the lowest accessible X-ray energy is no longer limited by windows and air absorption but rather by the beamline spectrum and the detector. The minimal X-ray energy compatible with noise-free counting for the PILATUS is below 2 keV. With EIGER, hybrid pixel detectors will enter into a new realm of spatial and temporal resolution. Continuous read-out with frame rates up to 3000 Hz and a pixel size of 75 μm are ideally suited for all scanning type of imaging experiments, time-resolved and high-throughput experiments as well as for outrunning radiation damage. A short overview of the novel aspects of the detector technology will be given. The main emphasize of the presentation will be on the science enabled by the combination of advanced source, optics and detector instrumentation.

Keywords: hybrid pixel detectors, single photon counting, in-vacuum detectors