PILATUS DETECTORS - NEXT GENERATION INSTRUMENTS FOR ADVANCED X-RAY DIFFRACTION STUDIES.

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X-ray crystallography has benefited strongly from the high flux and brightness of third-generation synchrotron sources and from the development of modern detectors like charge-coupled devices. However, these detectors have serious limitations with respect to readout speed, dynamic range, detective quantum efficiency, point-spread function, dark current and readout noise. This makes accurate measurements of weak intensities a challenging, if not to say an impossible task. Particularly, the lack of energy discrimination is a massive obstacle in experiments where most of the desired information is in the weak intensities.

The situation is different for PILATUS detectors, which have been developed at the Paul Scherrer Institut for the Swiss Light Source (SLS). These detectors are based on CMOS hybrid pixel technology - a technology, which originates from high energy physics and has been adapted to synchrotron applications.
PILATUS detectors have a number of outstanding features: frame rates of 12-300 Hz, noiseless full frame readout time of 2.2 ms, dynamic range of 20 bits, electronic gating and an adjustable lower energy threshold which permits energy discrimination. Pixels are physically distinct in so far as an overexposure of a pixel does not influence the neighboring ones.

Novel data collection strategies (e.g. fine-phi-slicing, energy-slicing) become possible due to some unique features of PILATUS detectors. The fast and noise-less readout allows to take crystallographic data in continuous mode, without opening and closing the shutter for each frame. This fine-phi-slicing mode results in Bragg diffraction data of higher quality.
The adjustable energy threshold of the detector can be used to perform energy-slicing experiments. In such a Laue experiment, an energy window, which is defined by successive increments of the threshold, is moved through the white beam and the corresponding diffraction images are recorded.

Results from various x-ray experiments will be presented, including diffuse scattering studies and Laue microdiffraction experiments. Special focus will be put on some detector specific corrections, especially the count-rate correction, which implies an adapted data collection strategy. This strategy differs significantly from classical data collection with integrating detectors.