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CMOS Hybrid Pixel Detectors for Scientific, Industrial and Medical Applications

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Crystallography is the principal technique for determining macromolecular structures at atomic resolution and uses advantageously the high intensity of 3rd generation synchrotron X-ray sources . Macromolecular crystallography experiments benefit from excellent beamline equipment, recent software advances and modern X-ray detectors. However, the latter do not take full advantage of the brightness of modern synchrotron sources. CMOS Hybrid pixel array detectors, originally developed for high energy physics experiments, meet these requirements. X-rays are recorded in single photon counting mode and data thus are stored digitally at the earliest possible stage. This architecture leads to several advantages over current detectors: No detector noise is added to the signal. Readout time is reduced to a few milliseconds. The counting rates are matched to beam intensities at protein crystallography beamlines at 3rd generation synchrotrons. The detector is not sensitive to X-rays during readout; therefore no mechanical shutter is required. The detector has a very sharp point spread function (PSF) of one pixel, which allows better resolution of adjacent reflections. Low energy X-rays can be suppressed by the comparator At the Paul Scherrer Institute (PSI) in Switzerland the first and largest array based on this technology was constructed: The Pilatus 6M detector. The detector covers an area of 43.1 x 44.8 cm2 , has 6 million pixels and is read out noise free in 3.7 ms. Since June 2007 the detector is in routine operation at the beamline 6S of the Swiss Light Source (SLS). The company DETCRIS Ltd, has licensed the technology from PSI and is commercially offering the PILATUS detectors. Examples of the wide application range of the detectors will be shown.