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Development of High Performance X-ray Cameras at DESY: from prototypes to complete systems

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With the continual drive towards bigger, better and brighter light sources, whole new areas of scientific research are possible that would have been unimaginable or even believed impossible before.
However, even the best experiment or the best light source is worthless if the employed detection system is not up to the task at hand. This is especially true for light sources like the current and upcoming generation of Hard X-ray FELs, which introduce special challenges that are distinctly different from the challenges posed at current 3rd generation synchrotrons.
Cutting edge area-detector developments nowadays mostly, but not exclusively, provide a separate readout channel for each pixel, allowing sophisticated parallel signal processing. The hybrid pixel approach further makes it possible to optimize the sensor and the readout chip independently from each other, and profit from technological advances very quickly. Improvements in microchip production (Moore's law) make it possible to achieve faster readout, smarter signal processing and smaller pixels, while new sensor materials and designs can have a range of benefits such as better quantum efficiency.
In this talk, two hybrid pixel systems and one CMOS imaging system developed by the photon science detector group at DESY (FS-DS) are presented: The AGIPD system, a high dynamic range 4.5 MHz burst mode camera for use at the European XFEL, the LAMBDA system, a Medipix3 based large area detector with 55 um pixel size and the ability to support either silicon or high-Z sensors and is currently being commissioned at PETRA-III synchrotron beamlines, and the PERCIVAL system with 27 um pixels and large dynamic range, optimized for operation at soft x-ray energies between 250 eV and 1 keV at 120 Hz repetition rate.

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