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Detector Developments for Photon Science at DESY

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Over the past decade or so, DESY's Photon Science Detector group has spearheaded a number of developments - motivated by the dire need for faster large-area imagers with high dynamic range that is a direct consequence of the advances in synchrotron light sources and free electron lasers.

In particular, the Adaptive Gain Integrating Pixel Detector (AGIPD) provides a Megapixel array running at up to 6 MHz frame rates during Eu.XFEL's bunch trains, it was used to take first-light images at the European XFEL. Today, variants utilizing high-Z material and a yet-larger 4-Megapixel-Array with more compact electronics are under development.

For soft X-ray applications, the Pixelated Energy Resolving CMOS Imager, Versatile And Large (PERCIVAL) was conceived and is today being brought to operation by an international collaboration of light sources. It provides 2 Megapixels in a single 4.5x5cm² CMOS imager with 27x27um² pixels and spans single photon discrimination to over 10⁴ photons/pixel/frame; its primary foreseen operating range is 250eV-1keV. For soft X-ray imagers, as well as for e.g. UV detection, backside-illuminated sensors with ultrathin entrance windows are required and pose their own challenges.

Experiments at future light sources - both FELs and diffraction-limited synchrotrons - will require detectors that can acquire full multi megapixel images continuously at frame rates of 100kHz and more. This requires new system architectures, from readout ASIC through the front end to DAQ backend.

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