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The EIGER detector systems

EIGER is a single photon counting hybrid pixel detector developed at the Paul Scherrer Institute (PSI) for synchrotron applications.
The pixel size is 75x75 um^2 and it features noise as low as 70 e^- equivalent noise charge RMS (depending on settings) and a very high frame rate (up to 24 kHz). Each pixel has a counter which can be configured in 4, 8 or 12 bit mode. A larger dynamic range of 32 bits can be obtained by splitting the acquisition into short sub-frames and summing them on the readout boards. The minimum dead time between frames is 3 us thanks to the double buffering capabilities of the counter.

Large area EIGER detectors are being produced by tiling single modules. A single module consists of a 8x4 cm^2 silicon sensor bump bonded to 4x2 readout chips, for a total of 0.5 Mpixels. The largest of the systems in production at PSI is a 9~Mpixel detector for the coherent small angle X-ray scattering (cSAXS) beamline at the Swiss Light Source Synchrotron. The very high frame rate capability is conserved for multi-module systems due to fully parallel data processing. The count rate capabilities are 200-500 kHz/pixel at 90% linearity of the counter versus the incident photon flux. Rate corrections can be applied on-board before the sub-frame summation to compensate for fast varying pile-up rates. The on-board corrections restore the linearity up to at least 1.2 MHz/pixel incident rate. Performance of the detector, calibration and operational challenges of the large systems will be presented.

EIGER can also be used to detect electrons: characterization of the detector performances with low energy electrons (8-20 keV) and medium energy (>100 keV) has been performed. Results will be presented as well as plans to optimize the detector for electron detection towards the use of EIGER in photo-emission electron microscopes and transmission electron microscopes.

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