Advances with EIGER2 (CdTe) detectors for Synchrotron and Laboratory

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Hybrid photon counting (HPC) X-ray detectors are crucial ingredients for cutting-edge synchrotron research [1] by providing noise-free detection with advanced acquisition modes. In this regard, the latest HPC detector generation EIGER2 is setting new performance standards that push current horizons in X-ray science. These detectors combine all advantages of previous HPC detector generations while offering (i) 75 µm × 75 µm pixel size, (ii) kilohertz frame rates, (iii) negligible dead time (100 ns) and (iv) count rates of 10^7 photons per pixel.

Recently, EIGER2 detectors are available both with silicon and with CdTe sensors to provide high quantum efficiency at energies up to 100 keV. Two separately adjustable energy thresholds allow for reduction of high-energy background such as from cosmic radiation or higher harmonics radiation. For one, this active background suppression significantly improves signal-to-noise in laboratory applications where weaker signals are expected. For the other, these benefits advance established methods like crystallography and small angle X-ray scattering and empower new fields of research, such as X-ray photon correlation spectroscopy and coherent studies.

Here, we present results from detector characterization and application experiments, highlighting key properties such as count rate capability, readout and spatial resolution. We will further show the potential capabilities of newly released detector features, such as the double-gating acquisition mode for shot-to-shot background correction. Combined with characterization measurements at beamlines and in the laboratory, these results evidence how the EIGER2 detector systems will advance static and time-resolved X-ray experiments.

[1] Förster, A., et al. (2019) *Philos.* Trans. *R. Soc. Math. Phys. Eng. Sci.* **377**, 20180241.

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