

Modulation transfer function and energy response of the new Timepix4 pixel detector

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We present measurements of the spatial resolution of the new Timepix4.2 pixel detector ASIC bump-bonded to a 300um planar silicon sensor. We show a comparison of the Modulation Transfer Function (MTF) of the detector obtained both with X-ray photons at various energies, and 100keV and 200keV electrons in an electron microscope. Additionally, we present the per-pixel energy calibration distributions for the detector, obtained using laboratory sources and synchrotron data, and provide an 'equivalence formula' to allow calibration using test-pulses in situ.

The MTF for the detector was measured using the physical knife edge method. X-ray measurements were carried out both using a laboratory X-ray source and at the B16 synchrotron beamline at Diamond Light Source. Electron measurements were performed at the Rosalind Franklin Institute. All data sets were obtained using both the same detector and readout system (a Quantum Detectors Ltd. Prototype Timepix4 readout system), making the results directly comparable between photons and electrons. A provisional MTF value at Nyquist obtained for X-rays at 20keV is 0.49, and for electrons at 100keV is 0.22. We also present a study of the improvement in spatial resolution of the detector achievable by offline geometric and temporal hit clustering.

Authors: CREVATIN, Giulio; DIMOVA, Nina; PLACKETT, Richard (University of Oxford (GB))

Co-authors: Dr WEATHERILL, Daniel; WOOD, Daniel; Prof. BORTOLETTO, Daniela (University of Oxford (GB)); O'RYAN, Liam; GOLDSBROUGH, Roger

Presenter: DIMOVA, Nina

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