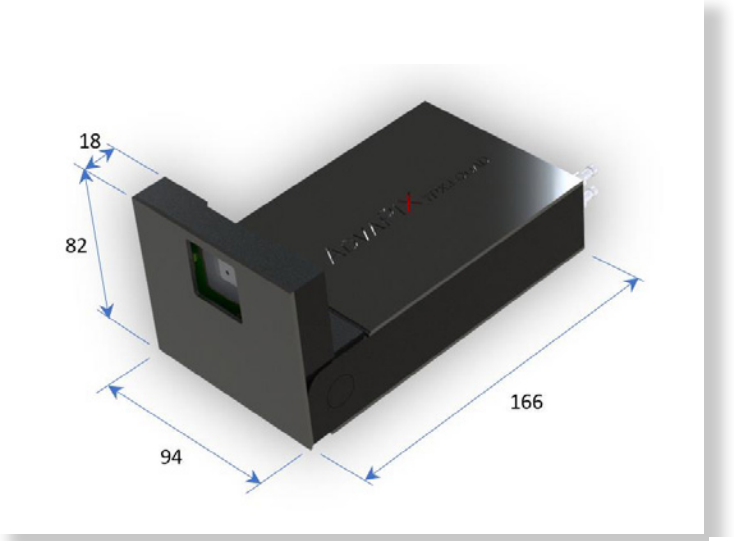
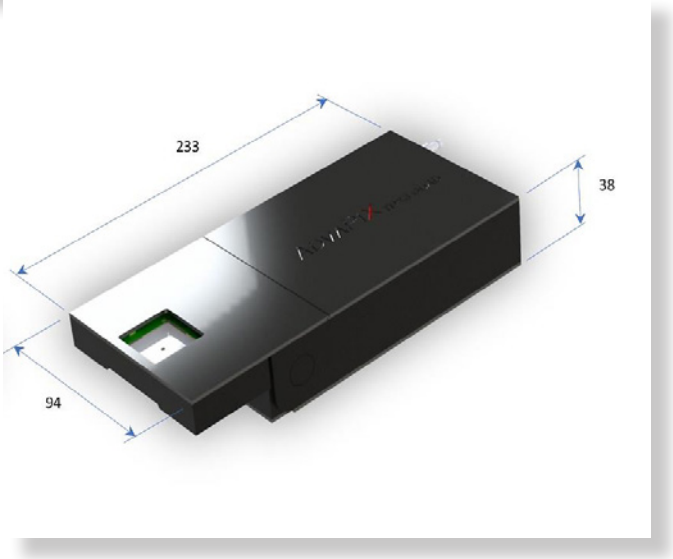
ADVAPIX TPX3 Quad with central hole

Fully spectral imaging detector with central hole: ideal for XRD, SAXS or SEM





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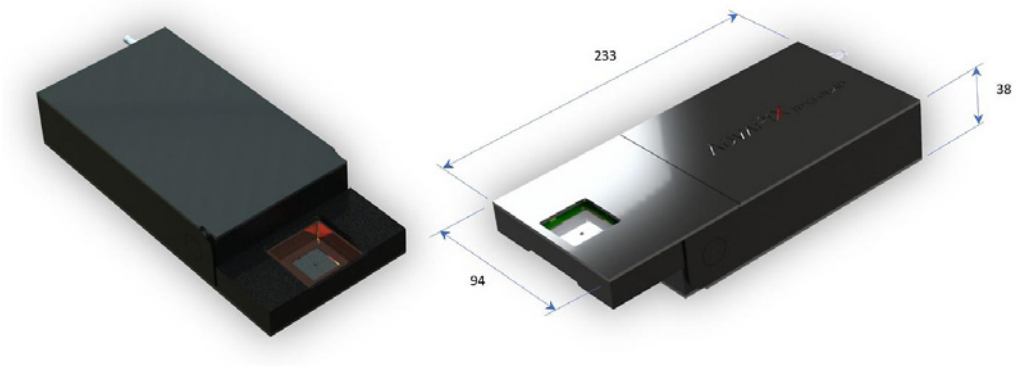
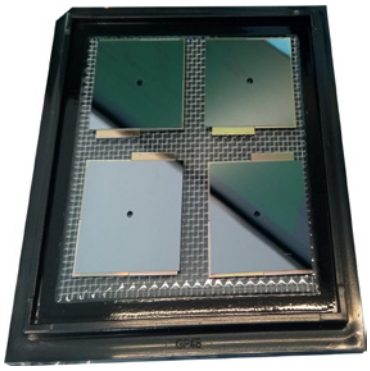
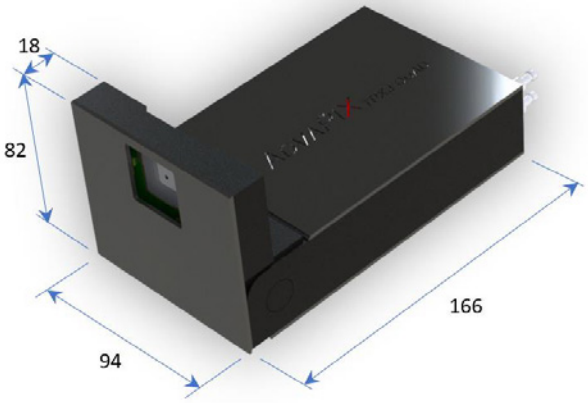


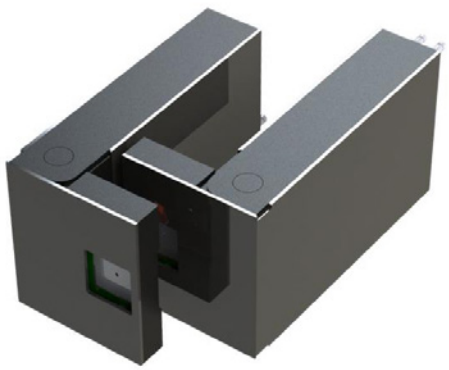
The #AdvaPIX TPX3 Quad presents a new line of ADVACAM detectors optimized for #XRD, #SAXS or similar tasks where a primary pencil beam of radiation passes through the detector without interaction. For this purpose we developed a Quad detector with monolithic sensor with central hole (the device version without central hole exists as well).

The detector is based on #Timepix3 chip developed by #Medipix collaboration in #CERN. Four #Timepix3 chips (256 x 256 pixels each, pixel pitch 55 micro meters) are assembled to single monolithic Silicon sensor 3x3 cm with circular hole with diameter of 2.04 mm in the centre.

The foldable design allows two basic geometries with different detector orientations for specific applications of users. The amount of material behind the sensor is minimized so that several modules can be layered. A combination of Silicon and CdTe layer can be especially advantageous maximizing detection efficiency and energy resolution.







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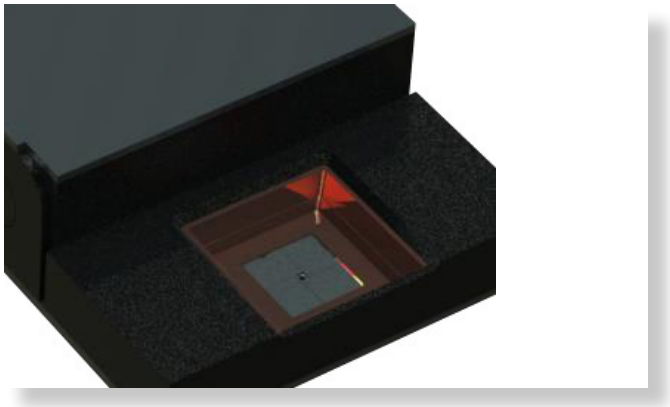
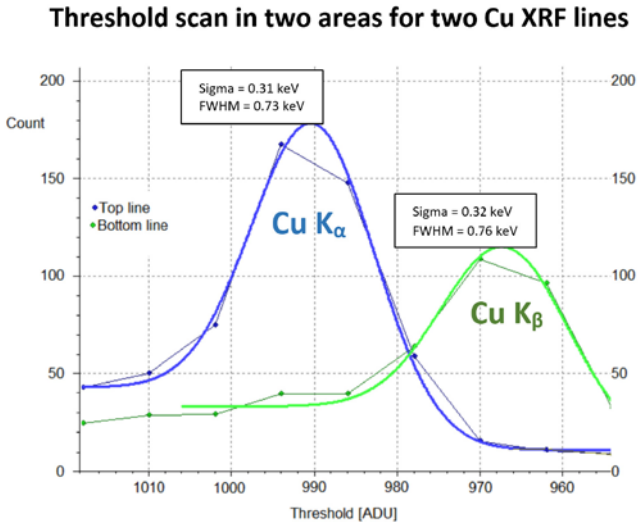
Readout electronics and hardware
The AdvaPIX TPX3 Quad uses single USB3.0 interface providing synchronized operation of all four Timepix3 chips. The maximal speed of 40 million hits per second for whole device is provided in fully spectral mode (called pixel mode or data driven mode). The #PiXet software is adapted for this new device.



The detector design is vacuum compatible. It can be optionally connected to water cooling circuit for better temperature stabilization.

Detector properties
Most of the functional properties are very similar to other #Timepix3 based devices of ADVACAM: #AdvaPIX TPX3 or #MiniPIX TPX3. The minimal threshold is about 2 keV (depending on sensor type and thickness). The energy resolution in counting mode is about 0.3 keV (sigma) at 8 keV (Cu K-alpha) for Silicon sensors.



This spectrum was measured with 0.3 mm thick Si sensor performing threshold scan in frame mode.

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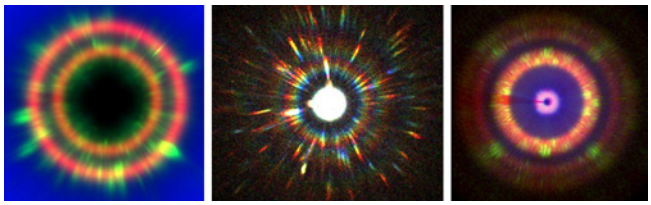
The typical energy resolution in pixel mode is shown in the table below for XRF K-alpha lines of several common metals (measured with 0.3 mm thick Si sensor).

Sources	Energy [keV]	Sigma [keV]	FWHM [keV]
Fe	6.398	0.70	1.66
Cu	8.04	0.80	1.87
Zr	15.744	0.71	1.68
Mo	17.441	0.74	1.75
Sn	25.191	0.73	1.72

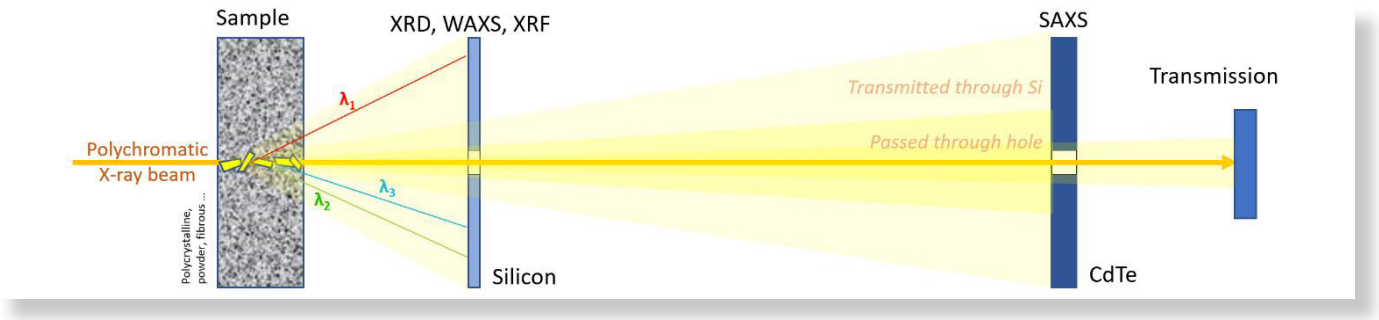
Typical applications
X-rays: The functional properties of Timepix3 detectors for Energy Dispersive #XRD (and #WAXS or #SAXS) were described in my previous article. There are clear benefits: Photon counting with energy discrimination, high spatial resolution of 55 µm (or better), fully spectral mode, effective suppression of radiation background and compact size.

The Quad Timepix3 detector with central hole offers 4 times larger solid angle coverage and does not require the beam-stop. The primary X-ray beam transmitted through the sample passes the hole in the sensor and can be detected downstream with additional detector bringing additional information.



The modularity of the detector can be used with great advantage combining transmission #XRD, #WAXS and #SAXS into single system with three stationary detectors: The first plane with silicon sensor is placed close to the sample recording #XRD and #WAXS signal.

The transmitted beam continues though the hole carrying #SAXS information which is detected by the second layer in suitable distance. The primary beam continues through the hole in the second layer and can be finally measured by third layer composed of single device such as #MiniPIX TPX3.



Electrons: electron microscopy #SEM, #STEM, channelling
Ions: #RBS, #ERDA, channelling ...

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