

MEASUREMENTS OF BACKGROUND SCATTER RADIATION IN CT SCAN ROOM USING ENERGY RESOLVING HYBRID PIXEL DETECTORS

W. S. Wong¹, Erik Fröjd^{1,2}, J.Damet³, C. Elandoy⁴, M. Campbell¹

1, Cern, Geneva Switzerland

2, Mid Sweden University, Sweden

3, Institute of Radiation Physics, Lausanne University Hospital, Switzerland

4, Department of Radiology, Lausanne University Hospital, Switzerland

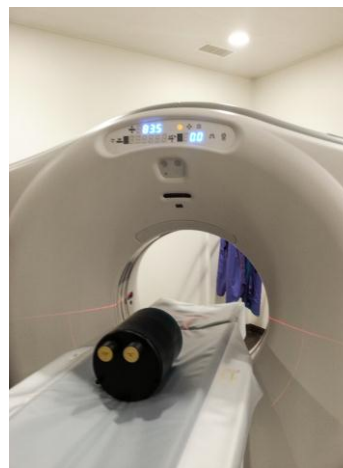
MOTIVATION

Hybrid Pixel Detectors feature

- Low energy threshold (2-4keV)
- Spectroscopic resolution
- Excellent time resolution (\sim ns - ms)
- High dynamic range
 - Small pixels
 - No dark current integration
- More complex calibration and data processing
- High price (depending on application)

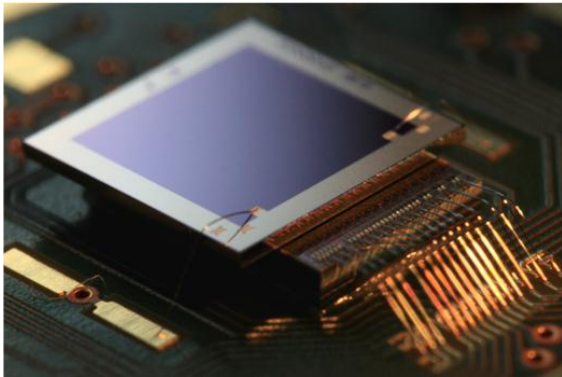
MEASUREMENT SETUP

- Dosepix and Timepix detectors with a 300um Si sensor
- Measurements performed at CHUV in Lausanne
- Ge Medical Systems Discovery CT750 HD CT-scanner
 - at 80kVp and 120kVp
- Measured scattered radiation during scan of a abdomen phantom

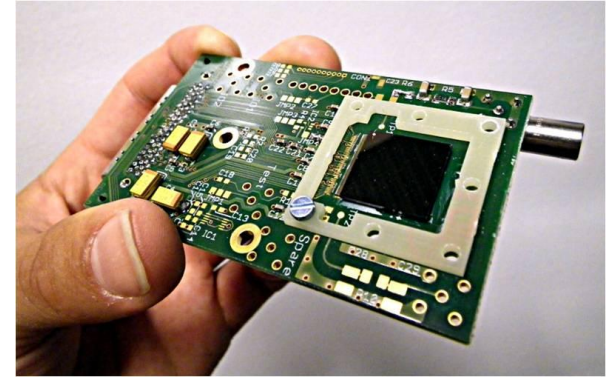
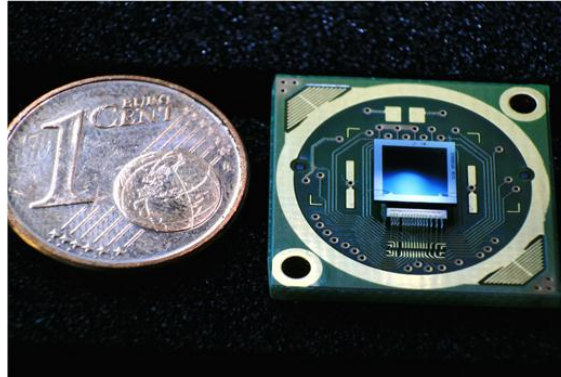


DETECTORS TESTED

- Developed within the framework of the Medipix2 collaboration
- Single Photon Processing
- Hybrid Pixel Detectors
- Energy measured using Time over Threshold



Dosepix



Timepix

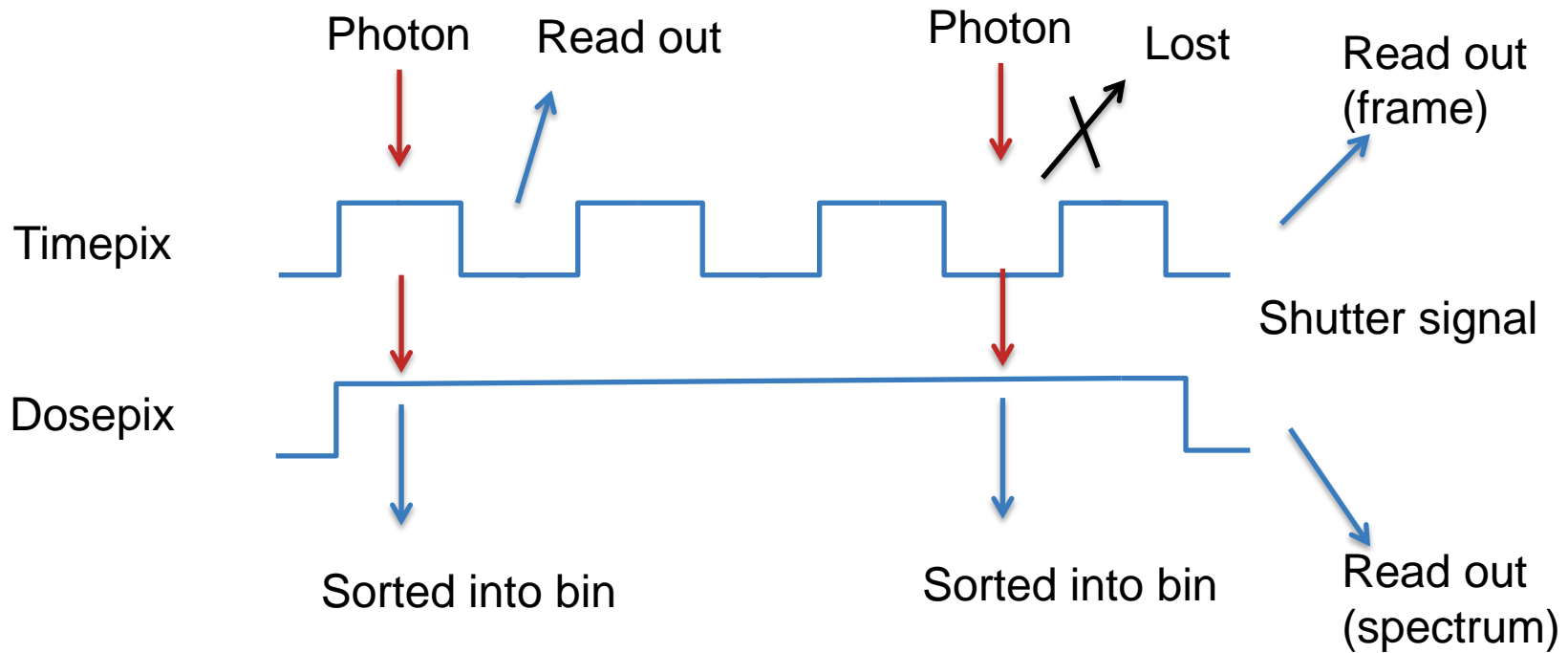
DETECTORS TESTED

	Timepix	Dosepix
Type	Hybrid Pixel Pixel	Hybrid Pixel Detector
Technology	0.25 μm CMOS	130 nm CMOS
Pixels matrix	256 x 256	16 x 16
Pixel size	55 x 55 μm	220 x 220 μm
Sensitive area	198 mm ²	12.4 mm ²
Collection	e ⁻ or h ⁺	e ⁻ or h ⁺
Minimum Threshold	~3.5keV	~3.5keV
Threshold	1 global analog	1 global analog
Operation Modes	Time over threshold Time of arrival Photon counting	Energy binning mode 16 digital thresholds for event-by-event energy binning Photon counting mode (8 bits) Integral ToT (24 bits)

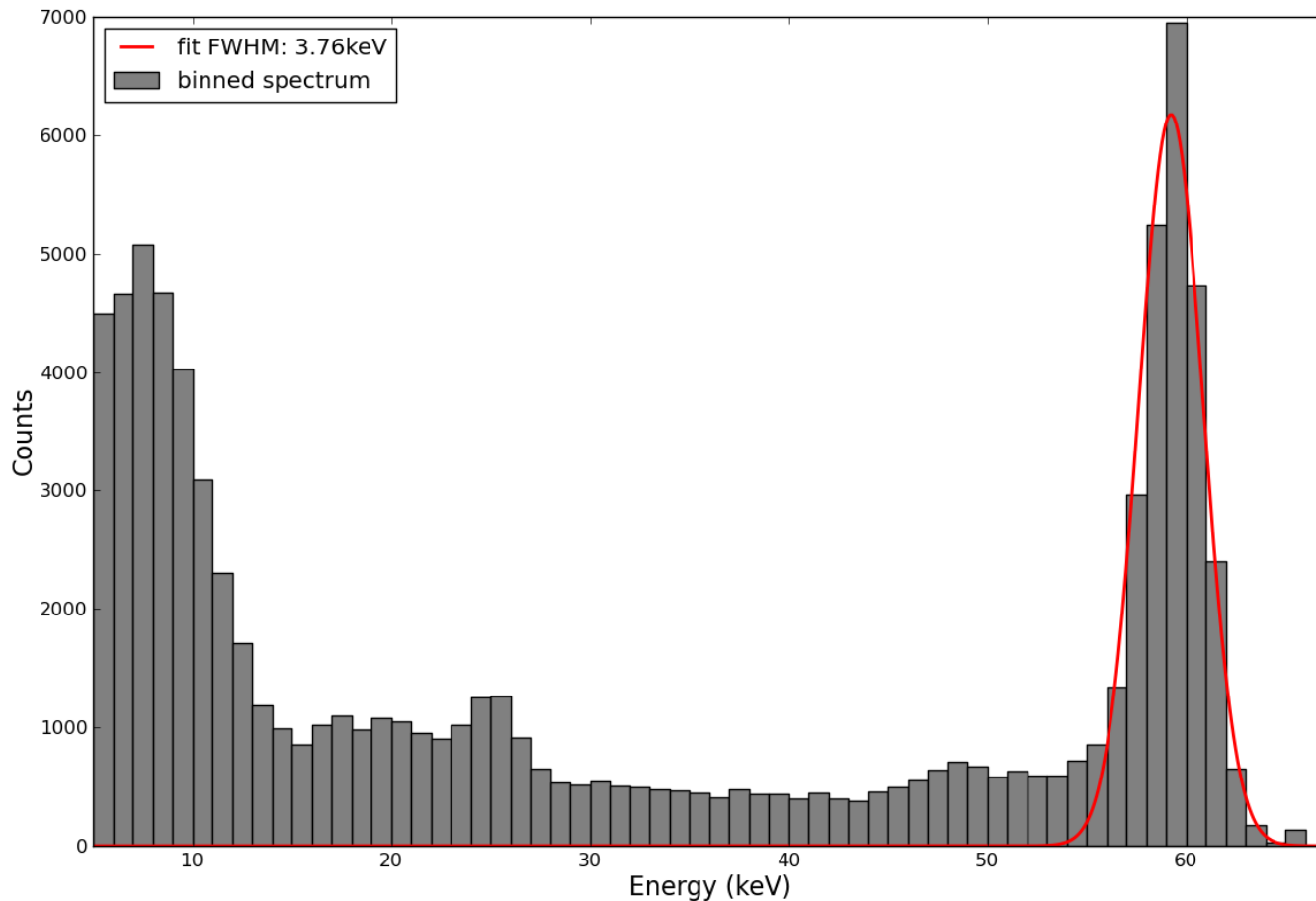
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DOSEPIX ENERGY BINNING MODE

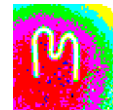


DOSEPIX ENERGY BINNED SPECTRA

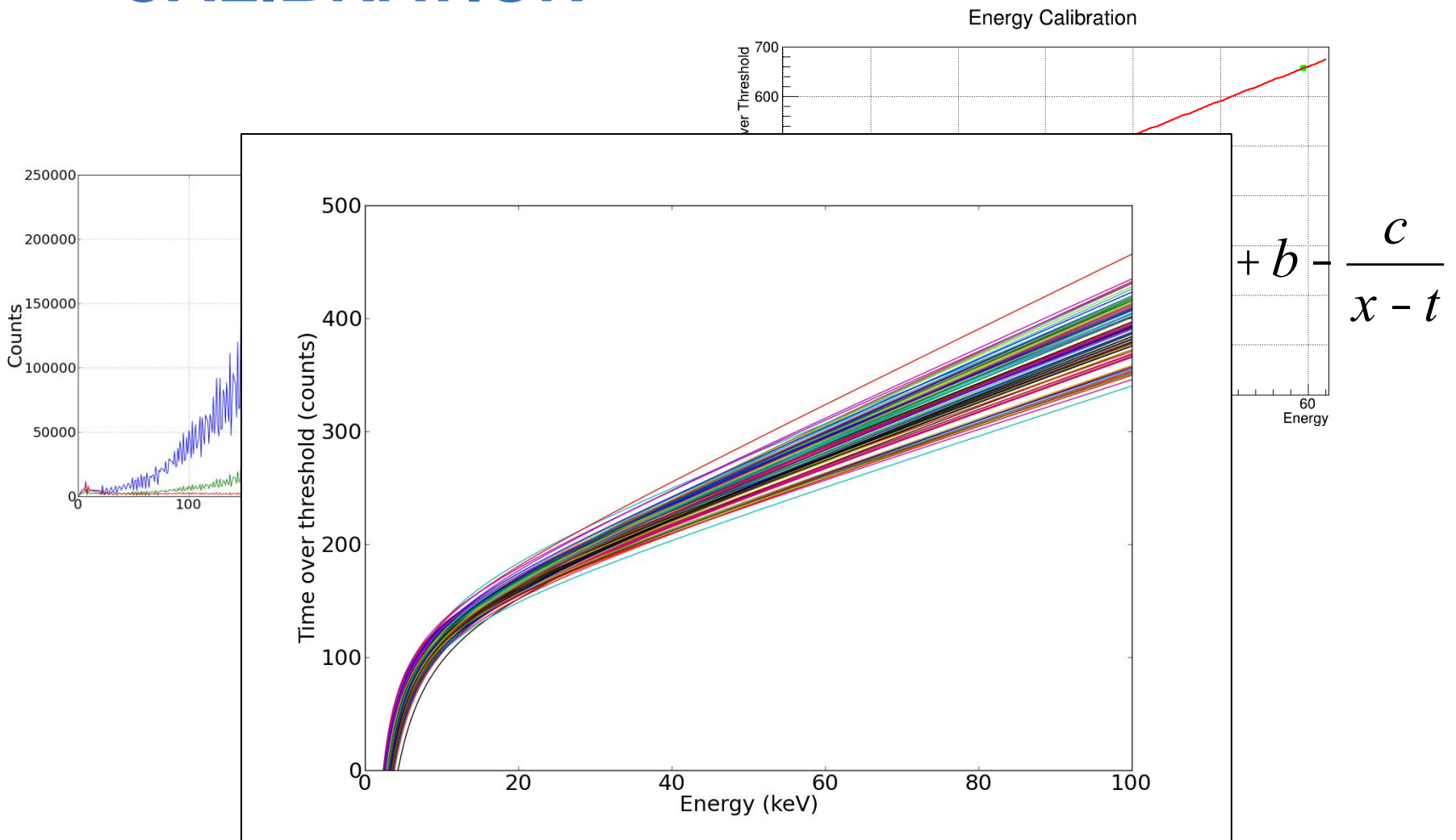


The 16 bins per pixel can be shifted to give a maximum of 256 bins per chip

^{241}Am spectrum measured with Dosepix
60 bins 5-65keV

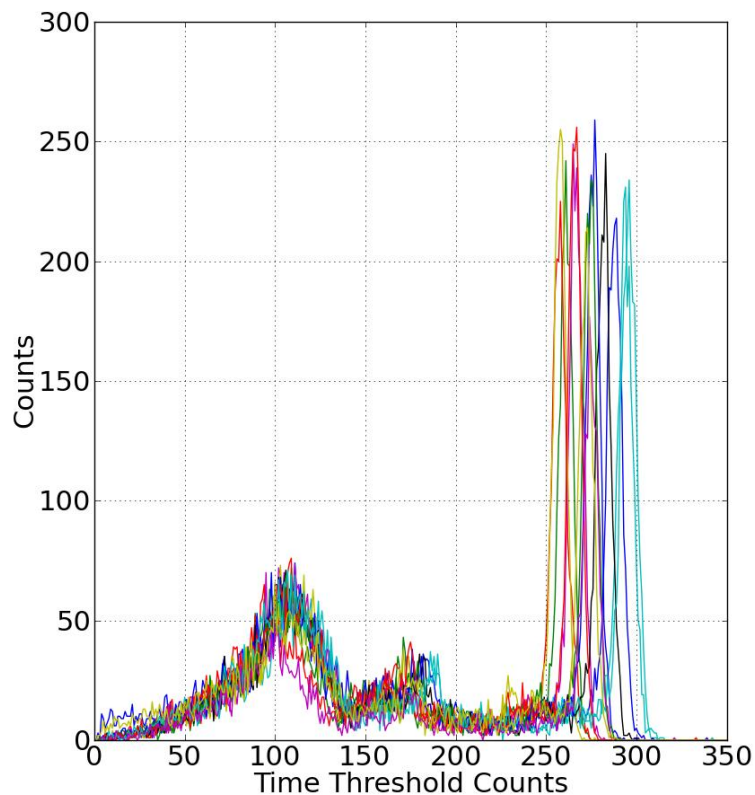


CALIBRATION

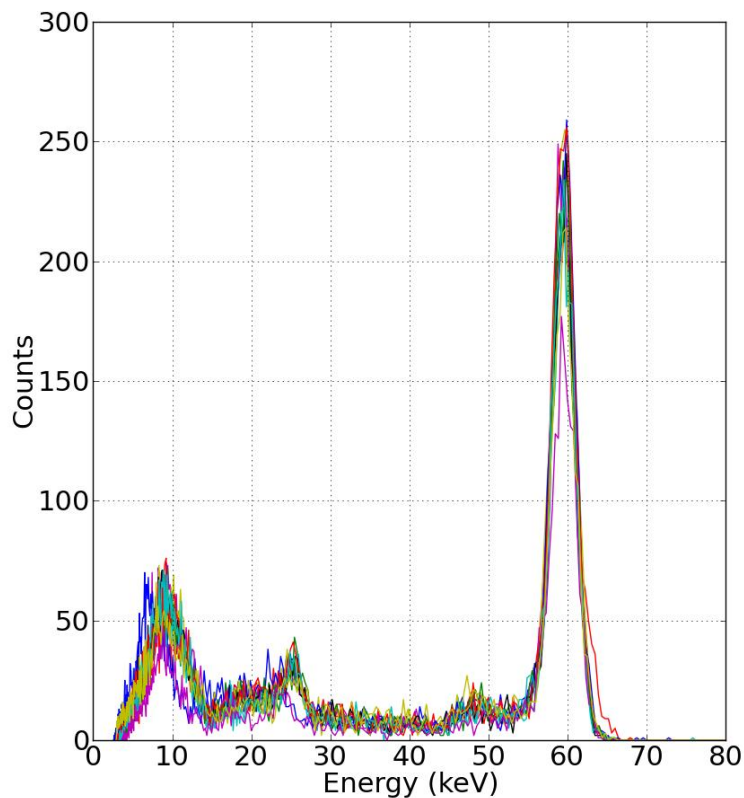


CALIBRATION VERIFICATION

Dosepix



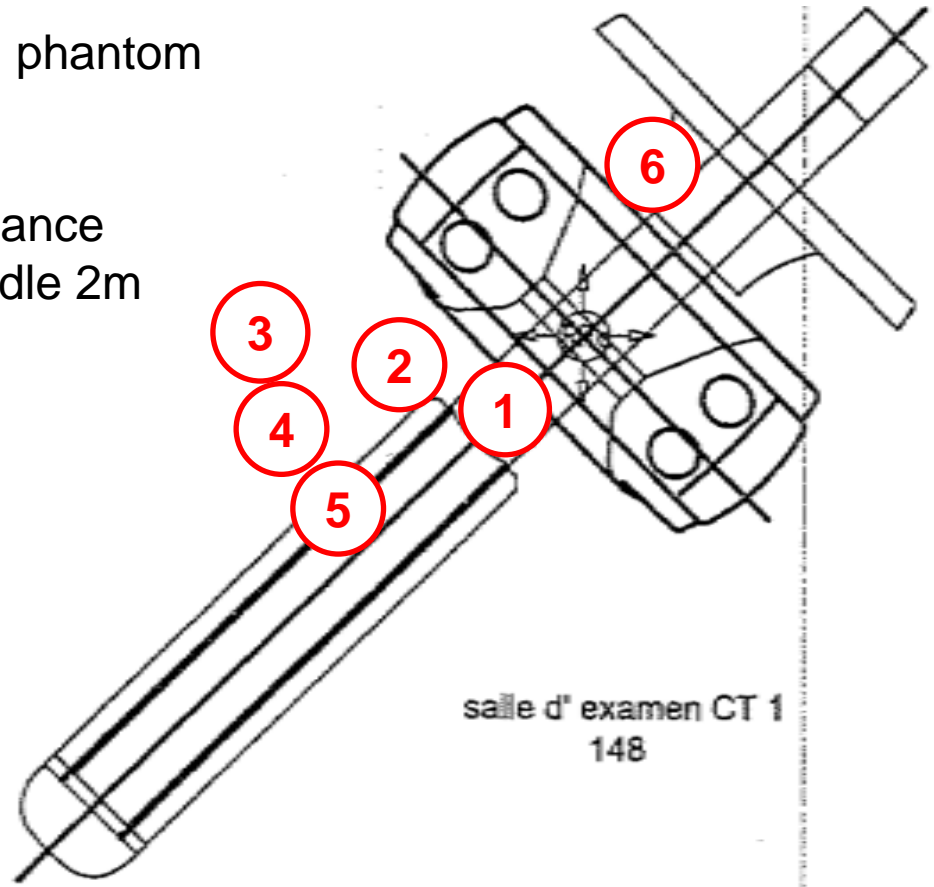
Before calibration



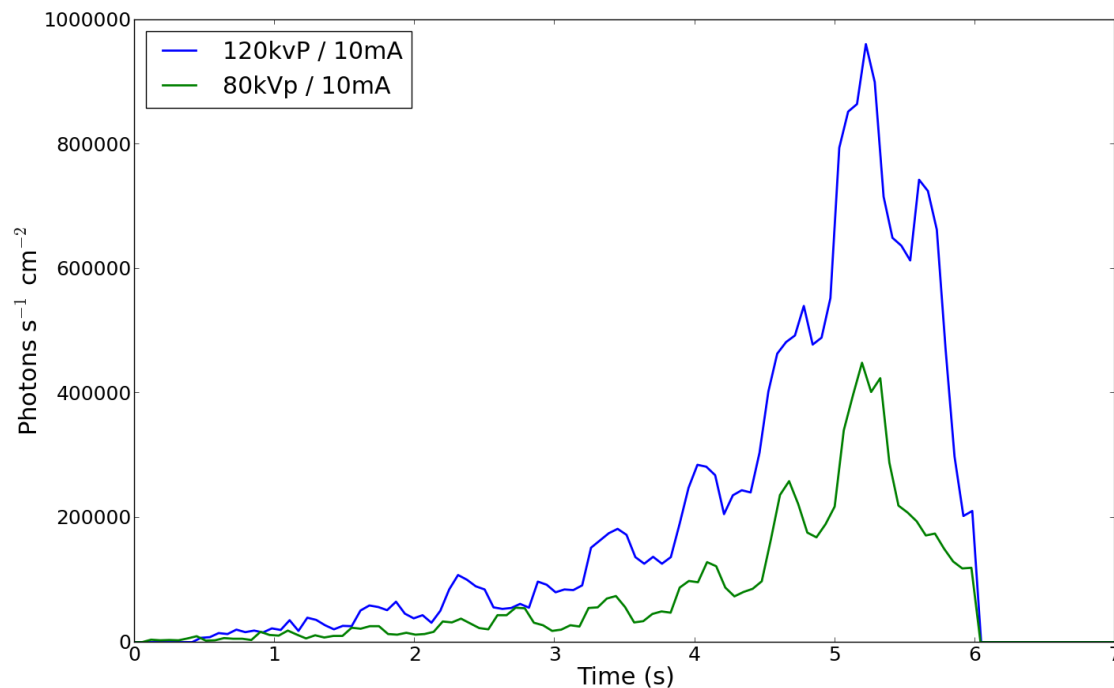
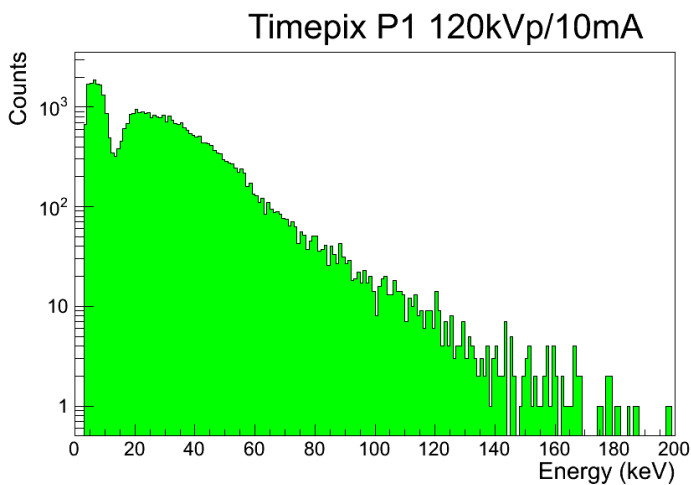
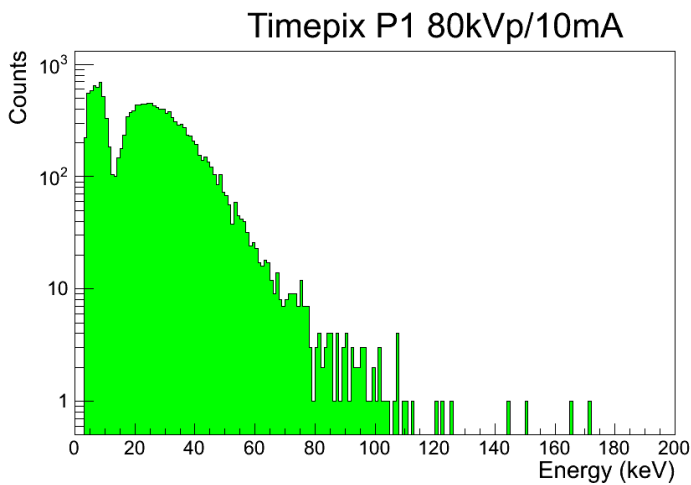
After calibration

MEASUREMENTS

1. On CT scan cradle 25cm from phantom
2. 45° 1m distance
3. 45° 2m distance
4. Next to the the cradle, 2m distance
5. On non moving part of the cradle 2m distance

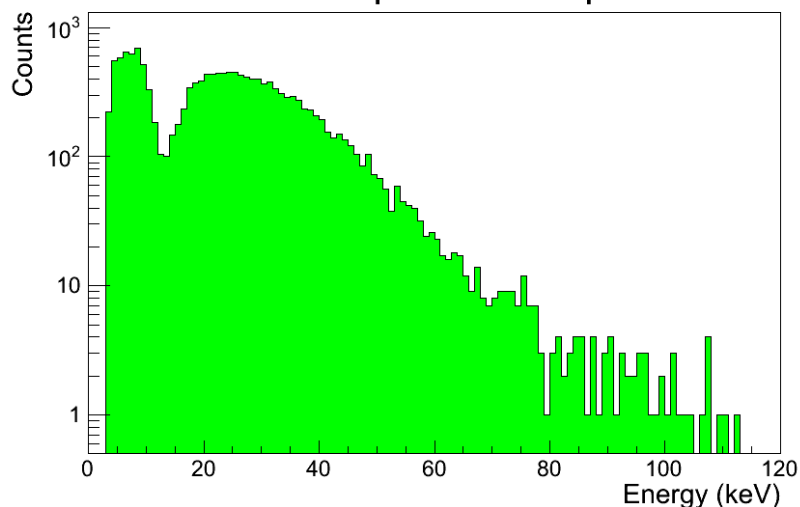


TIMEPIX POS1 ON CRADLE -25CM

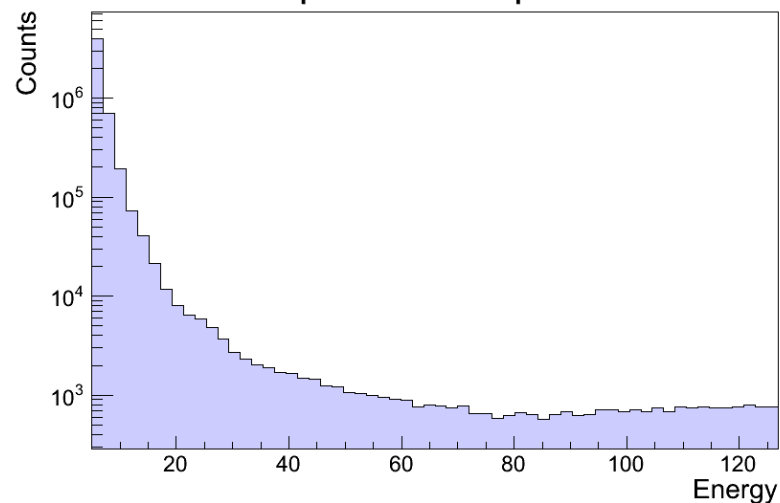


POSITION 1 ON CRADLE -25CM

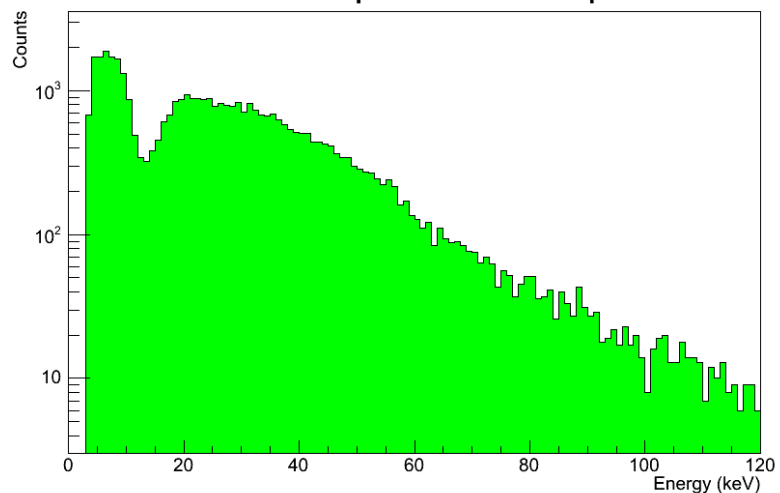
Timepix P1 80kVp/10mA



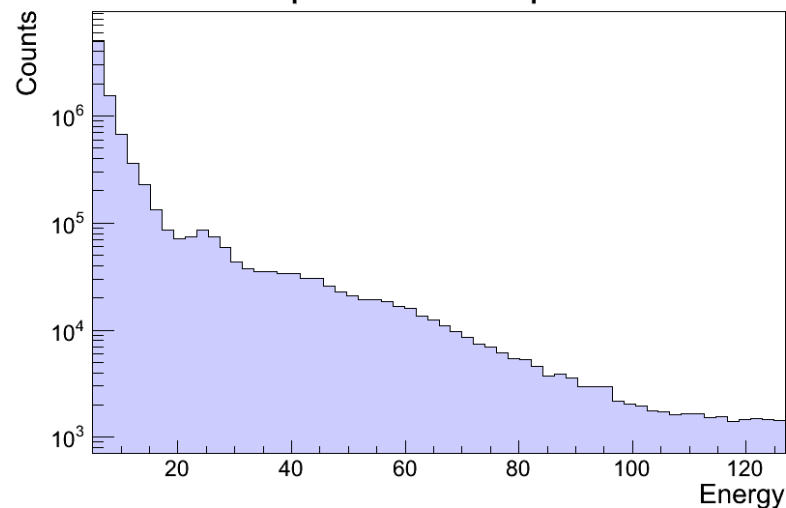
Dosepix P1 80kVp/10mA



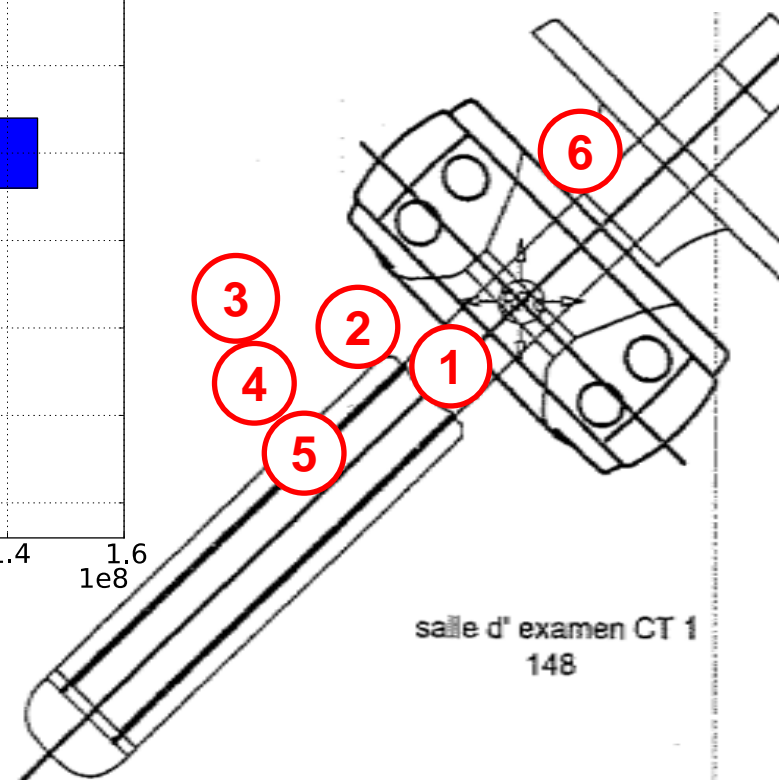
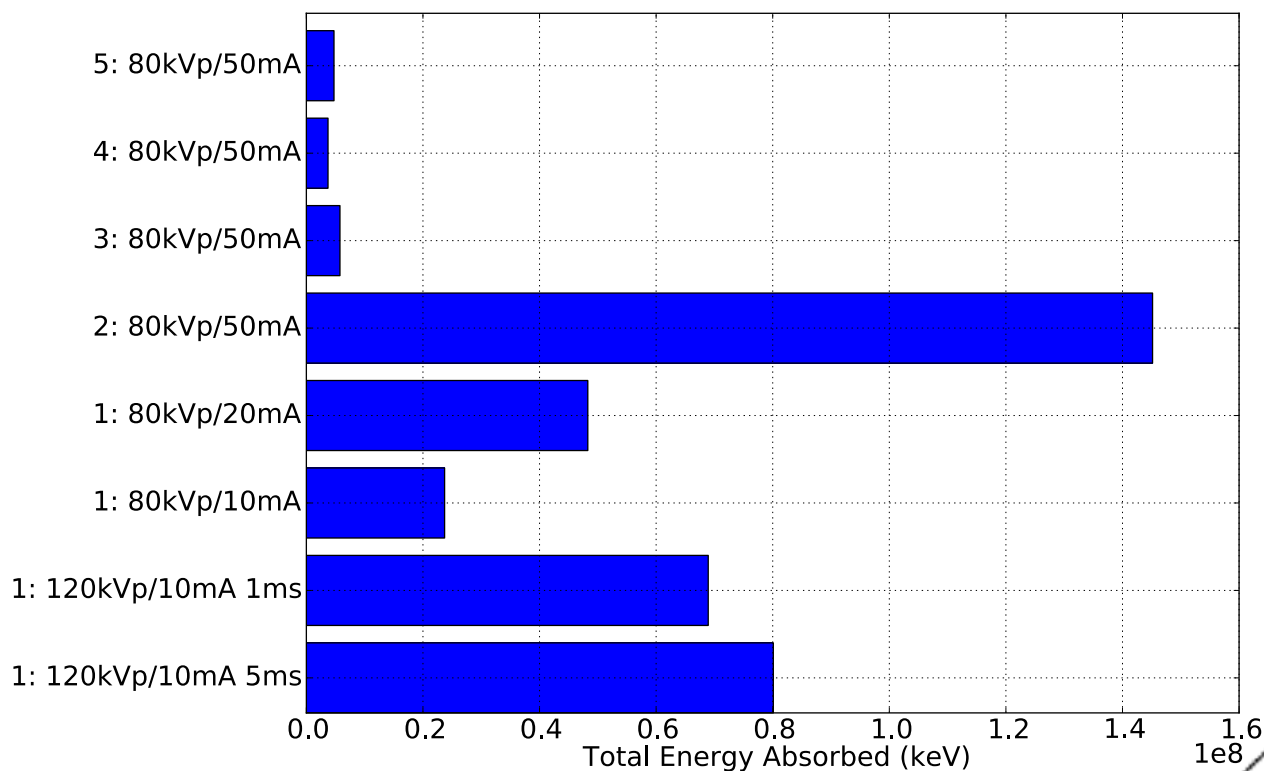
Timepix P1 120kVp/10mA



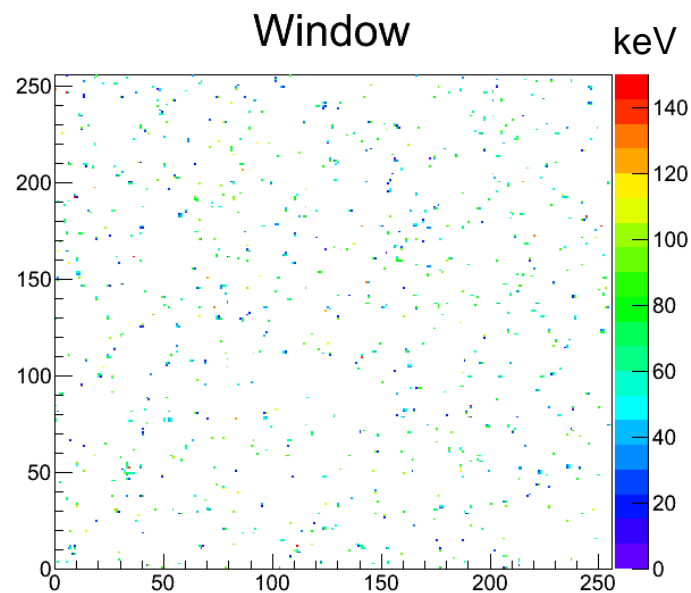
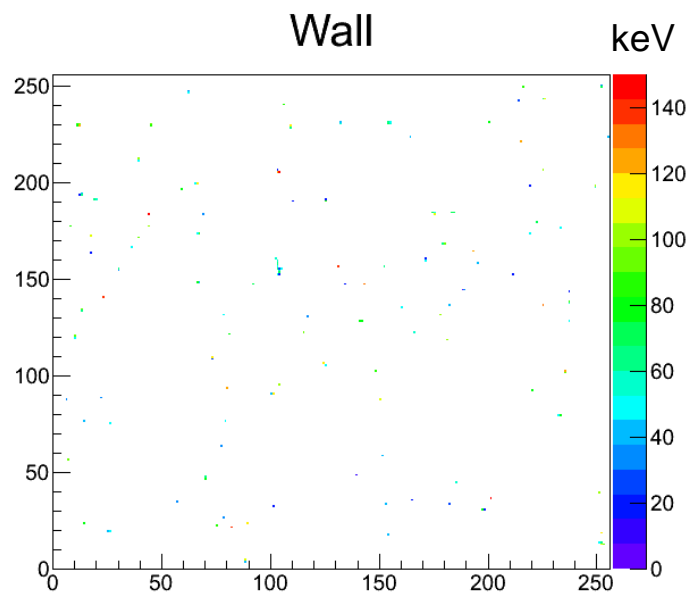
Dosepix P1 120kVp/10mA



INTEGRATED ENERGY, TIMEPIX



LOW FLUX MEASUREMENTS



CONCLUSIONS

- We have tested Timepix and Dosepix for measurements of scattered radiation in a CT scan room
- First results are promising and we have proven the feasibility of using these detectors for dose, dose rate and spectroscopic measurements
- Further work including signal to dose calibration, investigation of pileup effects, testing other sensor materials is planned

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