Spectral X-ray Implications for Attenuation and Scatter-based Tomography

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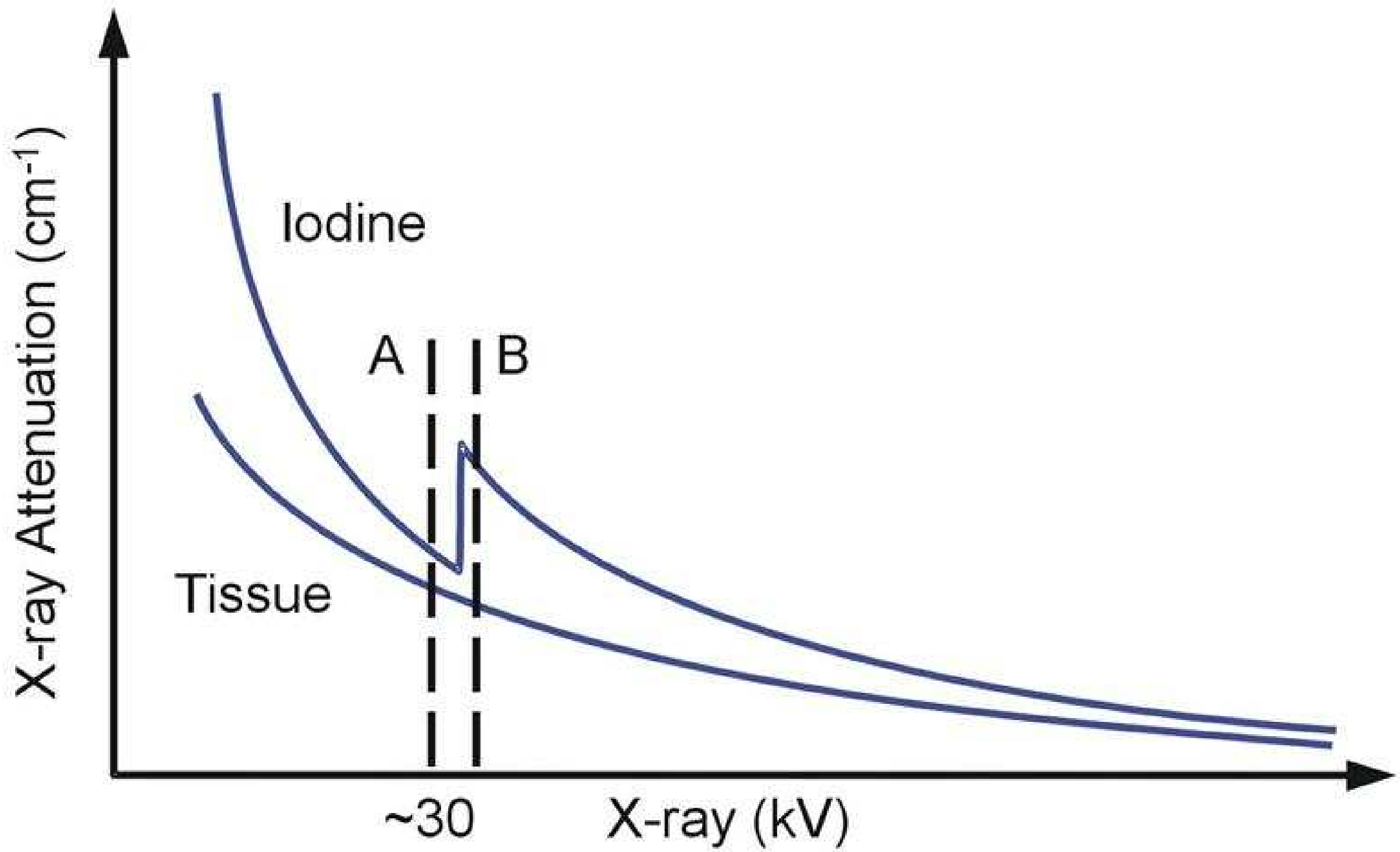
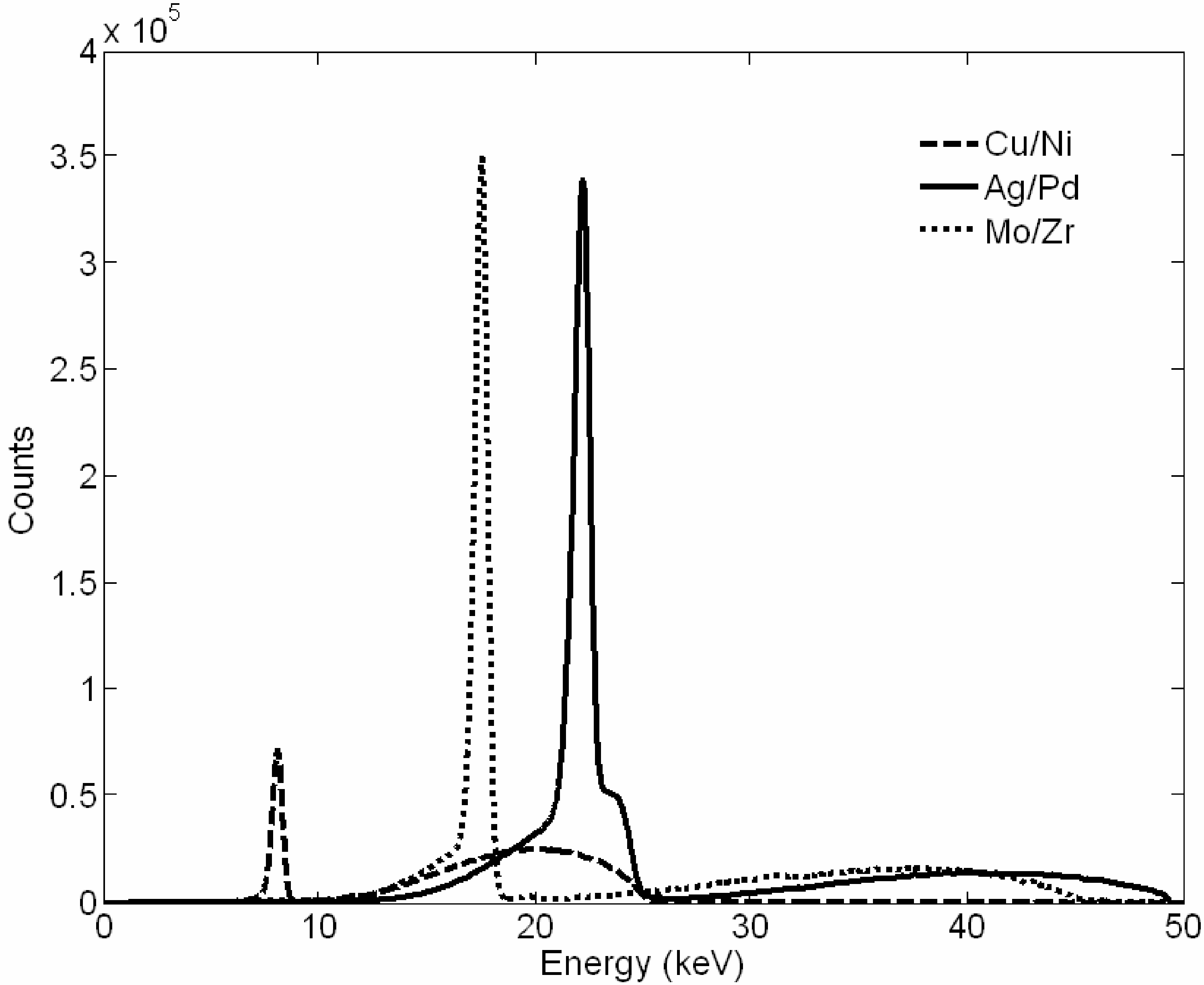
Dual Energy Subtraction

(Use of Kedge of x-ray attenuation)



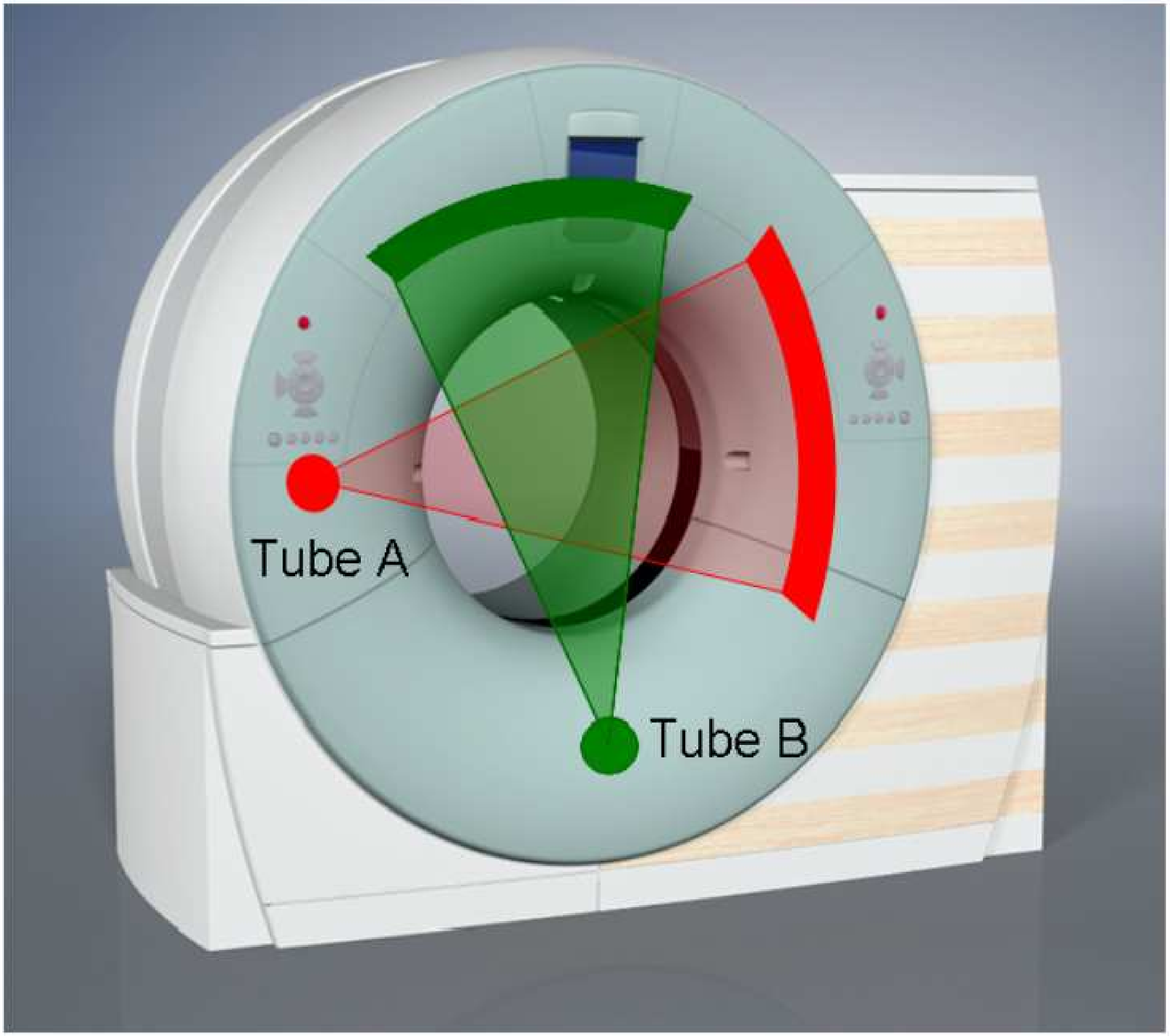
4/84/ELR



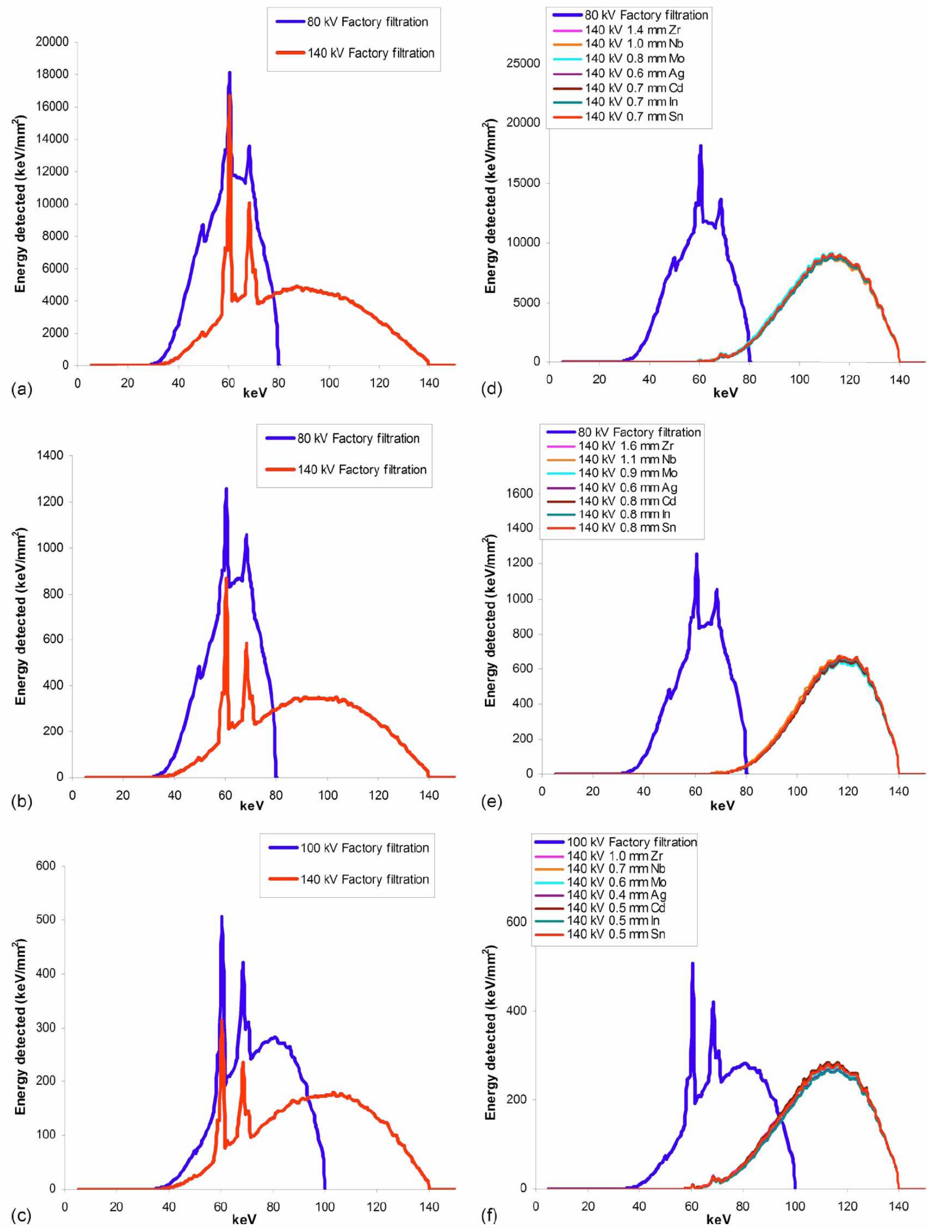
17227

DRE/08/09

Siemens Somatom M8 Dual-Tube, 0.33 sec rotation, 64-Channel CT Scanner

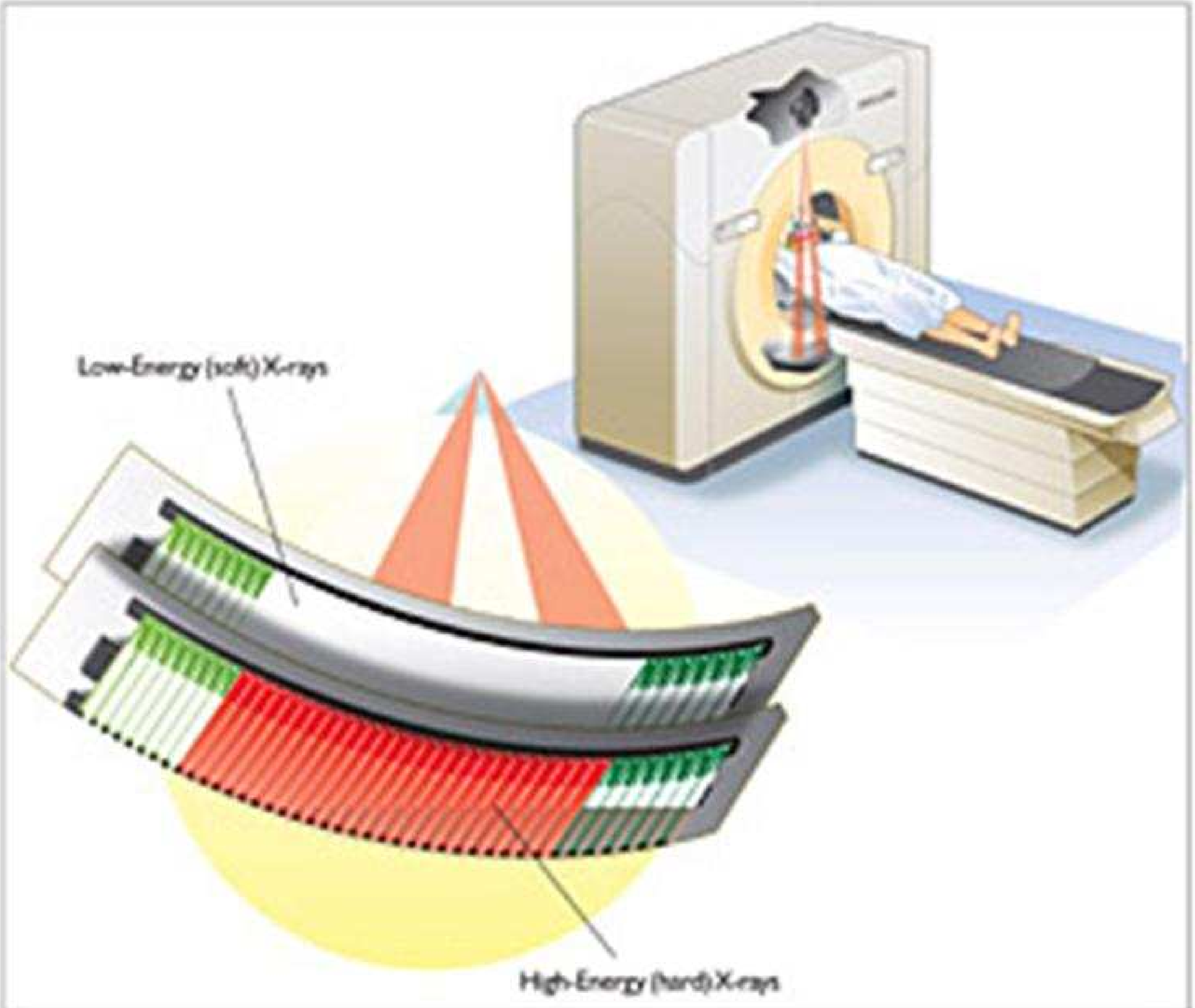


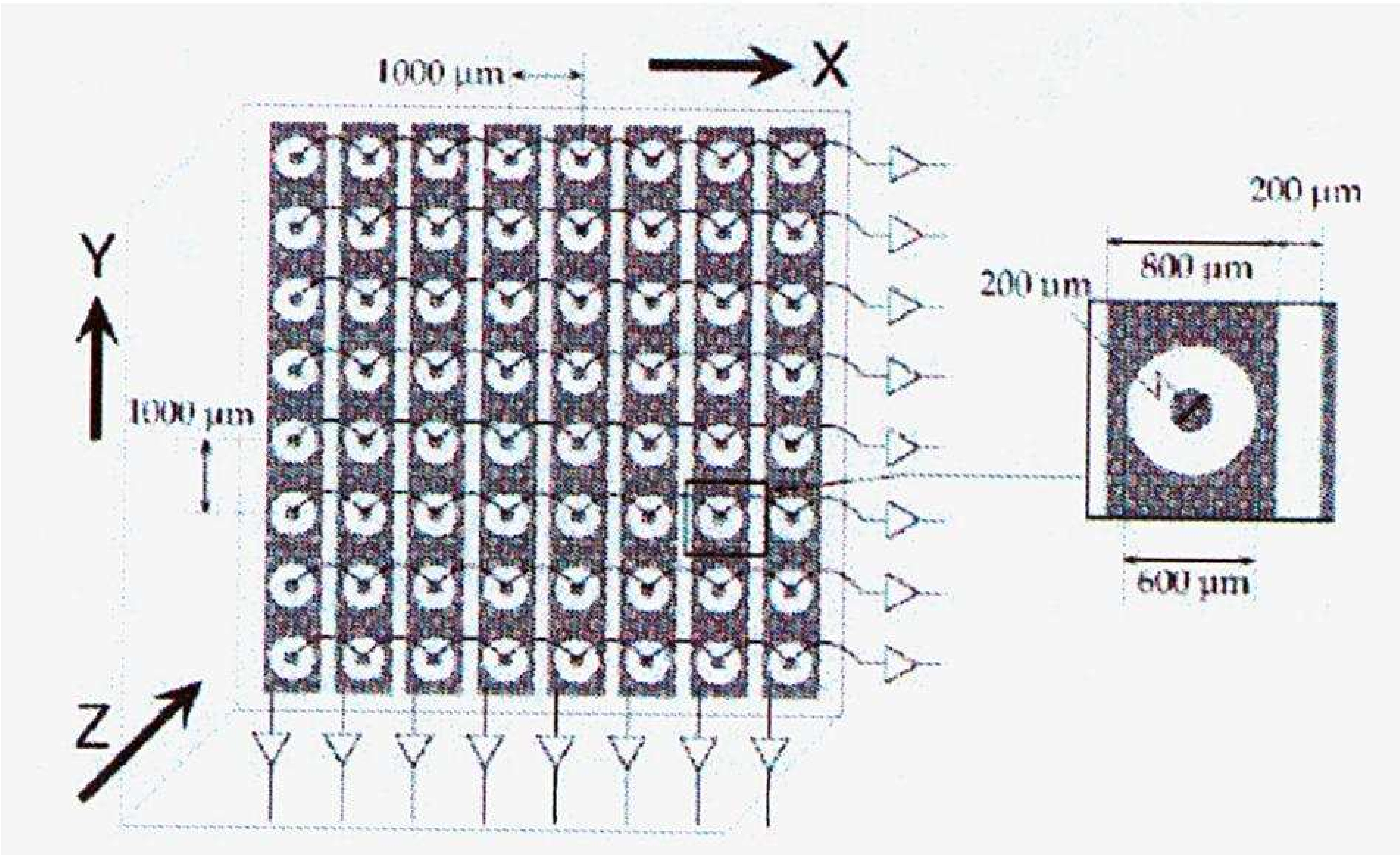
x1559


80 kV Factory filtration
140 kV Factory filtration
Energy detected (keV/mm²)
keV
(a)
80 kV Factory filtration
140 kV 1.4 mm Zr
140 kV 1.0 mm Nb
140 kV 0.8 mm Mo
140 kV 0.6 mm Ag
140 kV 0.7 mm Cd
140 kV 0.7 mm In
140 kV 0.7 mm Sn
(d)
80 kV Factory filtration
140 kV Factory filtration
(b)
80 kV Factory filtration
140 kV 1.6 mm Zr
140 kV 1.1 mm Nb
140 kV 0.9 mm Mo
140 kV 0.6 mm Ag
140 kV 0.8 mm Cd
140 kV 0.8 mm In
140 kV 0.8 mm Sn
(e)
100 kV Factory filtration
140 kV Factory filtration
(c)
100 kV Factory filtration
140 kV 1.0 mm Zr
140 kV 0.7 mm Nb
140 kV 0.6 mm Mo
140 kV 0.4 mm Ag
140 kV 0.5 mm Cd
140 kV 0.5 mm In
140 kV 0.5 mm Sn
(f)

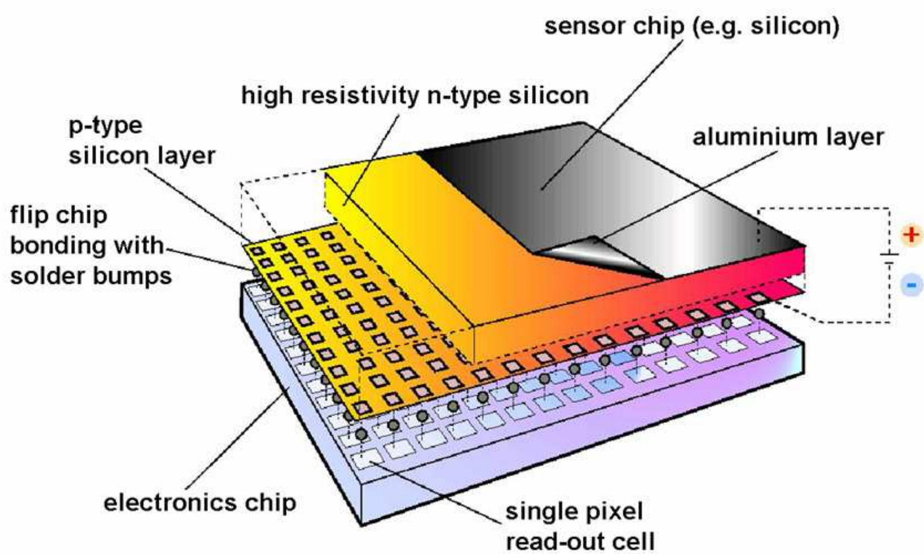
x1838

Spectral CT - Philips

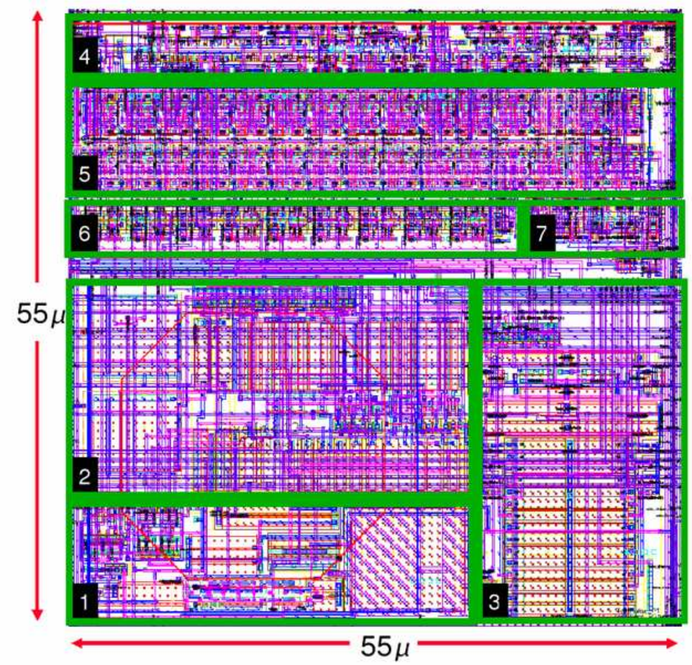



1000 µm
X
Y
1000 µm
Z
200 µm
800 µm
200 µm
600 µm

Medipix X-ray Imaging Array

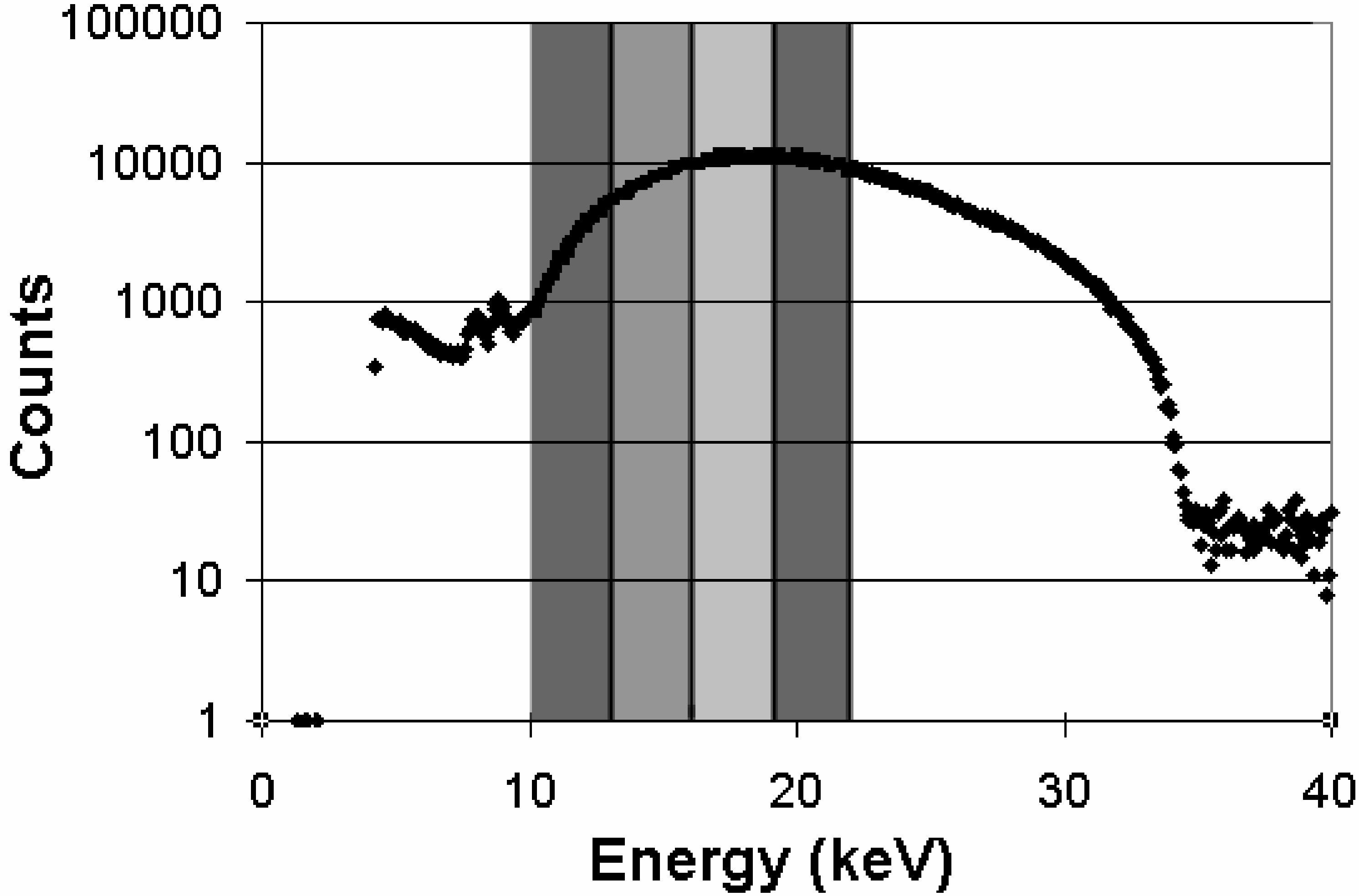


ARRAY

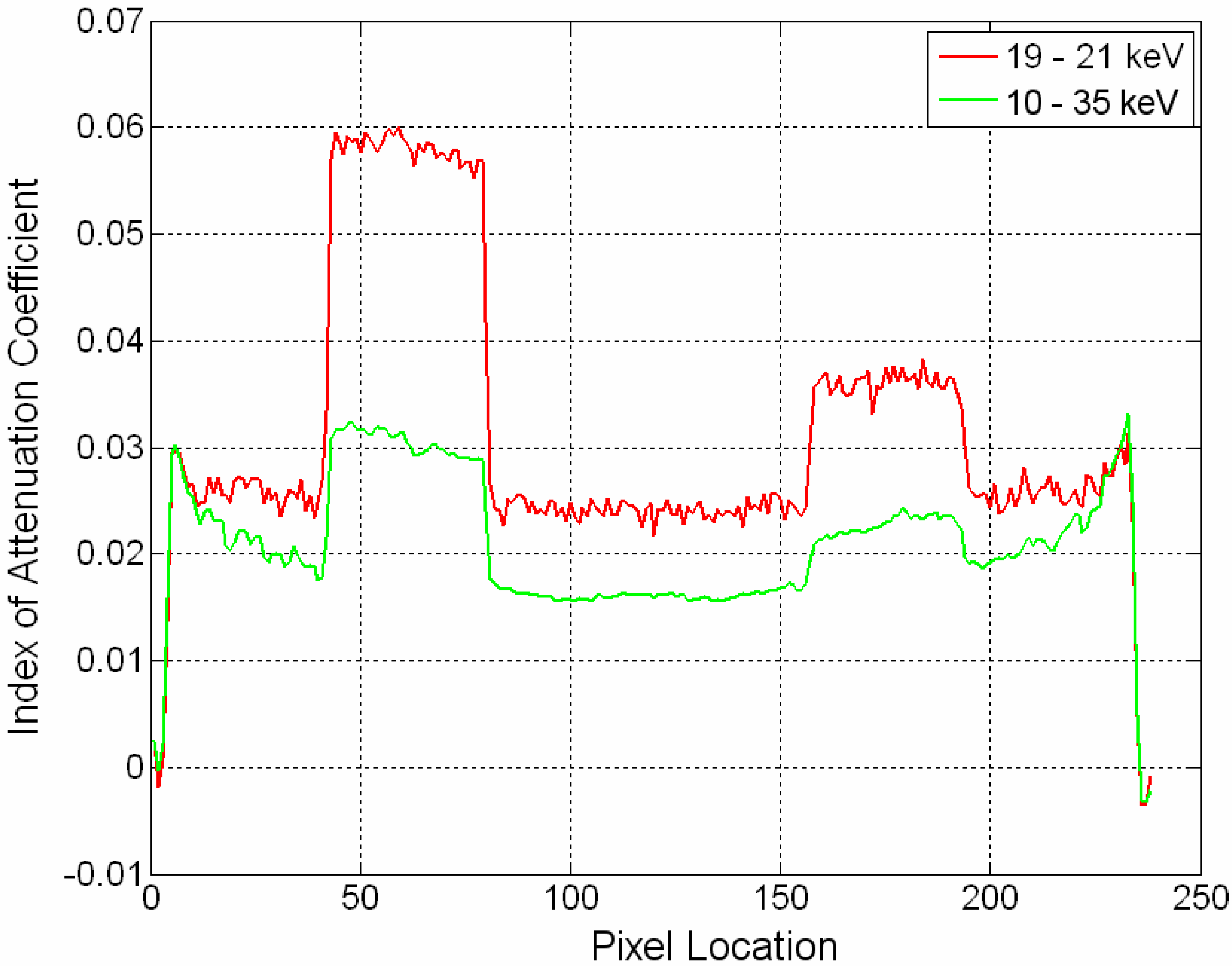


PIXEL

x1825A (x1800/x1825)



100000
10000
1000
100
10
1
Counts
0
10
20
30
40
Energy (keV)



17429 DRE/05/10

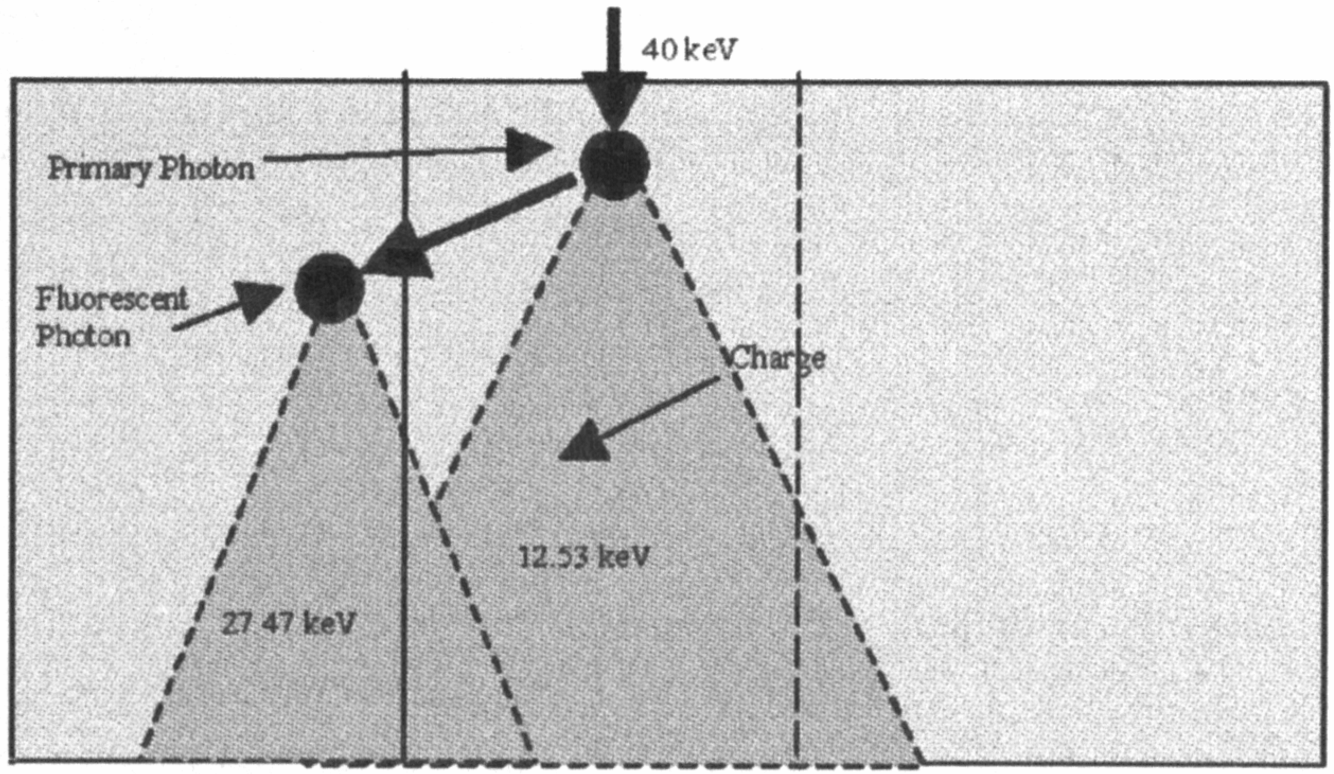
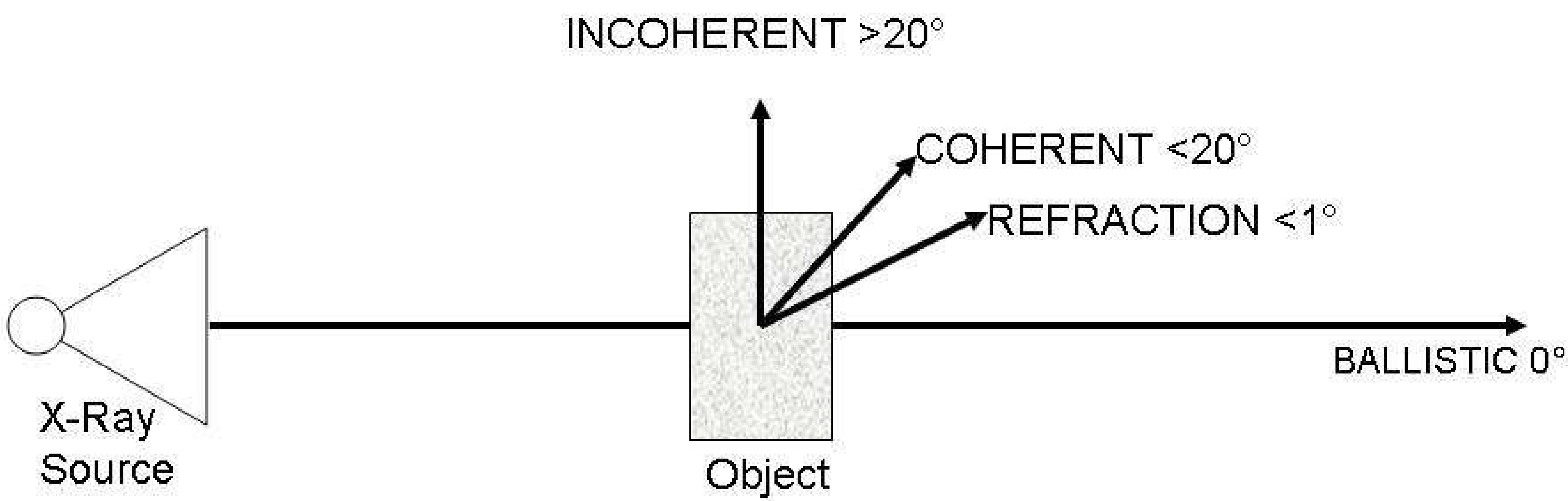


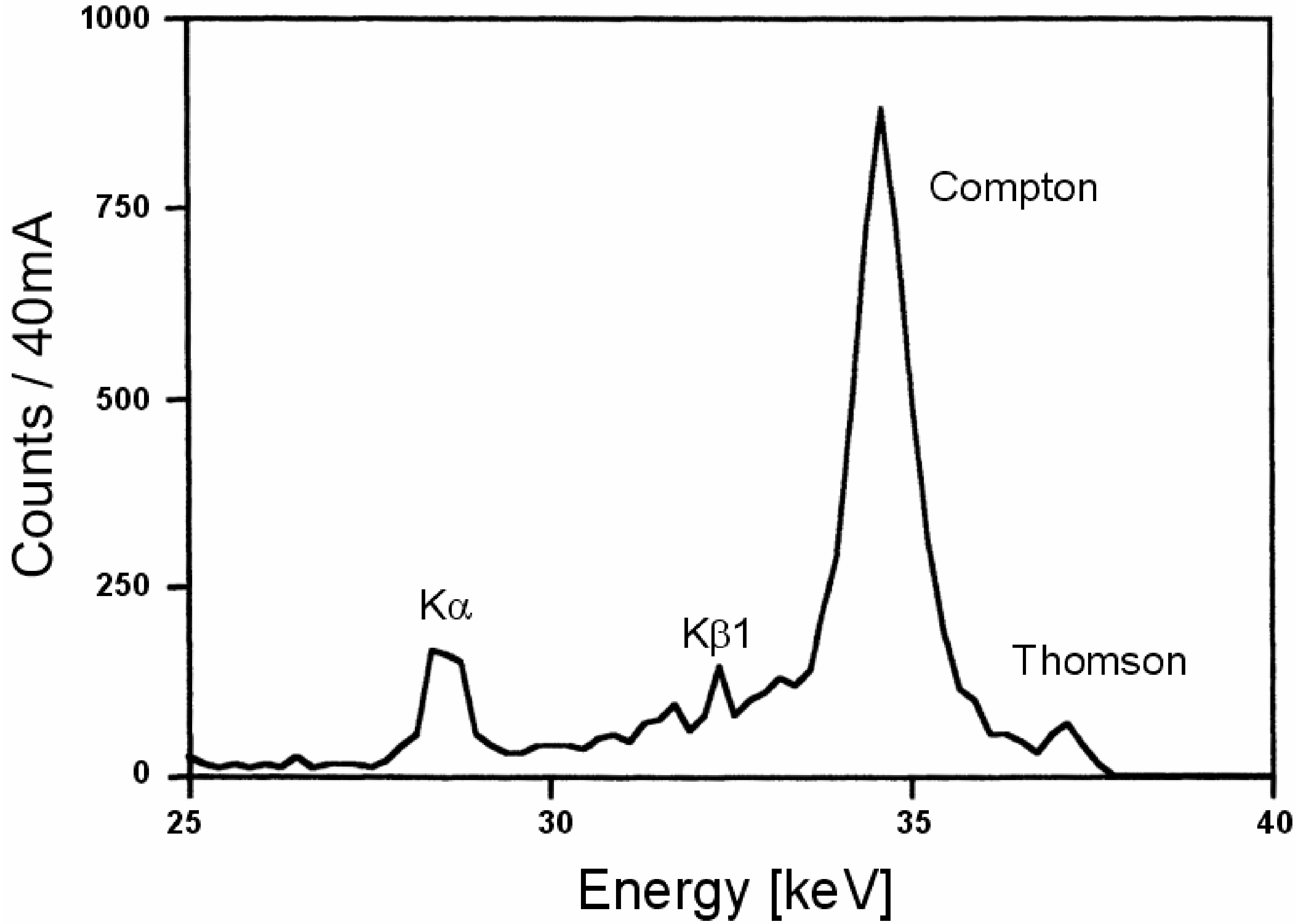
Fig. 1. A typical X-ray event in a detector. The primary photon is captured by a photoelectric event. A fluorescent photon is emitted and captured in the next pixel. The charge cloud from these two interactions widens by diffusion during drift towards the readout electrode. (only one type of carrier shown). It should be noted that most of the energy is deposited outside the pixel where the primary interaction occurred.

Fröjdh C, et al. Spectral Response of Pixellated Semiconductor X-ray Detectors, IEEE Nuclear Science Symposium Conference Record (2005). 2967-2969.

x1938

Scatter Types

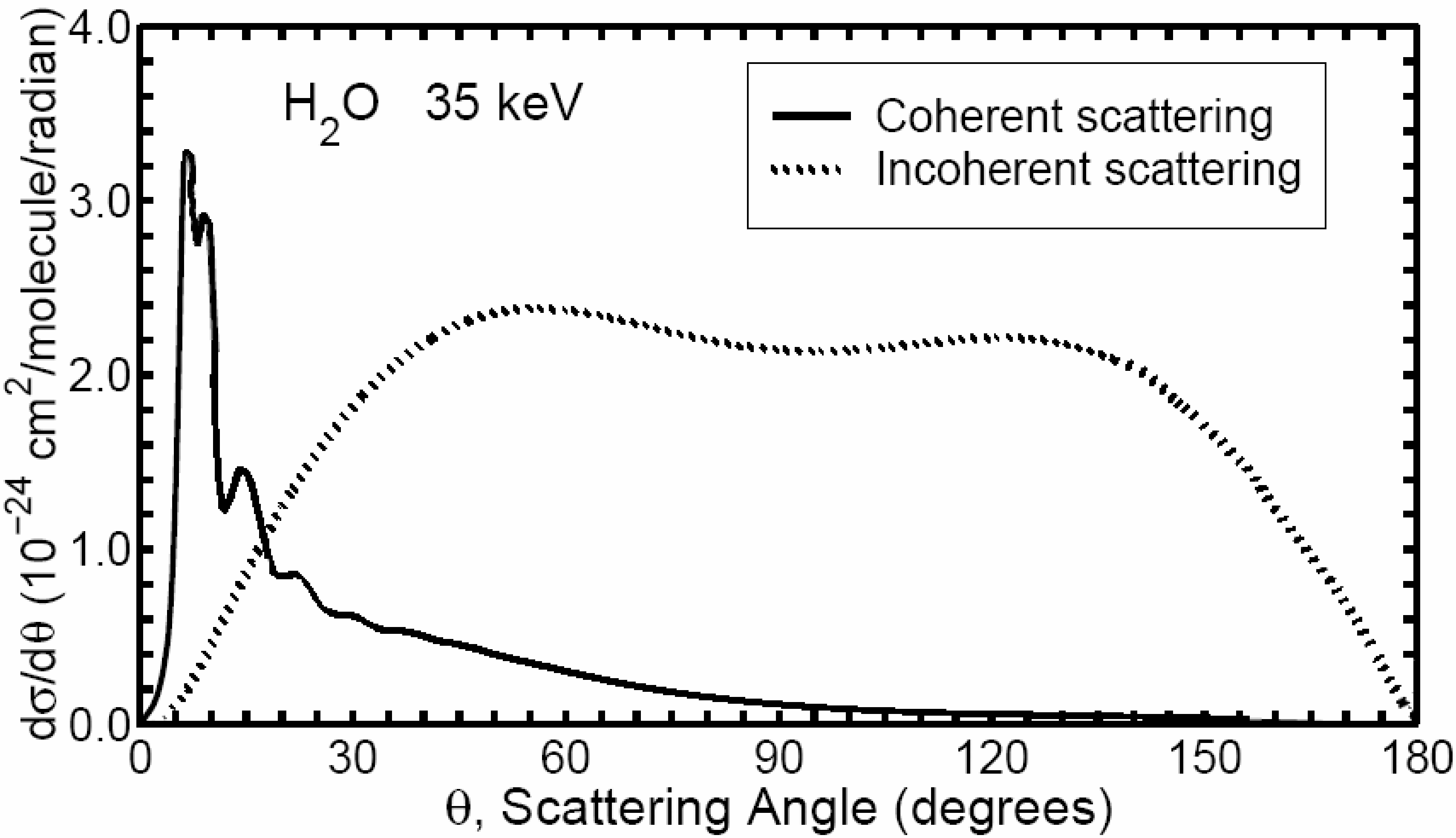




T. Takeda, et al., Developments in X-ray Tomography, SPIE Vol. 3149, 1997, p 167

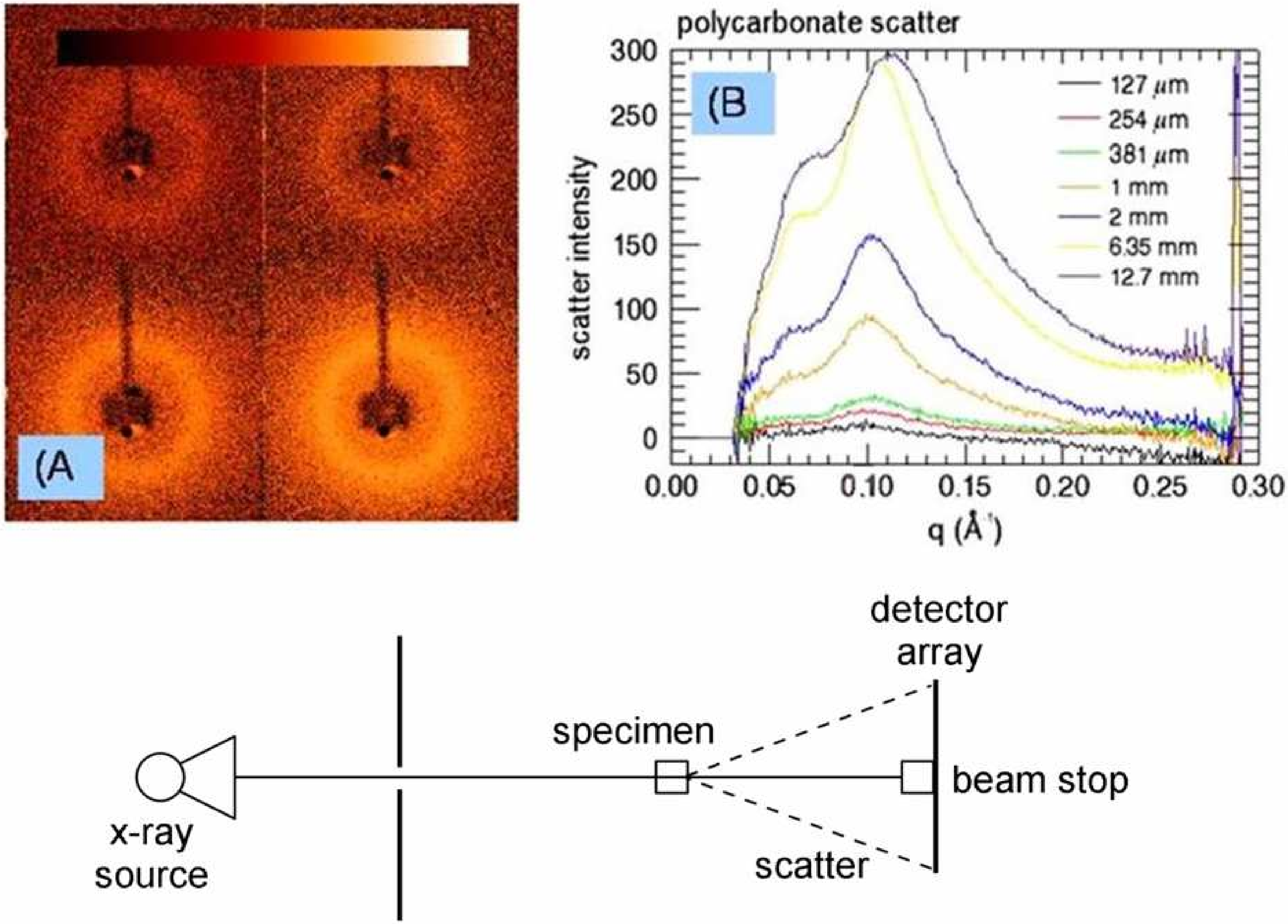
Figure 6. Actual spectrum of projection data in FXCT

x0903



Johns, P.C. et. al., SPIE TD01: 355-357, 2002, (Ottawa, Canada).
[SPIE Regional Mtg. Optoelectr., Photonics, Imaging]

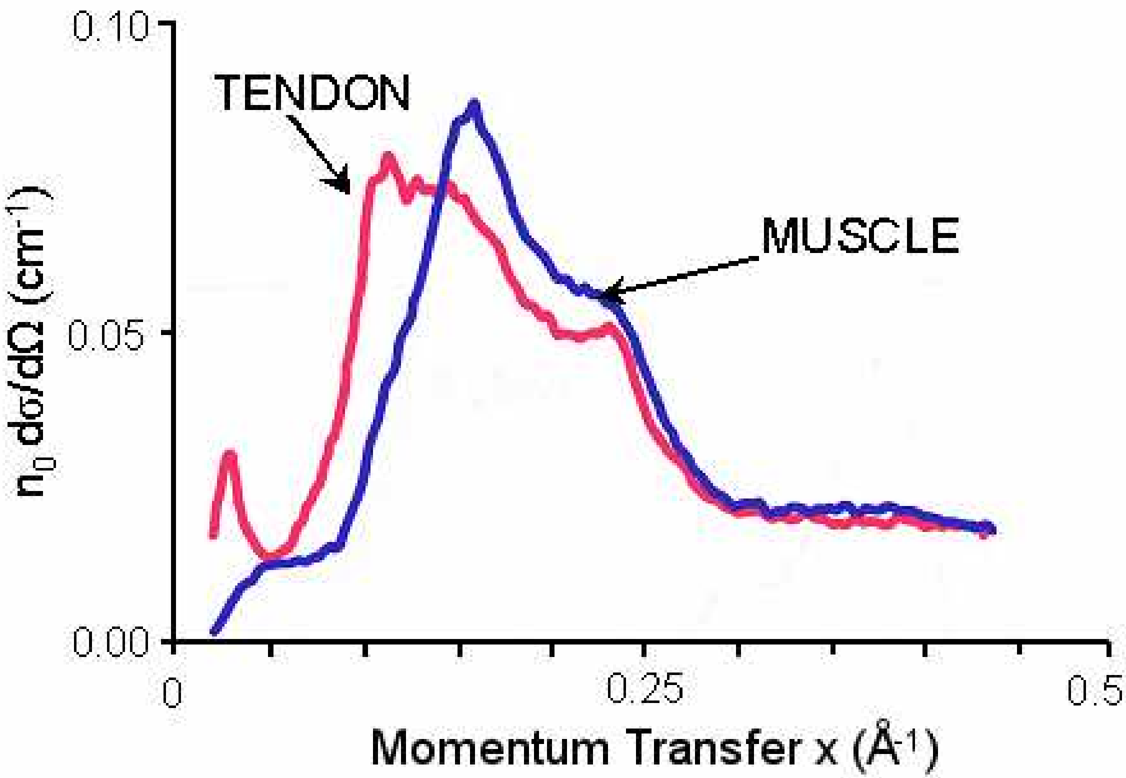
x1829A



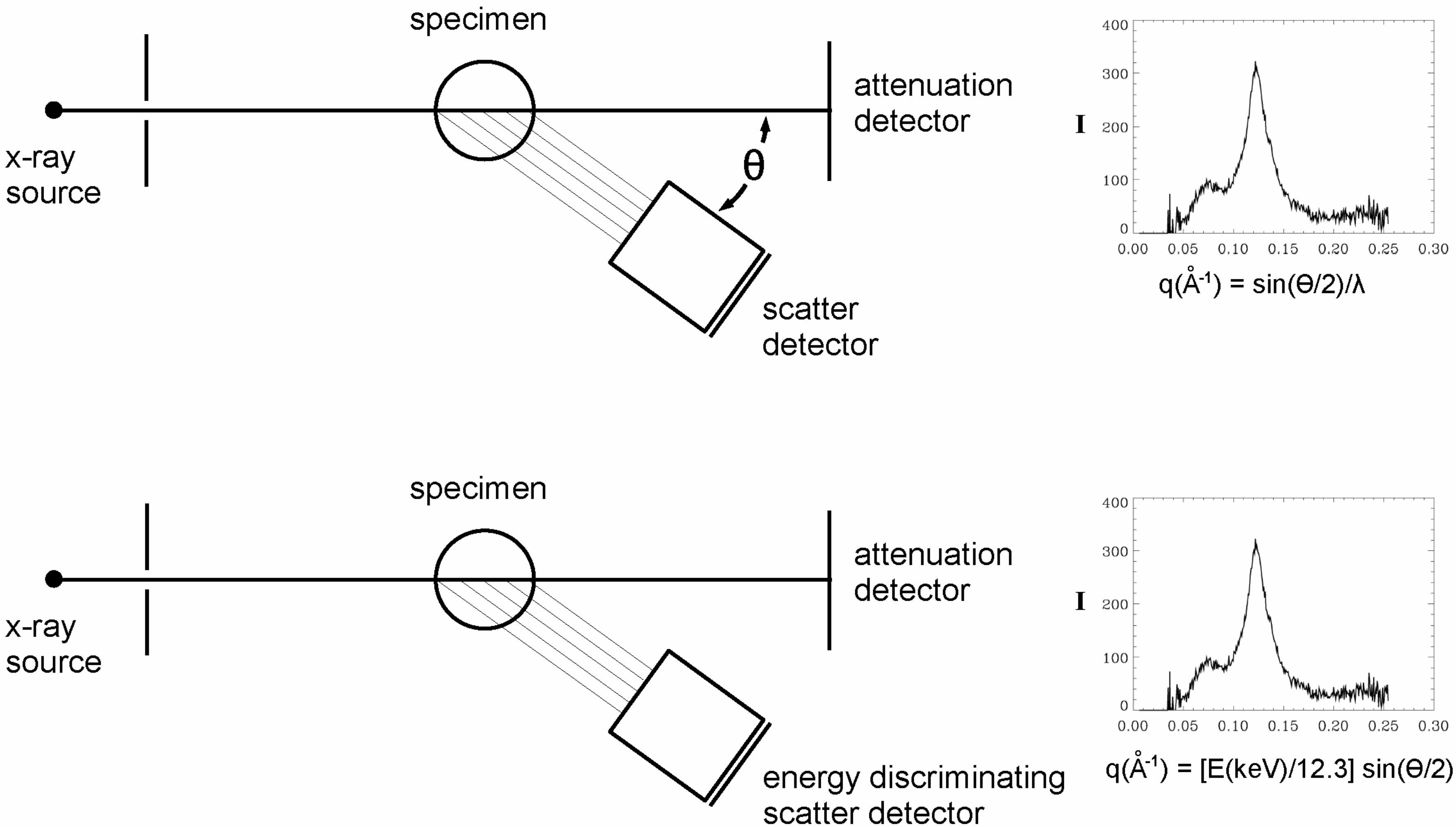
16908B

ELR/10/09

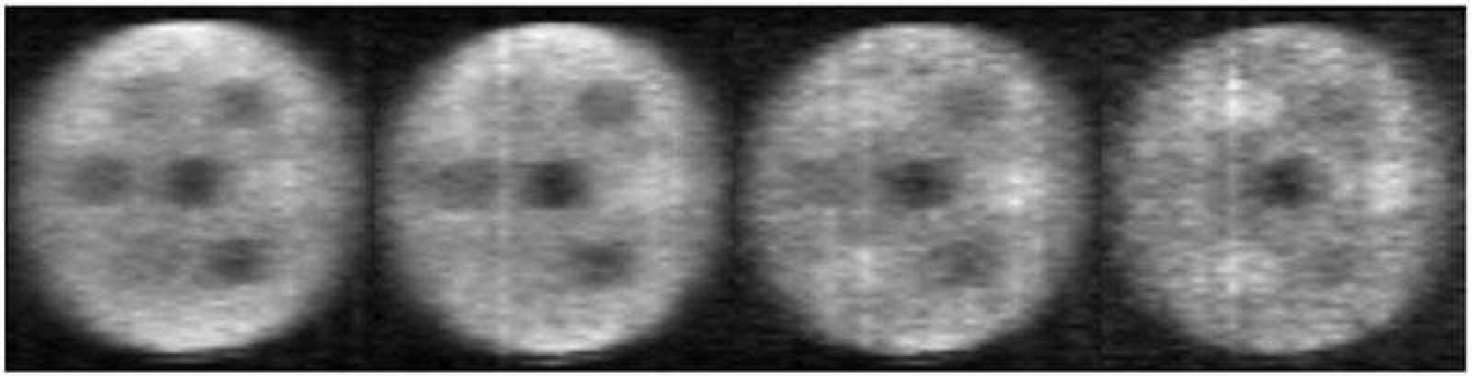
X-ray Diffraction Measurements of Tissues



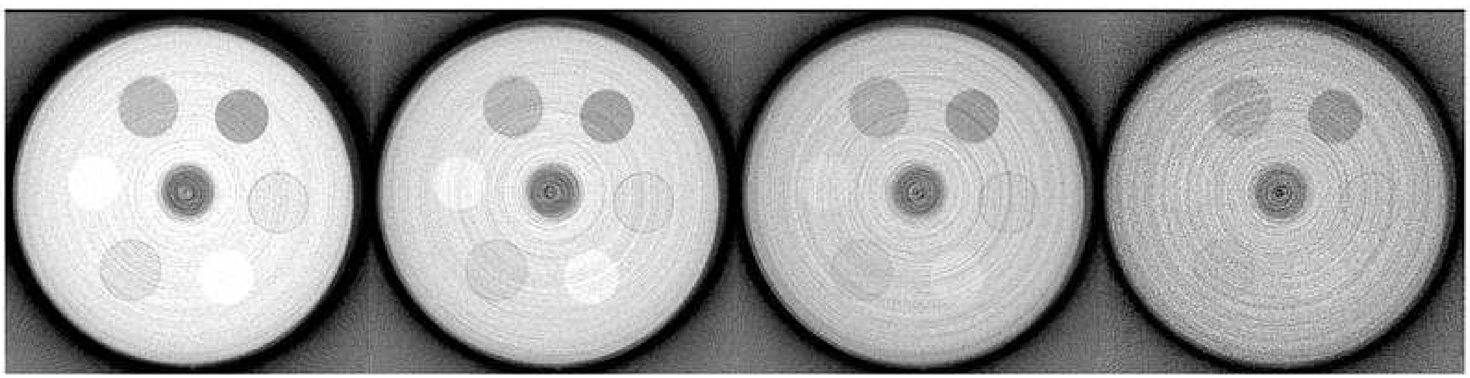
X1506-A J. Kosanetzky et. al., Med. Phys. 14(4) Jul./Aug.1987



17155 **ELR/03/09**

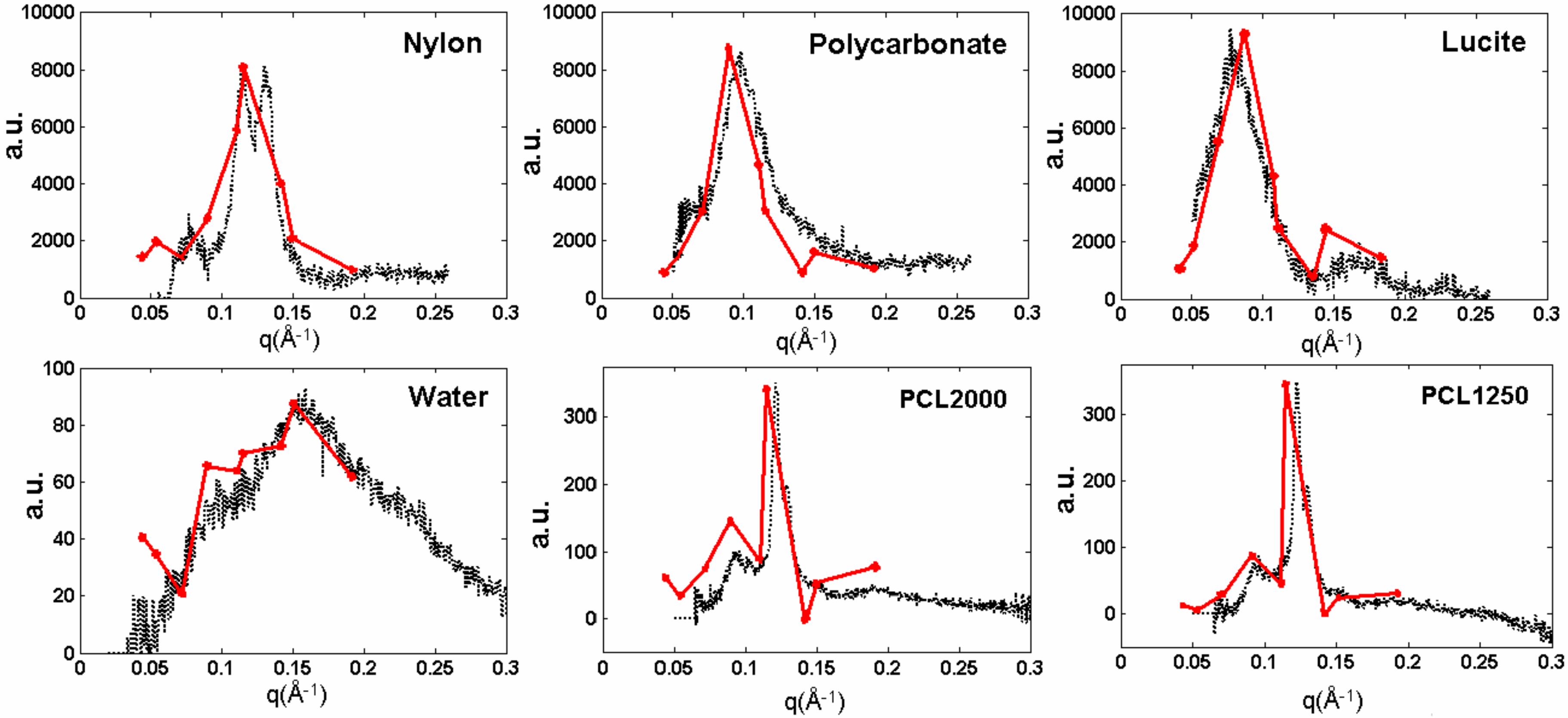


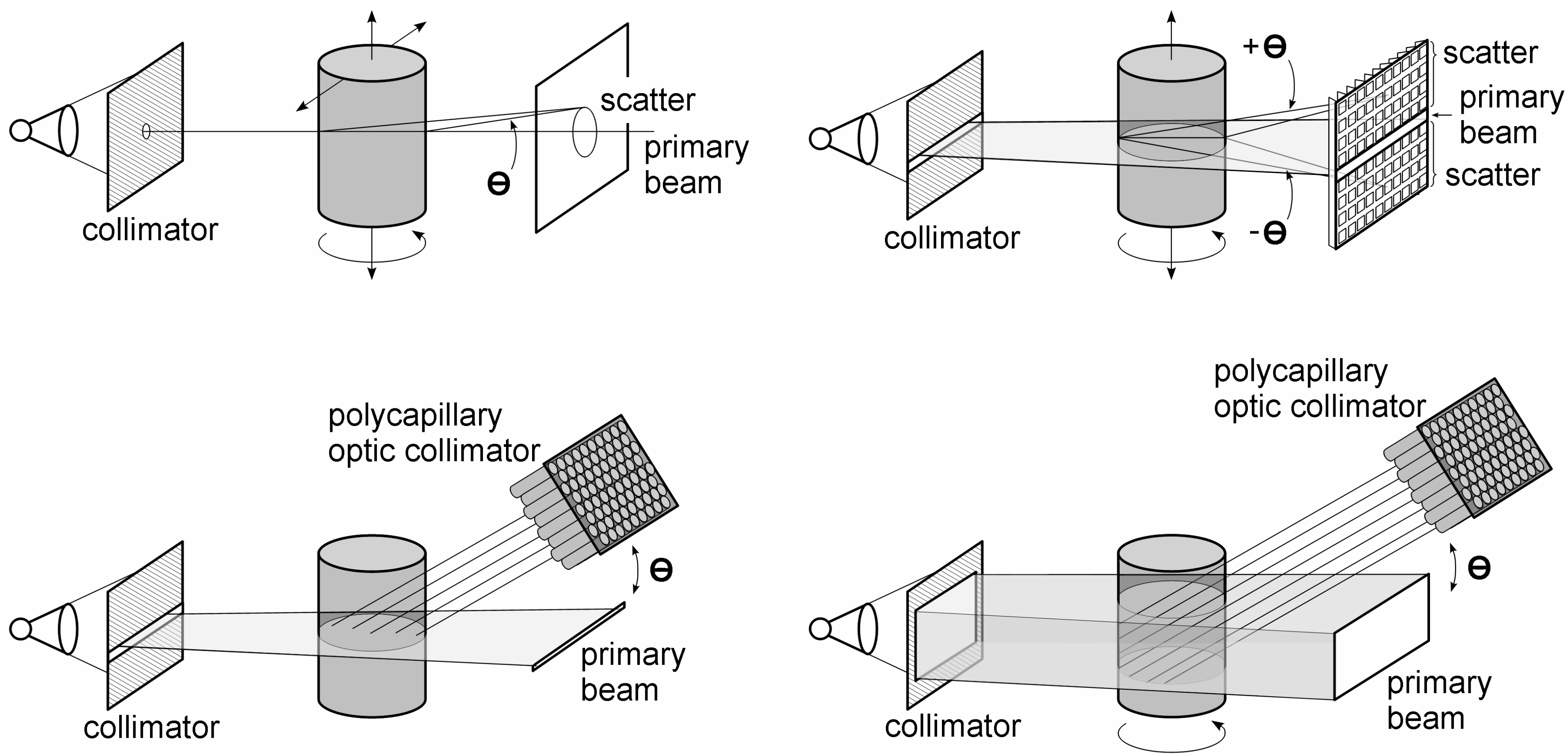
11.5 keV 14.5 keV 17.5 keV 20.5 keV



11.5 keV 14.5 keV 17.5 keV 20.5 keV

Momentum Transfer Functions - Spectral (●—●) or Multi-Angular (---)





17542

ELR/10/2010

SOME ALGORITHMS NEEDED TO FULLY UTILIZE SPECTRAL X-RAY IMAGING

1) **MODELS TO MITIGATE:** ARRAY HETEROGENEITY
CHARGE SHARING
PHOTON COUNT PILE-UP
DETECTOR FLUORESCENCE

2) **RECONSTRUCTION ALGORITHMS TO MITIGATE PHOTON-SPARCE SCAN DATA**
-- Use of a priori information
-- Use of broad spectrum data
-- Use of region-of-interest scan data

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