Potential of High-Z Elements in Photon-Counting Micro-CT for Optimized Material Decomposition

C. Amato, L. Klein, J. Maier, S. Sawall, N. Gehrke, D. Franke,
S. Gkoumas, T. Thüring, A. Briel, C. Brönnimann, and M. Kachelrieß

Declaration of Financial Interests or Relationships

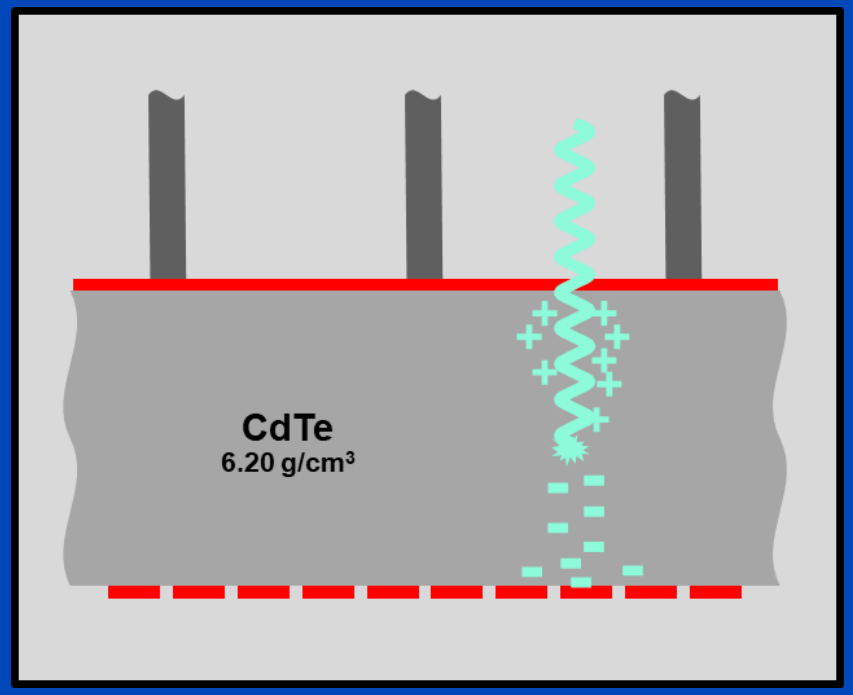
Dr. N. Gehrke, Dr. D. Franke and Dr. A. Briel are with nanoPET Pharma GmbH, Berlin, Germany.

Dr. S. Gkoumas, Dr. T. Thüring,and Dr. C. Brönnimann are with DECTRIS Ltd., Baden-Dättwil, Switzerland.

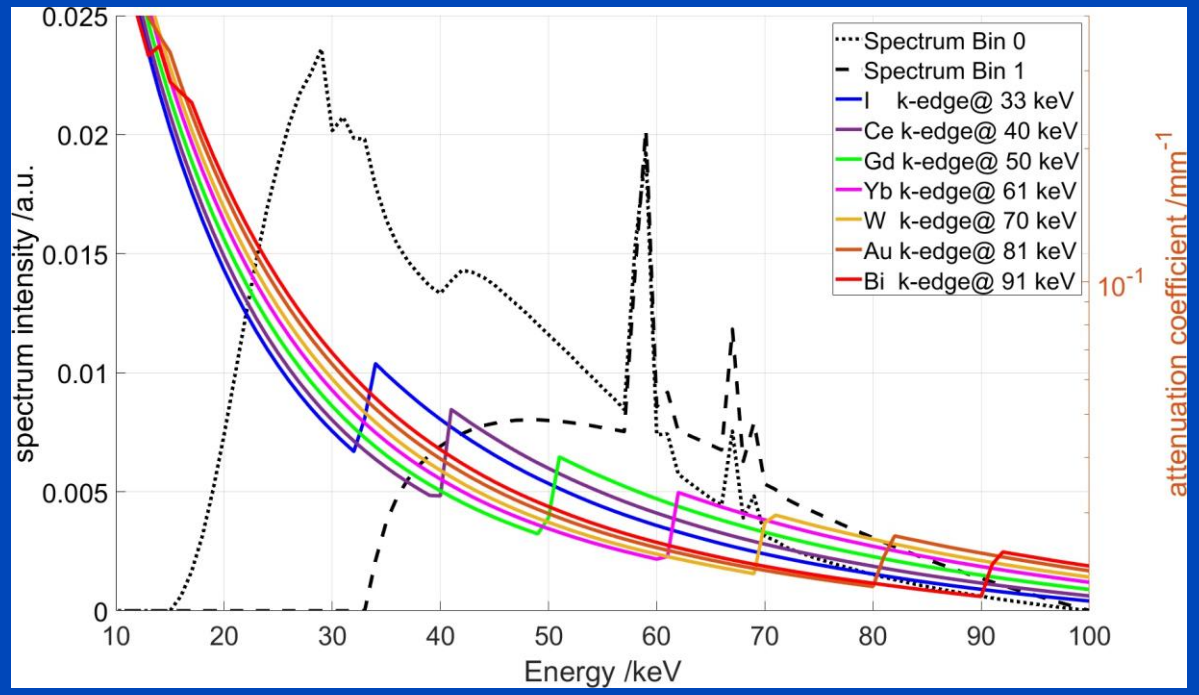
Potential of High-Z Elements in Photon-Counting Micro-CT for Optimized Material Decomposition

C. Amato, L. Klein, J. Maier, S. Sawall, N. Gehrke, D. Franke,
S. Gkoumas, T. Thüring, A. Briel, C. Brönnimann, and M. Kachelrieß

Aim of the work:
Compare different high-z elements for optimized material decomposition in photon-counting micro-CT.



Schematic of the sensor layer of a photon-counting detector



Bins of a 100 kV spectrum detected by a PC detector with T=16/ 32 keV black dashed/dotted lines). In color, attenuation coefficients of the investigated high-Z elements with varying K-edges.

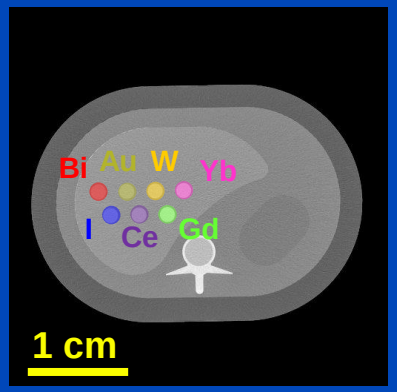
dkfz.

Potential of High-Z Elements in Photon-Counting Micro-CT for Optimized Material Decomposition

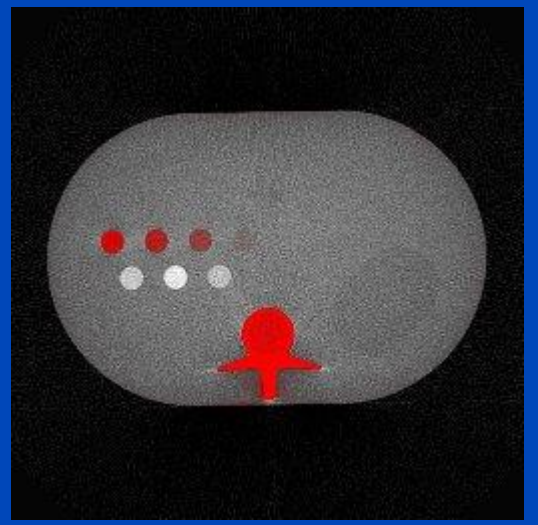
C. Amato, L. Klein, J. Maier, S. Sawall, N. Gehrke, D. Franke,
S. Gkoumas, T. Thüring, A. Briel, C. Brönnimann, and M. Kachelrieß

Simulation settings:

- Mouse size phantom (3 cm wide)
- Seven inserts of 10 mg/mL solutions of high-Z elements
- Tube voltage (*U*): 60, 80 and 100 kv
- Prefiltration: 2 mm Al
- Two energy thresholds (T_0 / T_1): all combinations between 16 keV and *U*(keV)-6 keV in 2 keV steps
- Realistic spectral response (Dectris Säntis detector)
- Poisson noise
- FDK reconstruction



Material decomposition



Each high-z element is decomposed together with water (2 bins-> 2 materials) and the dose normalized contrast-to-noise ratio (CNRD) is evaluated in the high-z element material map

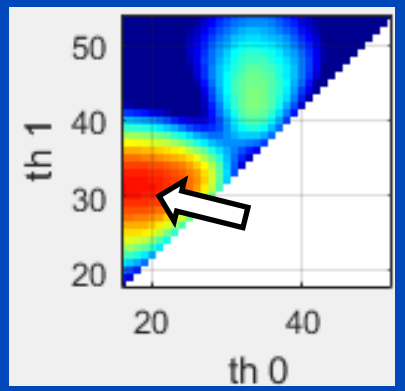
Red scale: Bismuth
Gray scale: water

dkfz.

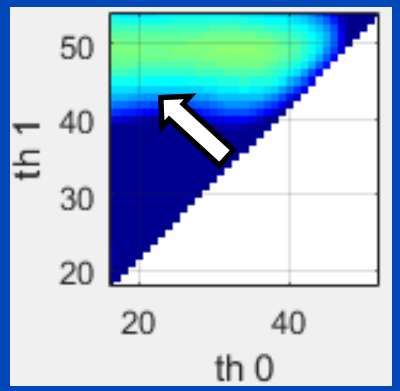
Potential of High-Z Elements in Photon-Counting Micro-CT for Optimized Material Decomposition

C. Amato, L. Klein, J. Maier, S. Sawall, N. Gehrke, D. Franke,
S. Gkoumas, T. Thüring, A. Briel, C. Brönnimann, and M. Kachelrieß

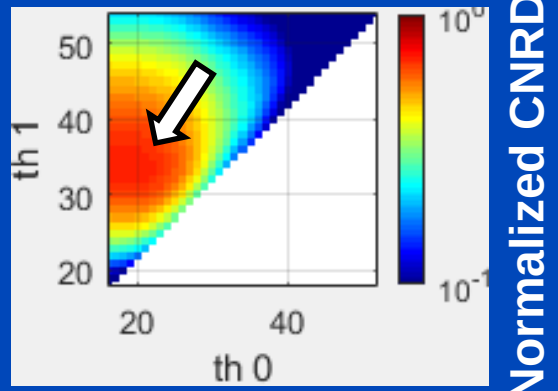
Choice of optimal thresholds for each high-z element.
Examples at 60 kV:



Iodine



Gadolinium

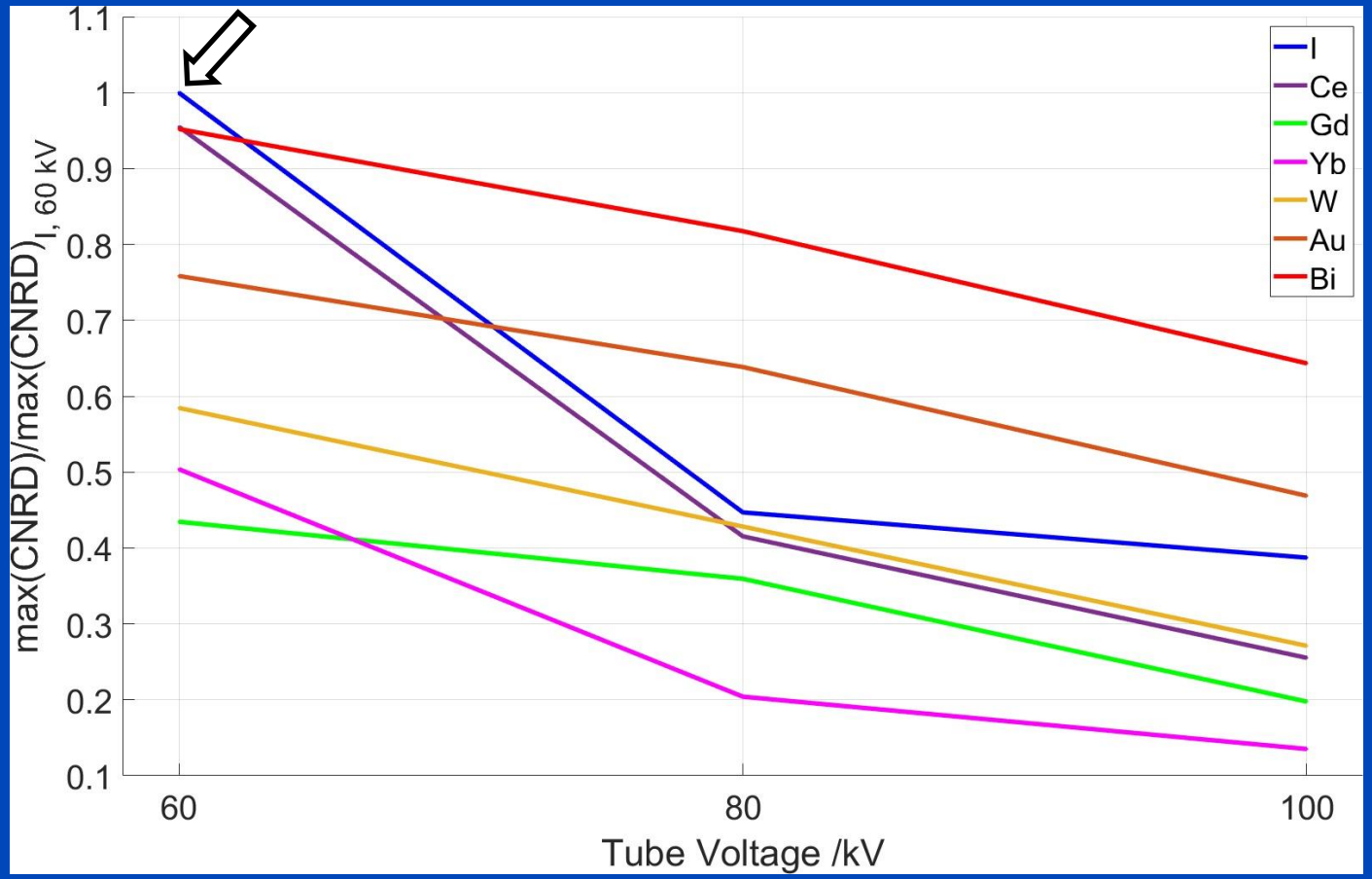


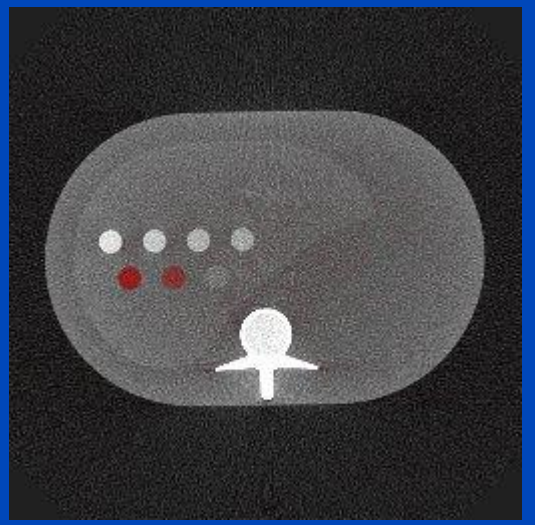
Bismuth

dkfz.

Potential of High-Z Elements in Photon-Counting Micro-CT for Optimized Material Decomposition

C. Amato, L. Klein, J. Maier, S. Sawall, N. Gehrke, D. Franke,
S. Gkoumas, T. Thüring, A. Briel, C. Brönnimann, and M. Kachelrieß



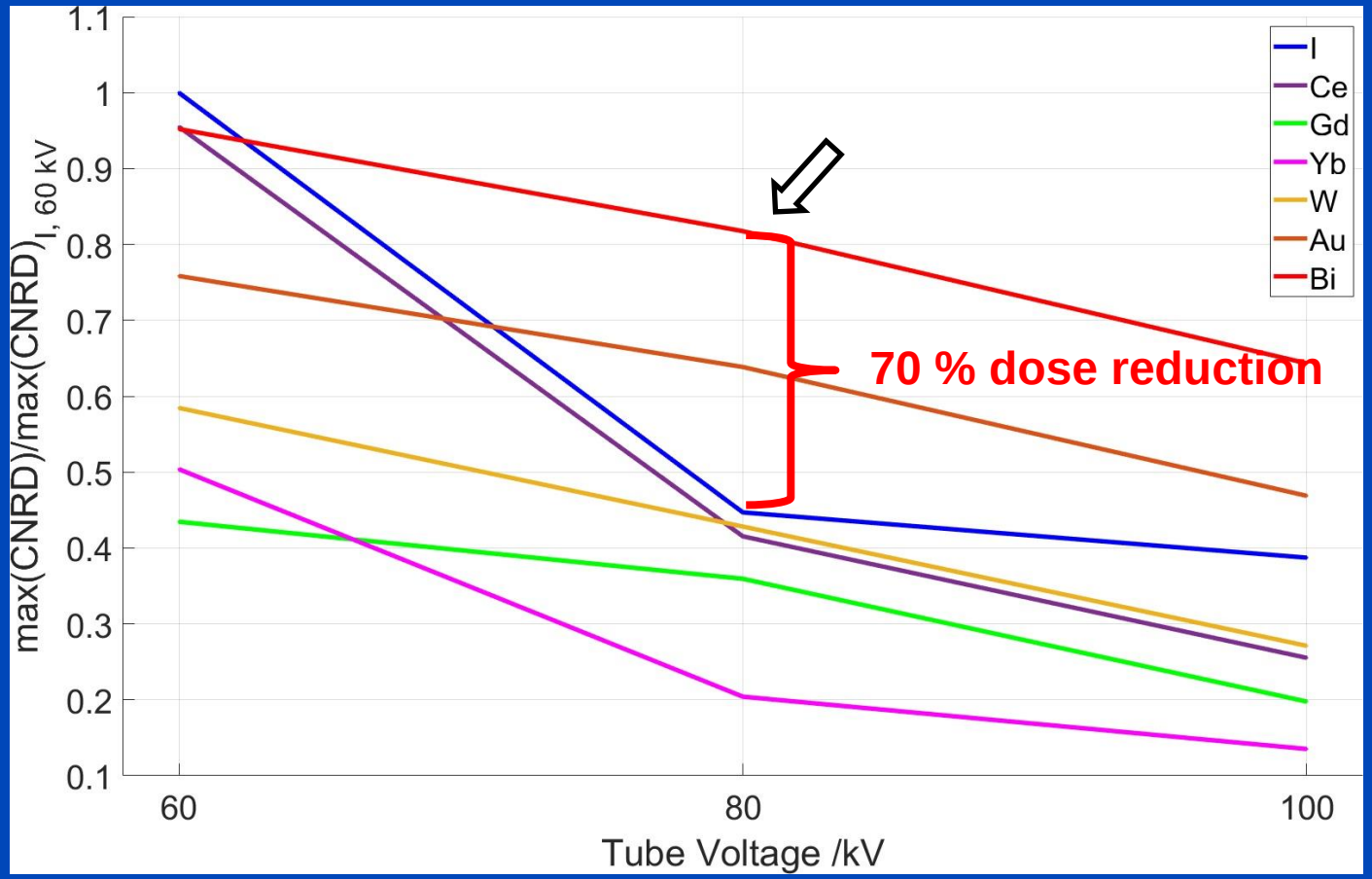


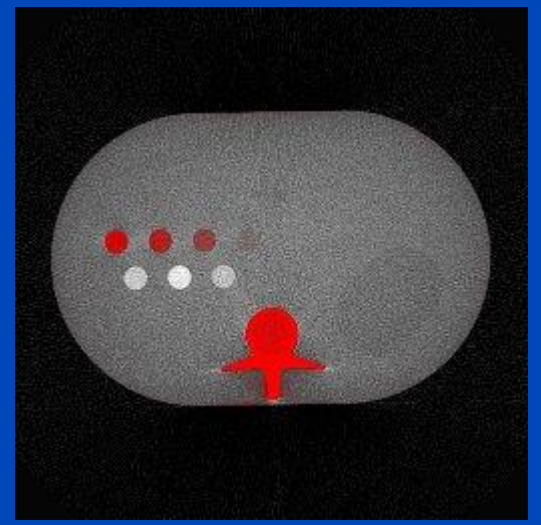
Red scale: Iodine
Gray scale: water

dkfz.

Potential of High-Z Elements in Photon-Counting Micro-CT for Optimized Material Decomposition

C. Amato, L. Klein, J. Maier, S. Sawall, N. Gehrke, D. Franke,
S. Gkoumas, T. Thüring, A. Briel, C. Brönnimann, and M. Kachelrieß





Red scale: Bismuth
Gray scale: water

dkfz.

Potential of High-Z Elements in Photon-Counting Micro-CT for Optimized Material Decomposition

C. Amato, L. Klein, J. Maier, S. Sawall, N. Gehrke, D. Franke,
S. Gkoumas, T. Thüring, A. Briel, C. Brönnimann, and M. Kachelrieß

Thanks for your attention

dkfz.