

X-ray Spectral Imaging

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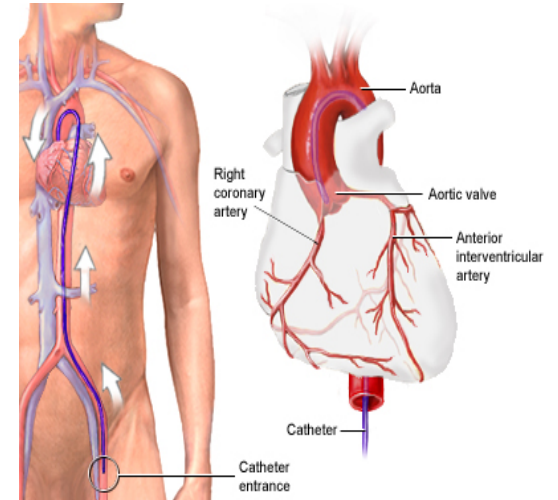
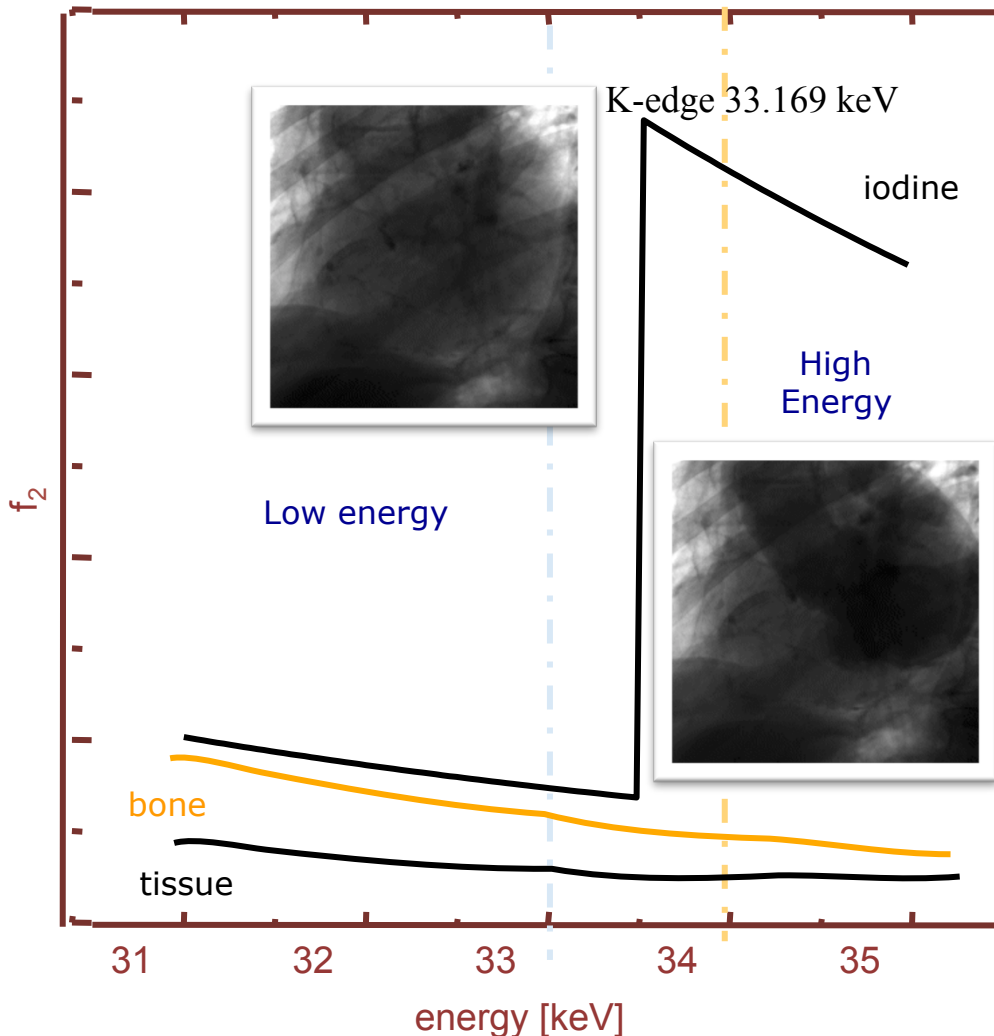
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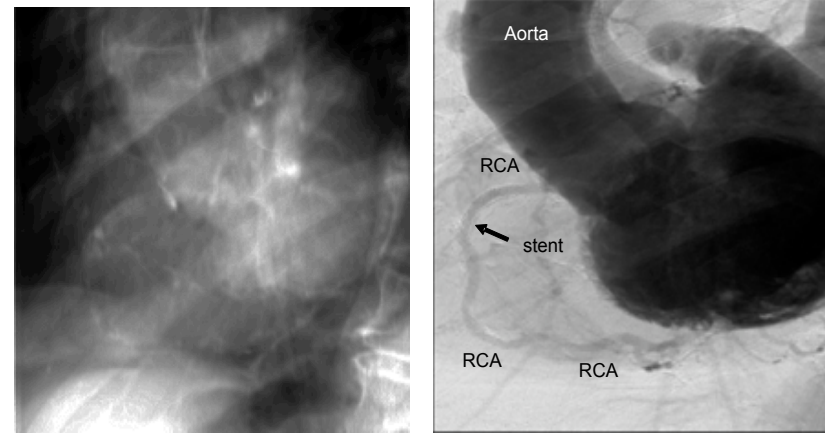
X-ray K-edge Subtraction Imaging (KES)

Taking advantage of the difference in the attenuation coefficient at energies below and above the K-edge of an element.

Need of monochromatic x-ray beam (SR)



Contrast agents in radiological imaging
→ Contrast enhancement

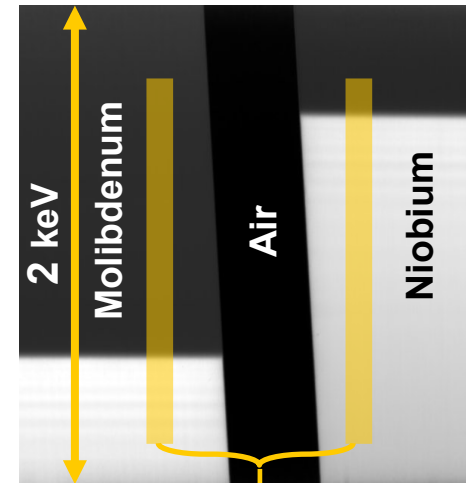
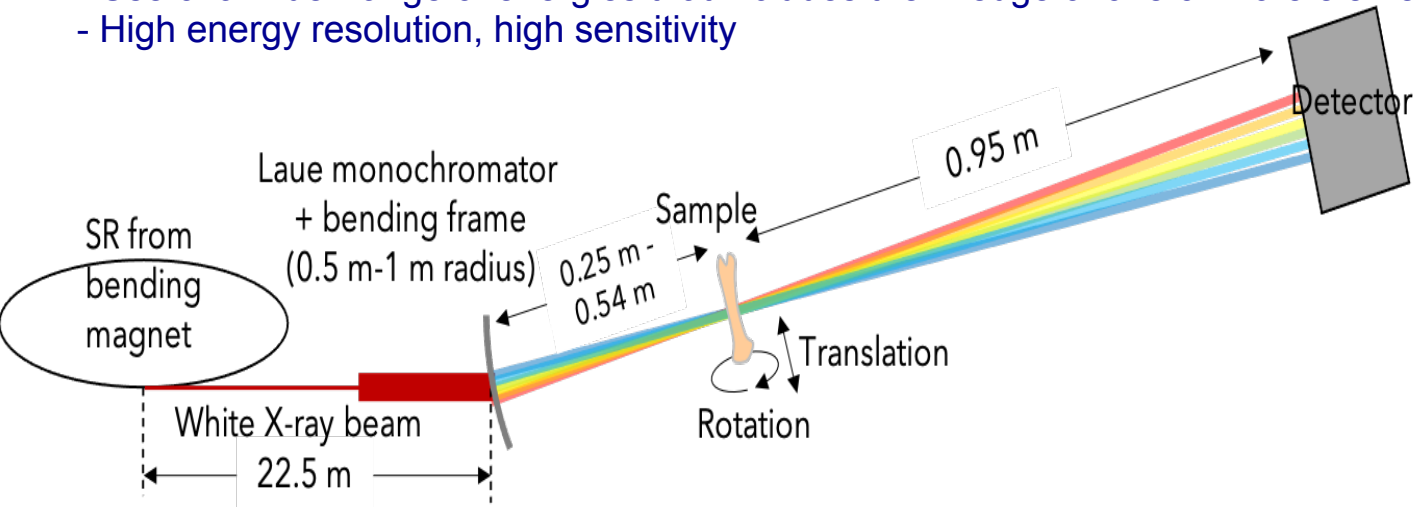


Subtraction of log images above and below
K-edge”: Water Image and Iodine Image

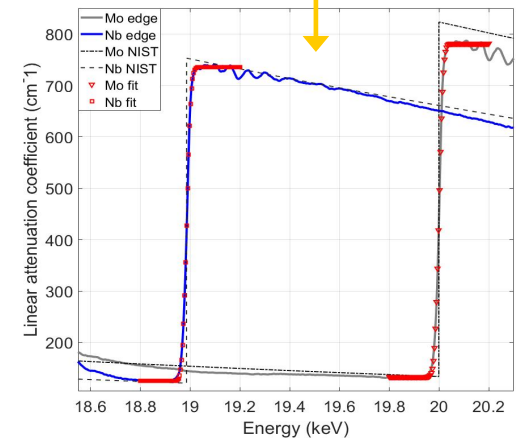
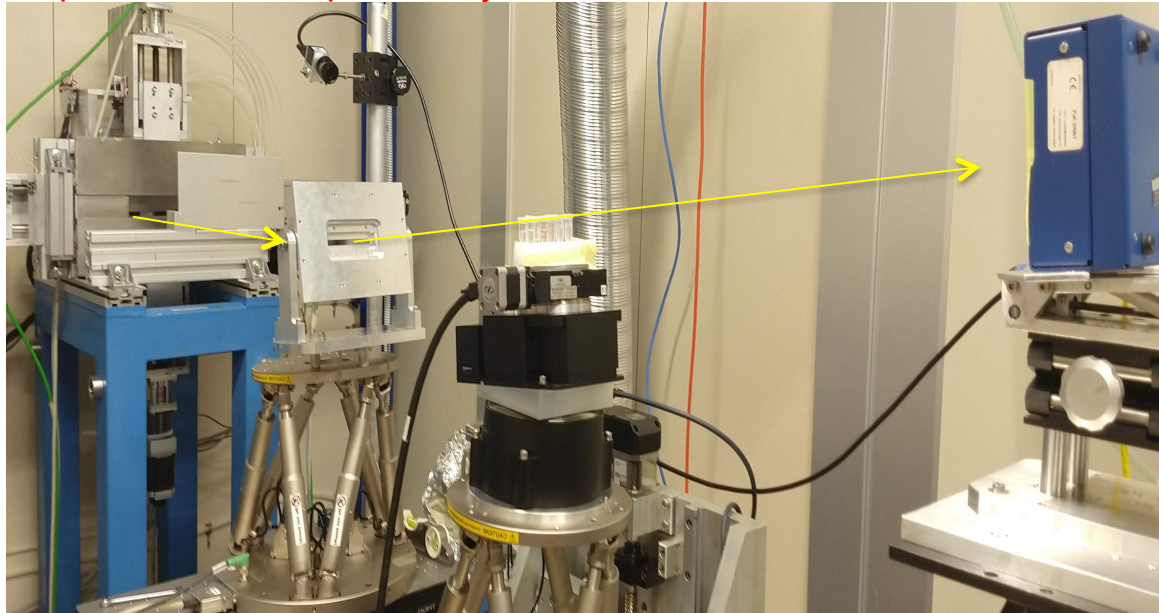
Spectral K-edge Subtraction Imaging (SKES)

SKES is a technique beyond KES:

- Continuous X-ray spectrum vertically dispersed
- Use of a wider range of energies that includes the K-edge of one or more elements
- High energy resolution, high sensitivity



Experimental set-up at the synchrotron ELETTRA

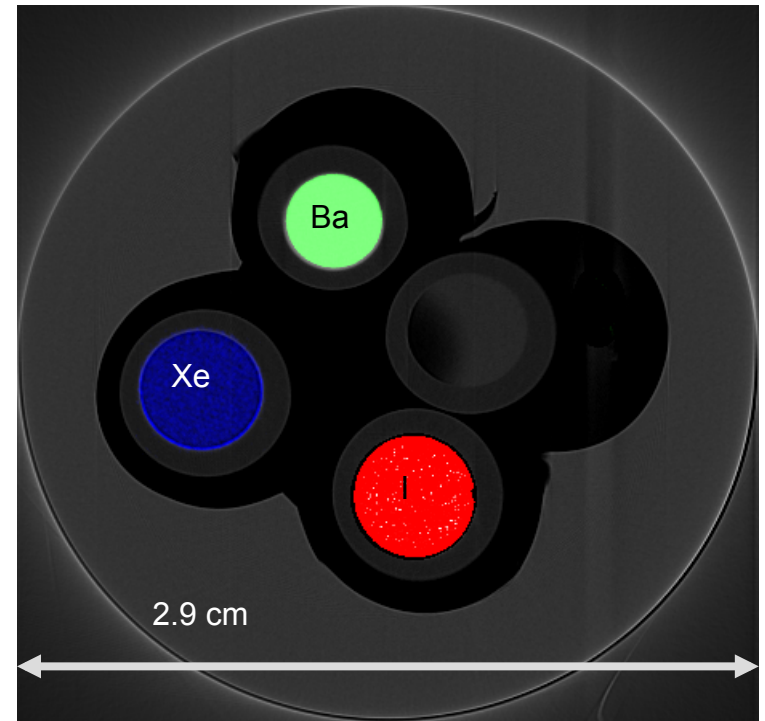
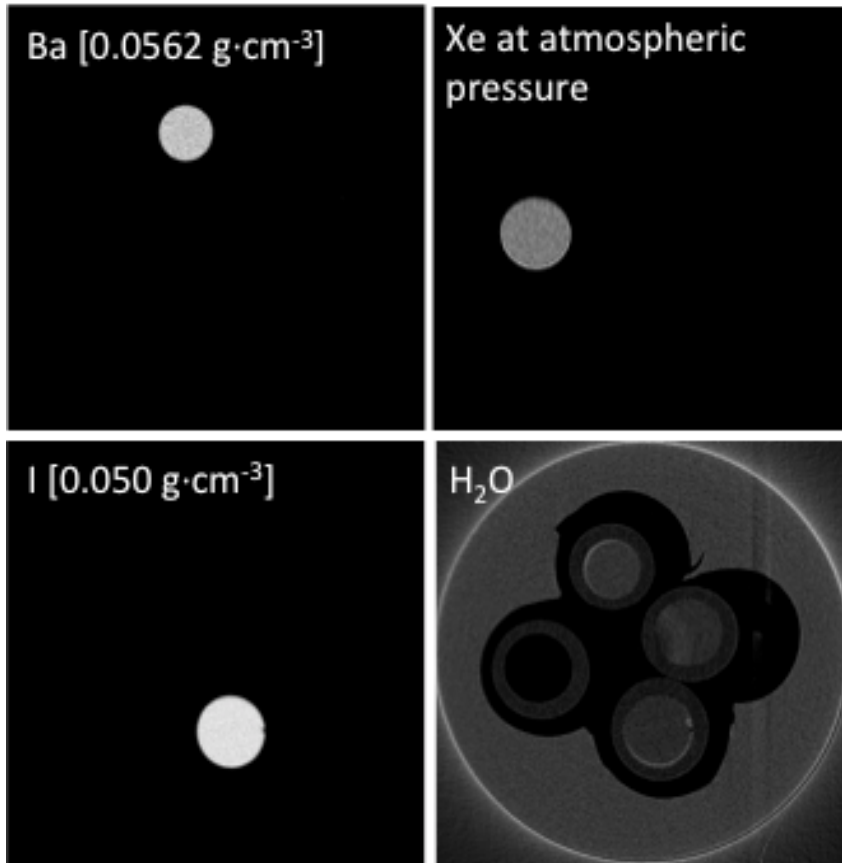


Two K-edges in a single shot

Spectrally decomposed CT

Bending the crystal at the smallest curvature radius (0.5 m), an **energy bandwidth of 5.7 keV** along the sagittal plane has been obtained, centred at 35.4 keV. This allows studying **three K-edges** at the same time. Our first results demonstrate the feasibility **of multiple K-edge applications** making use, for instance, of iodine-, barium- and xenon-based contrast agents, which is appealing for simultaneous **pulmonary, cardiac, and inflammation** imaging. Quantitative evaluation of the element concentrations is possible.

Three K-edges



Quantitative concentration evaluation

Trace element	Theoretical ρ (g · cm ⁻³)	Estimated ρ (g · cm ⁻³)
Ba	0.0562	0.057 ± 0.002
Xe	≤ 0.059	0.0040 ± 0.0004
I	0.050	0.053 ± 0.002
H ₂ O	1	0.97 ± 0.18