

Smart*Light 2.0

a compact tunable x-ray source

Ids van Elk, Coen Sweers, Peter Mutsaers, and Jom Luiten

Tunable x-rays from a lab-scale setup

At Eindhoven University of Technology a lab-based tabletop x-ray source is being commissioned based on inverse Compton scattering (ICS). Here, relativistic electrons collide with a laser pulse producing monochromatic x-rays. This compact and tunable source will bridge the gap between conventional lab sources and synchrotrons, making high quality and tunable x-rays better accessible for a wide range of applications.

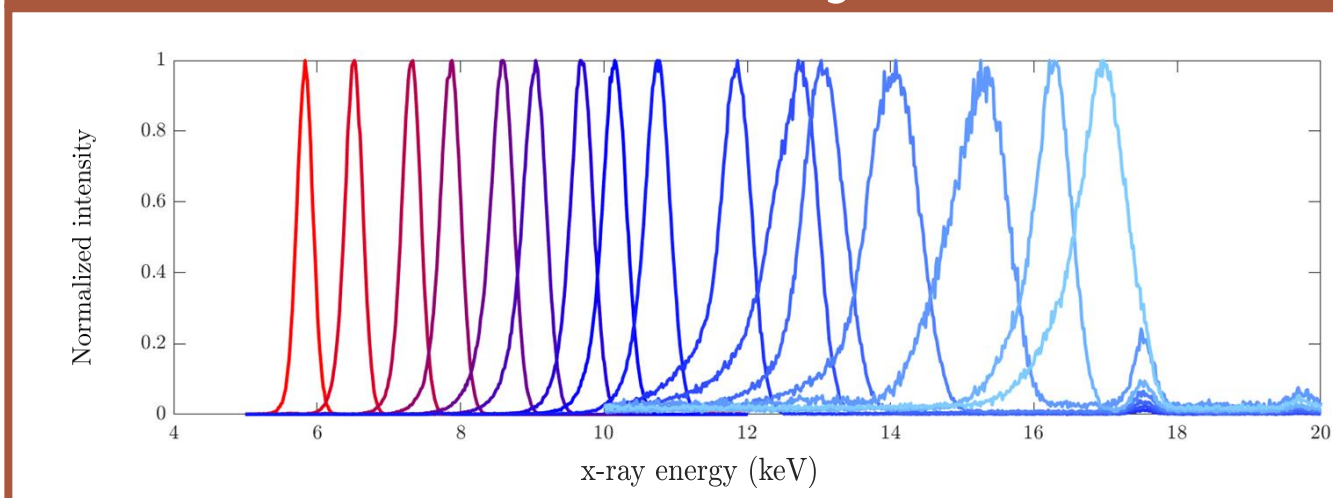
electron beam

Beam energy	10-25 MeV
Bunch charge	10 pC
Repetition rate	500 Hz

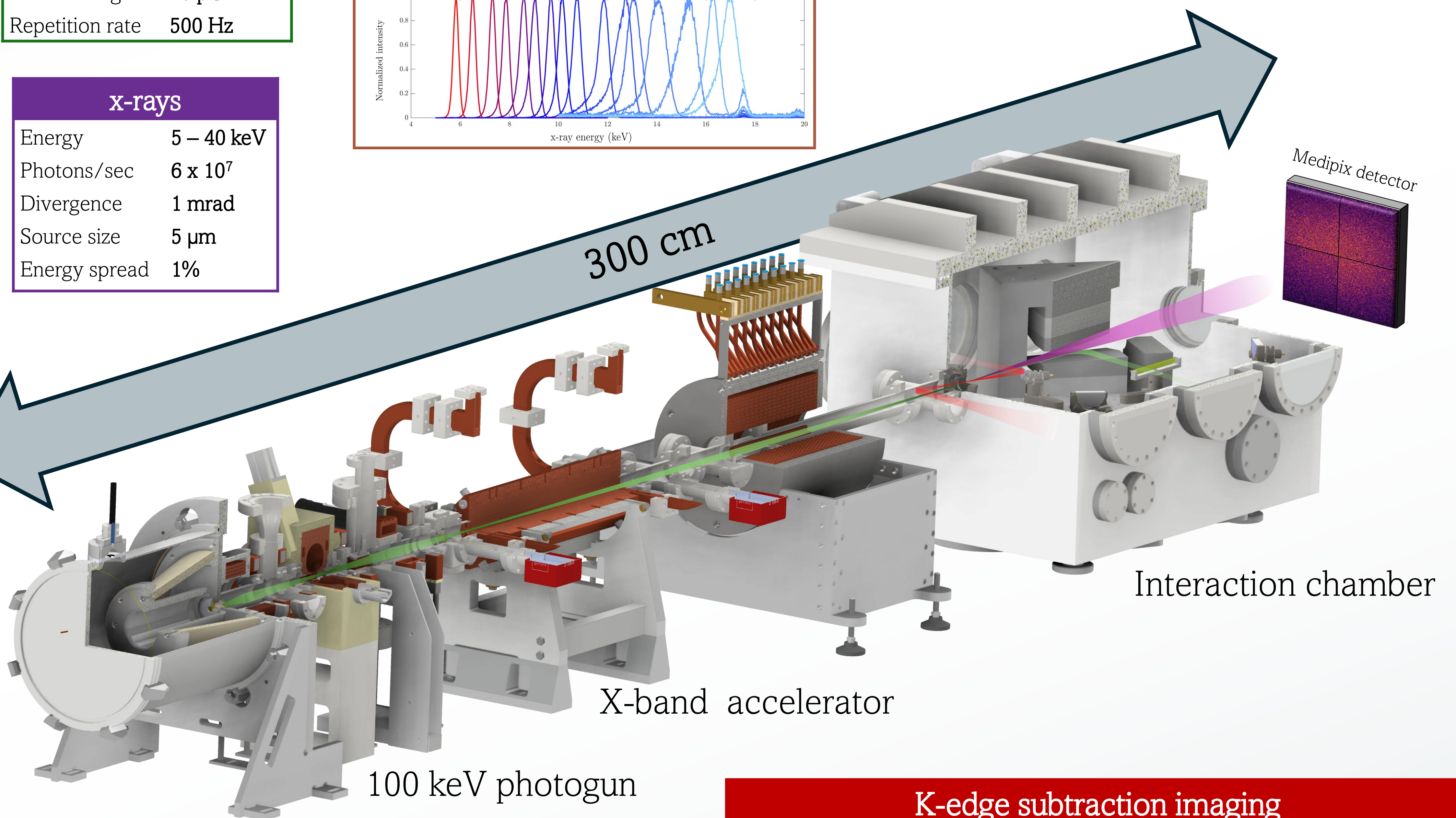
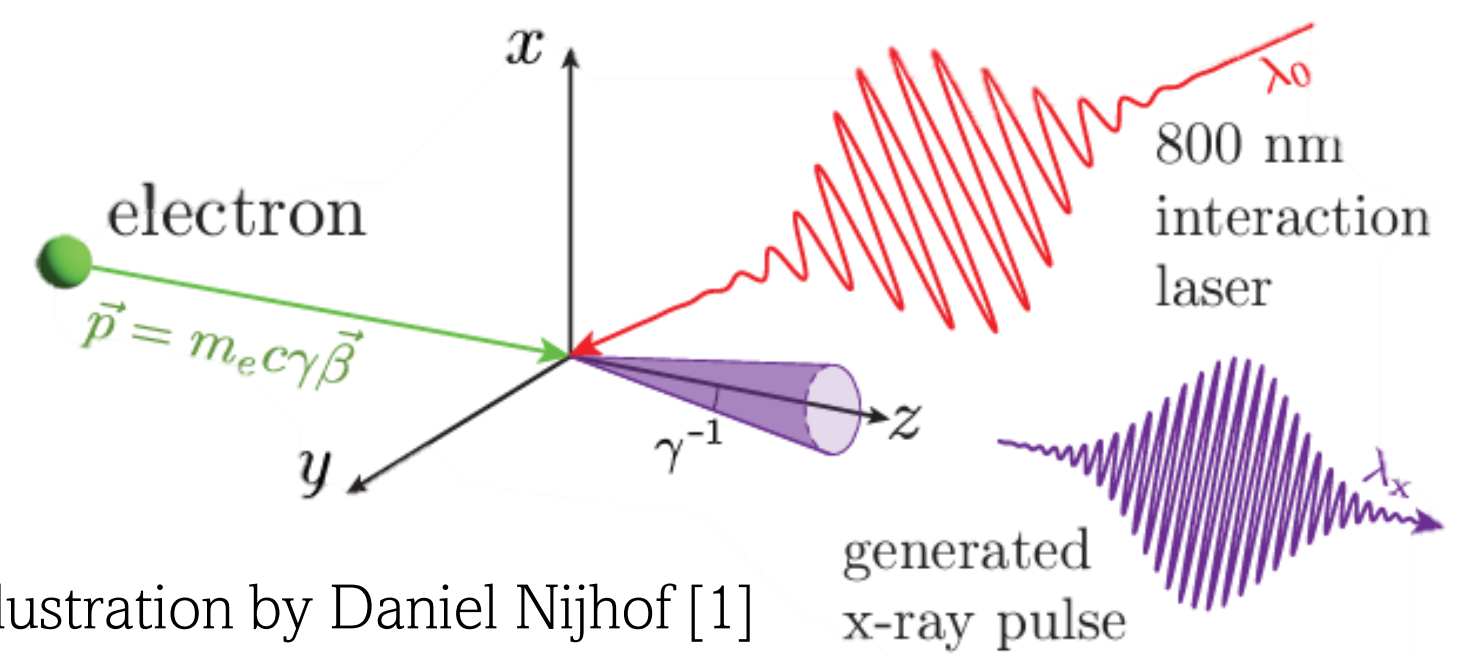
x-rays

Energy	5 – 40 keV
Photons/sec	6×10^7
Divergence	1 mrad
Source size	5 μm
Energy spread	1%

Tunability

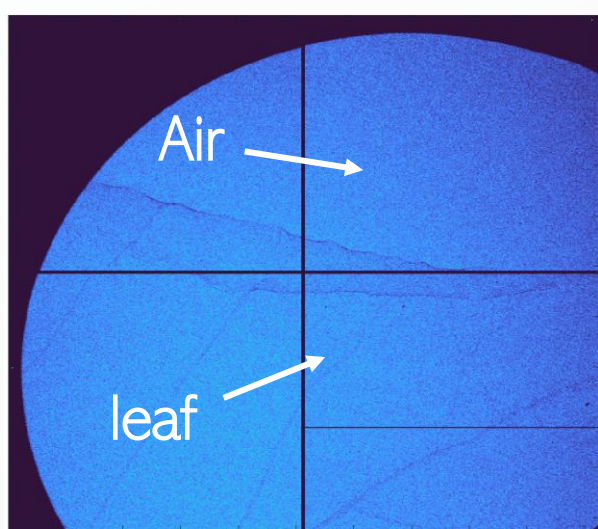


inverse Compton scattering

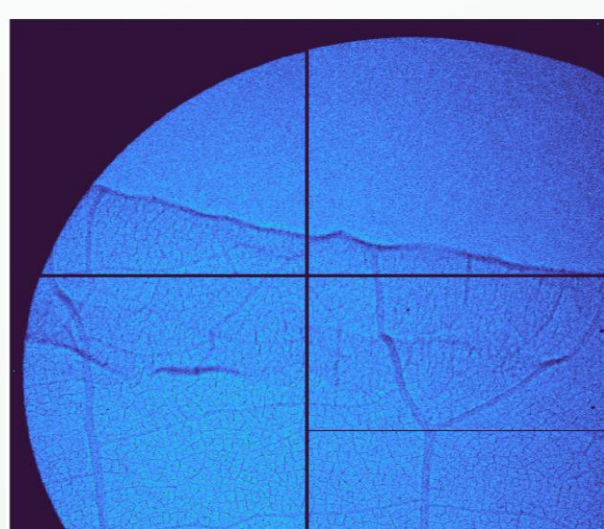


Phase contrast imaging

10 cm from detector



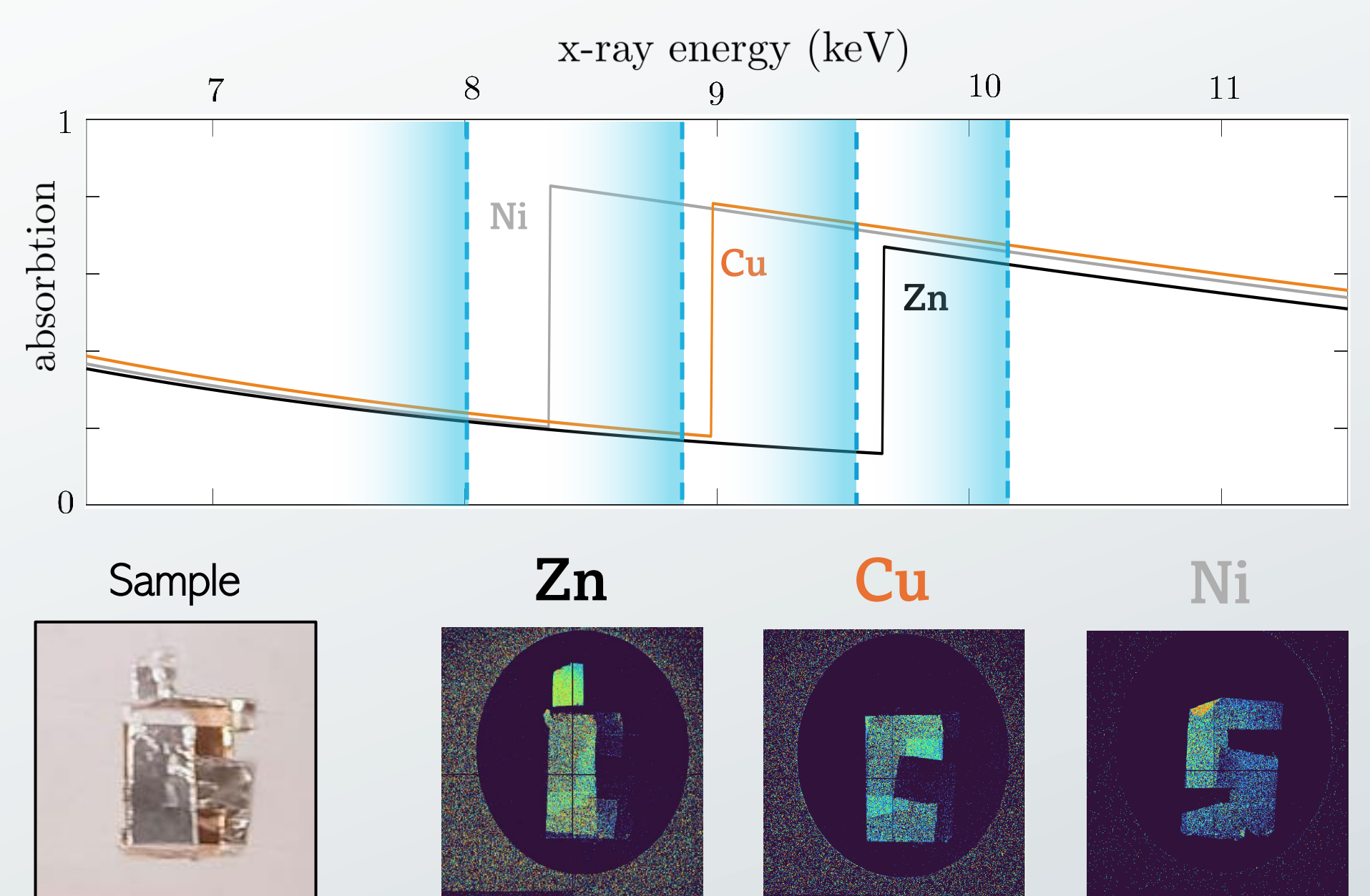
150 cm from detector



Future developments

Thermionic gun [2]	burst mode operation
Soft x-rays	water window microscopy
Microbunching [3]	coherent amplification

K-edge subtraction imaging



References

- [1] Nijhof, D. F. J. (2024). "Ultracold electron source development and X-band acceleration for a compact ICS-based x-ray source."
- [2] Toonen, W. F., et al. "Development of a low-emittance high-current continuous electron source." Nucl. Instr. Met. 1013 (2021)
- [3] Schaap, B. H., et al. "Ponderomotive bunching of a relativistic electron beam for a superradiant Thomson source." Phys. Rev. Accel. Beams 26, 074401