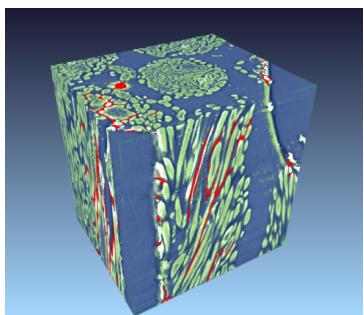
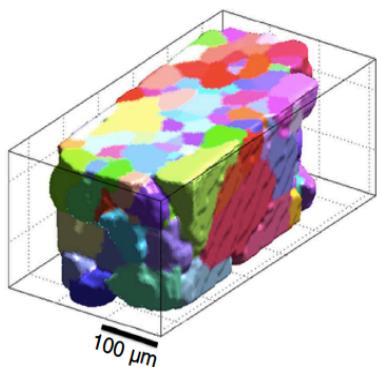


Røntgen og billeddannelse

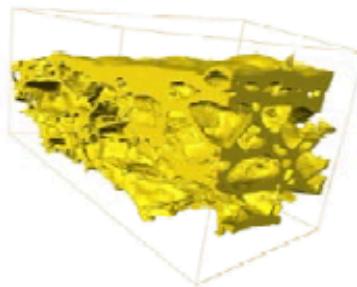
Henning Friis Poulsen



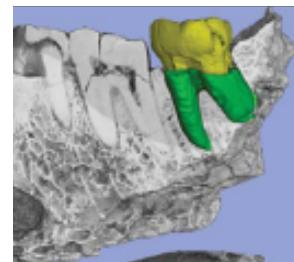
Revner i
vindmøllevejninger



Indre struktur
af metaller



Bagning
af brød



Tænder i
fosiler



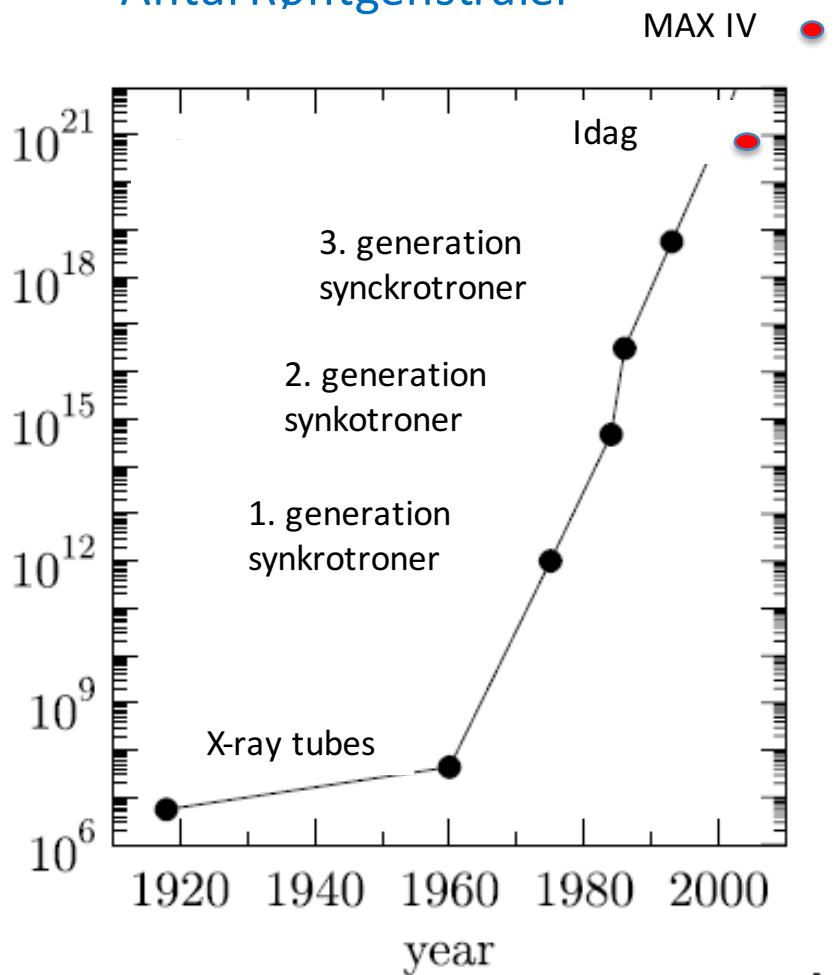
Kunst

Røntgenkilden MAX IV i Lund

MAX IV

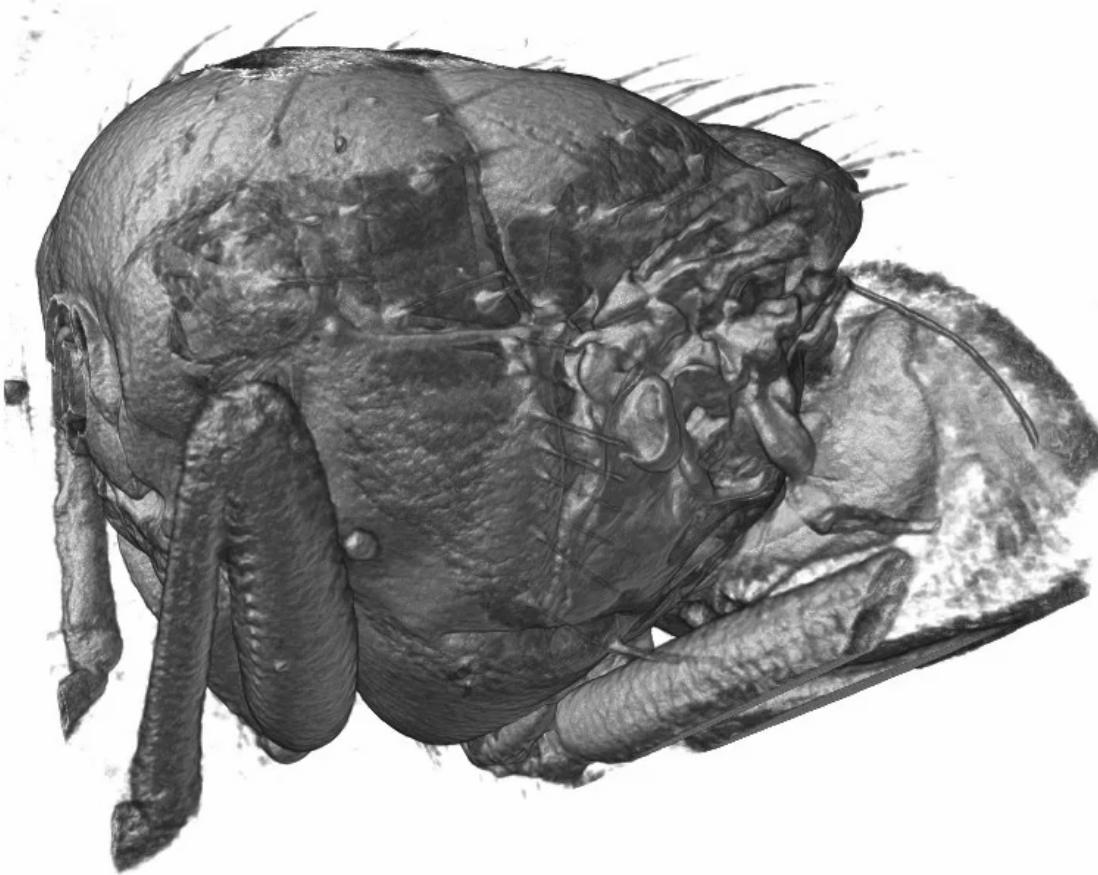


Antal Røntgenstråler

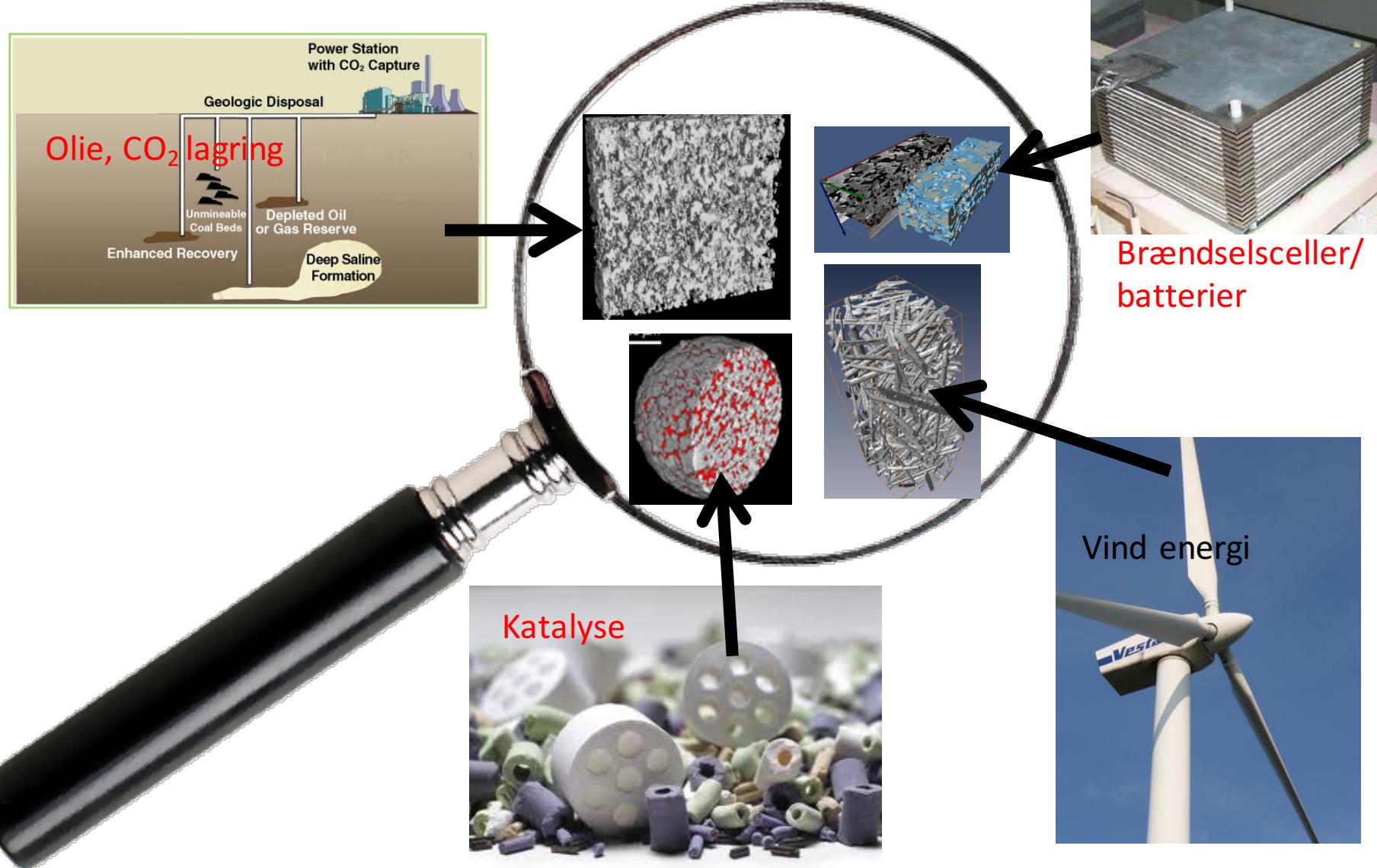


3D film af flue

Fly_close

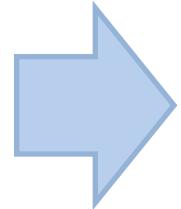
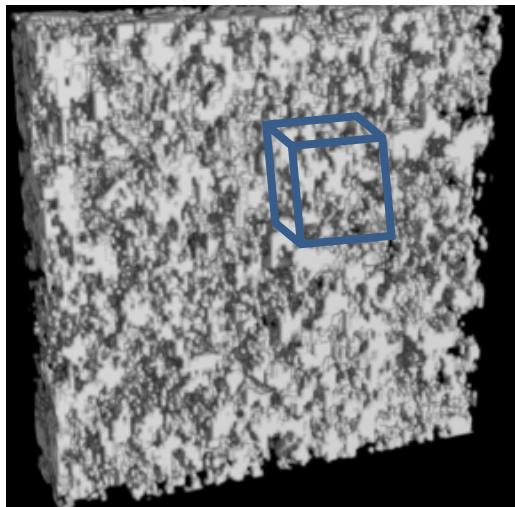


3D imaging af energi materialer



Input to 3D modellering (her: flow i porøst materiale)

3D kort af prøve fra undergrunden:



3D simulering af flow i prøven



- Hastighedsfelt

X-ray radiography

Wilhelm Conrad Röntgen discovered X-ray November 8 in 1895

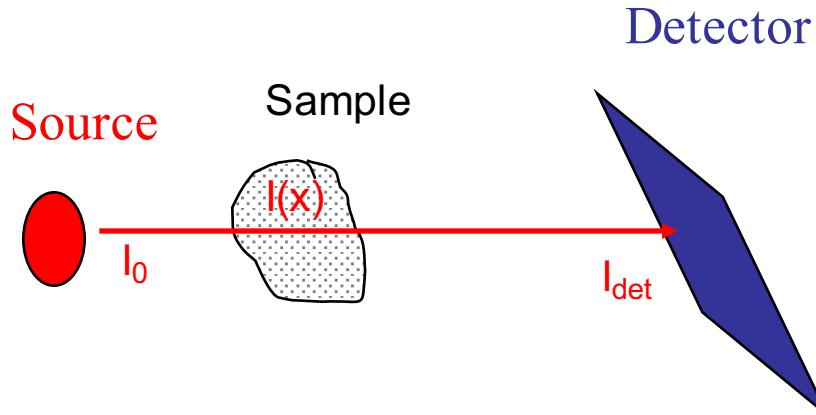


Wilhelm Röntgen



Frau Röntgen's left hand

Linear Attenuation coefficient

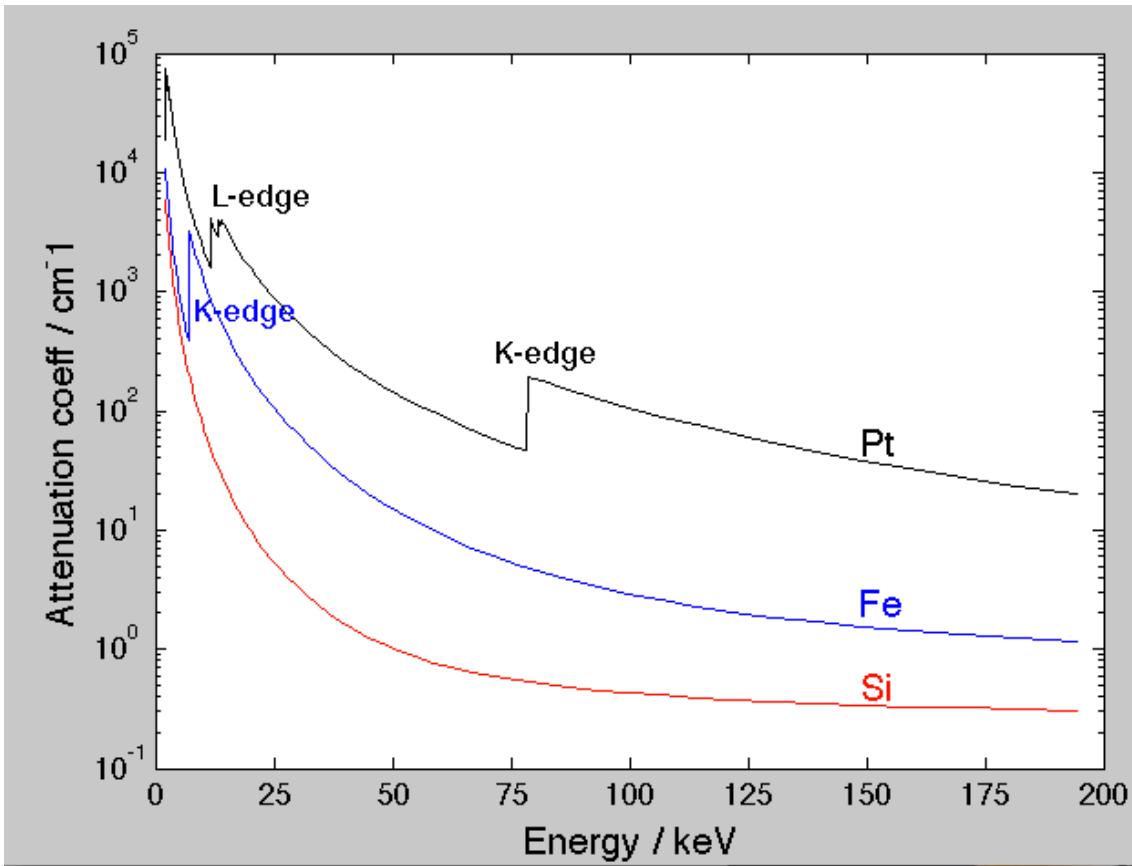


$$\frac{dI}{dx} = -\mu(x)I(x)$$



$$-\ln\left(\frac{I_{det}}{I_0}\right) = \int_{path} \mu(x) dx$$

Attenuation coefficient

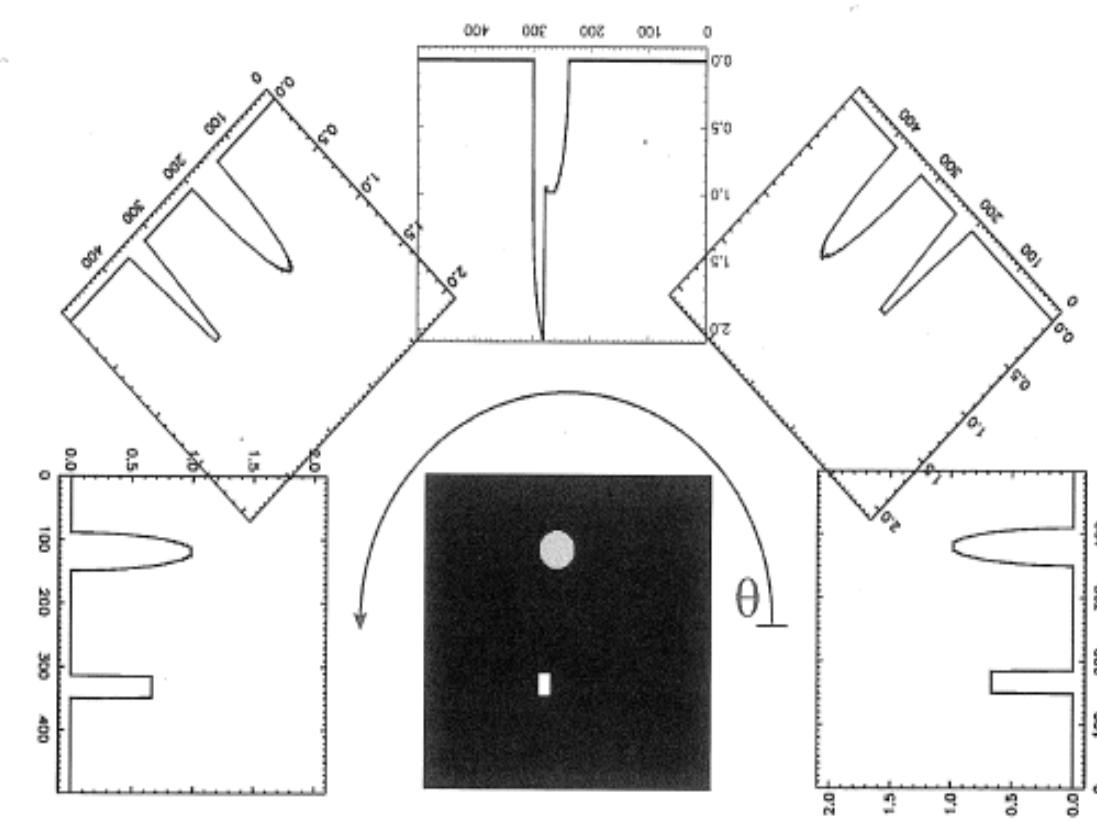


Approximation:

$$\mu \propto \sum_i Z_i^4 \rho_i / E^3$$

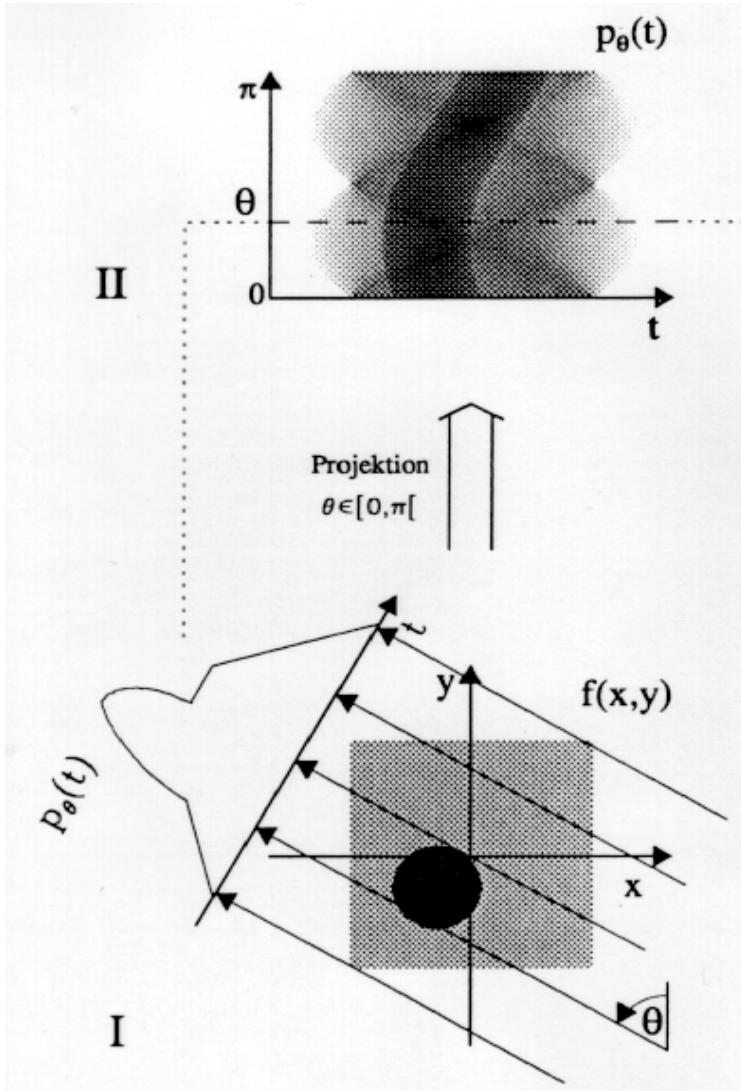
NB: unit cm^{-1}

Attenuation contrast tomography: the principle

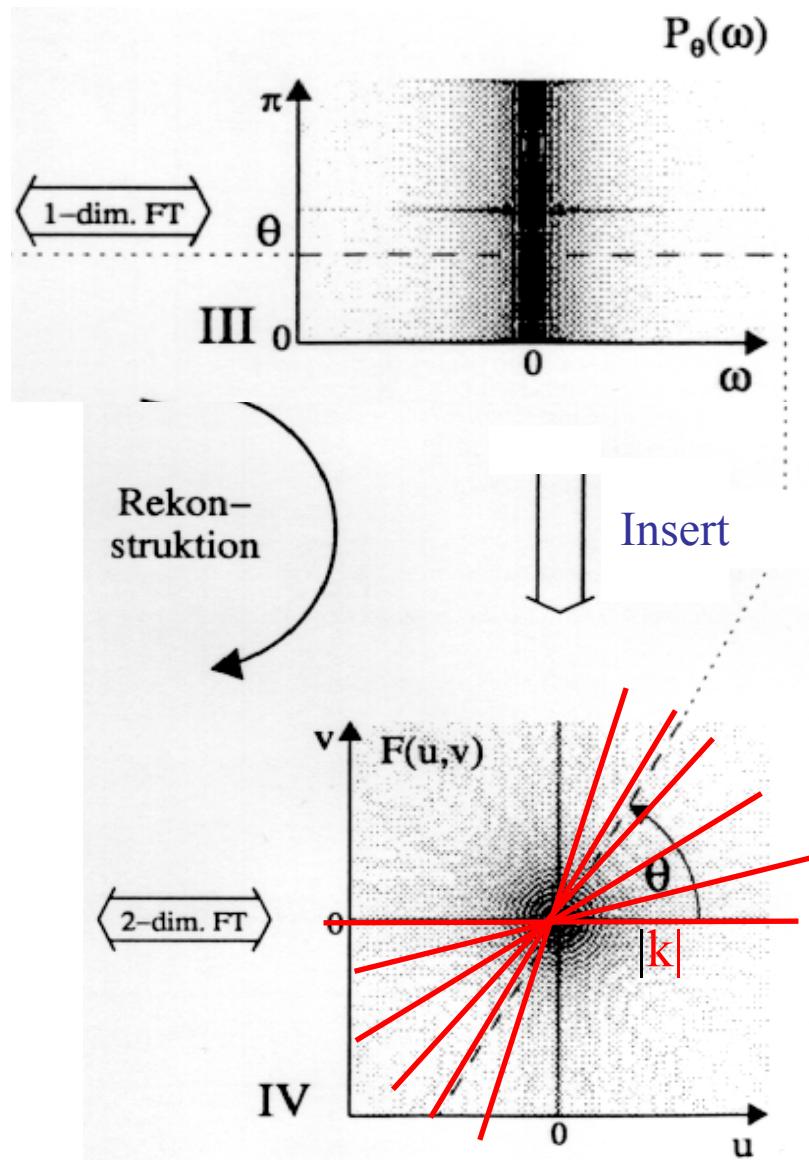


Filtered Backprojection

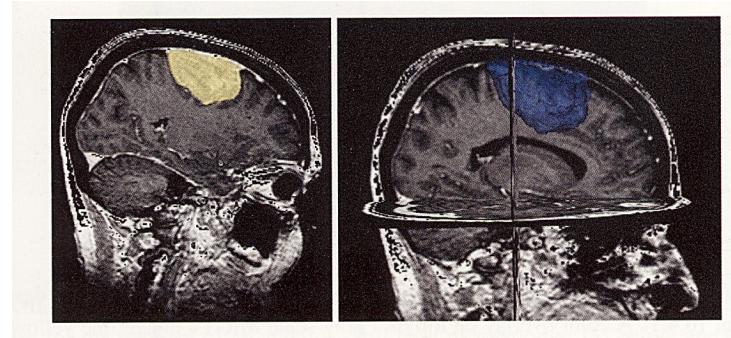
Direct space



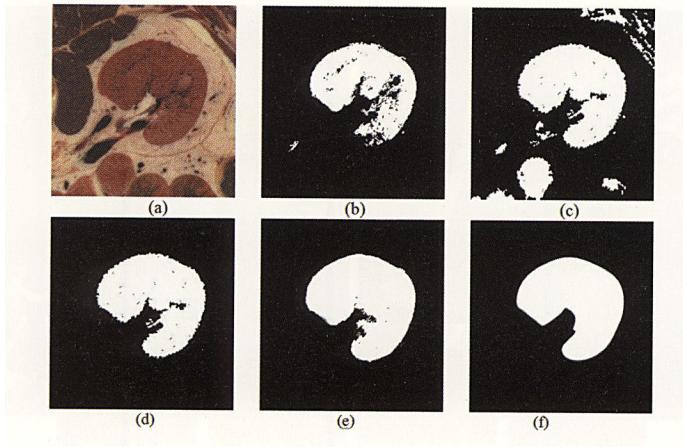
Fourier Space



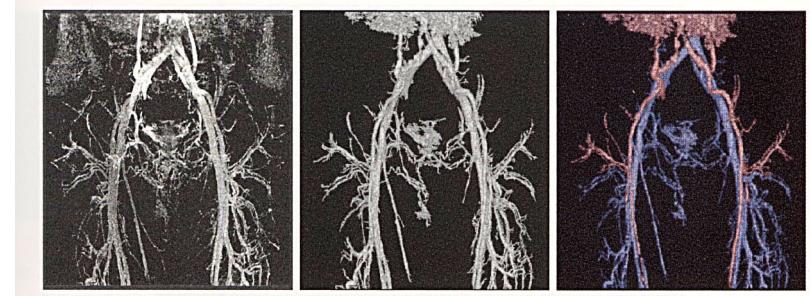
Reconstruction → *Segmentation* → *Quantification*



Segmentation

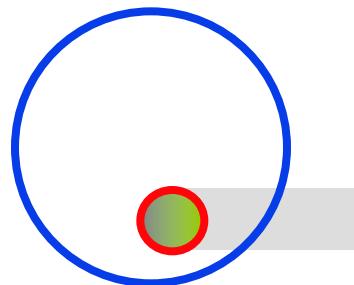
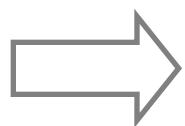


Fuzzy connectivity

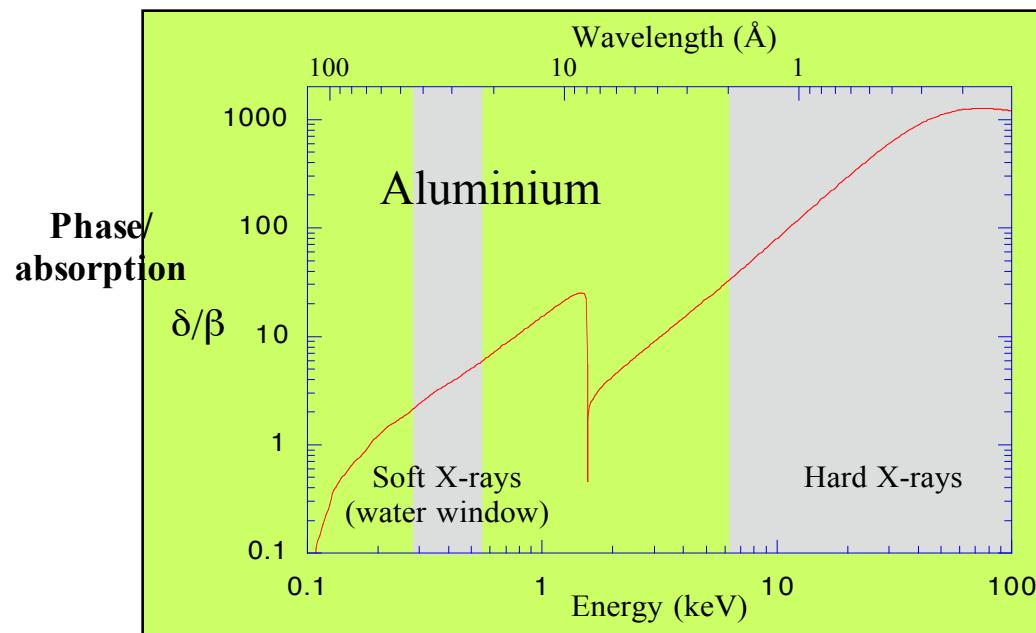
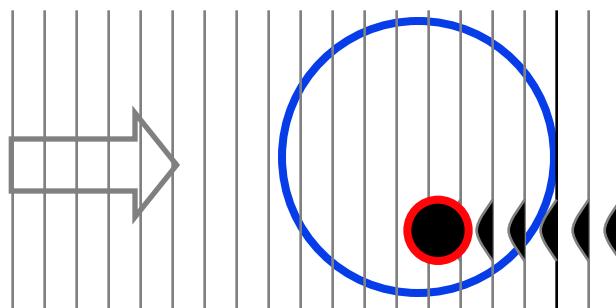


Phase Contrast Tomography

Absorption



Phase

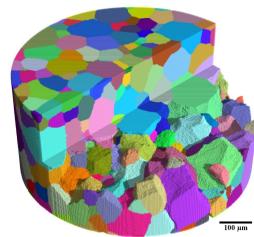


Smallest detectable hole at 25 keV
in a 4 mm thick sample:

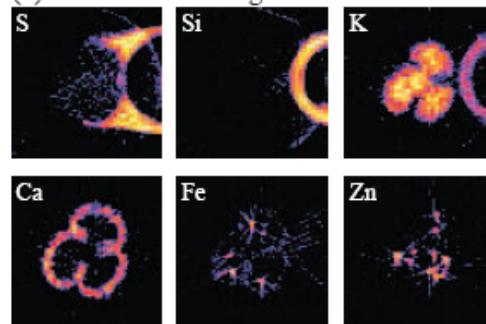
Absorption: 20 μm
Phase: 0.05 μm

Tomography using other contrast mechanisms

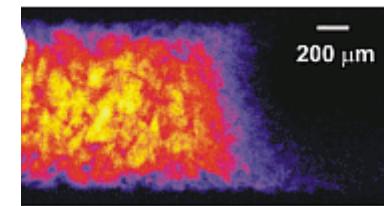
3DXRD (grains, orientations)



Flourescence

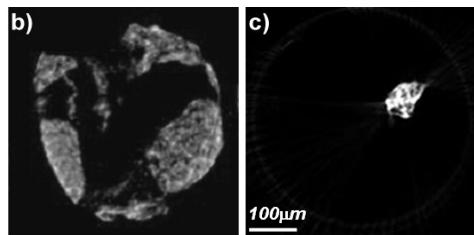


EXAFS and XANES



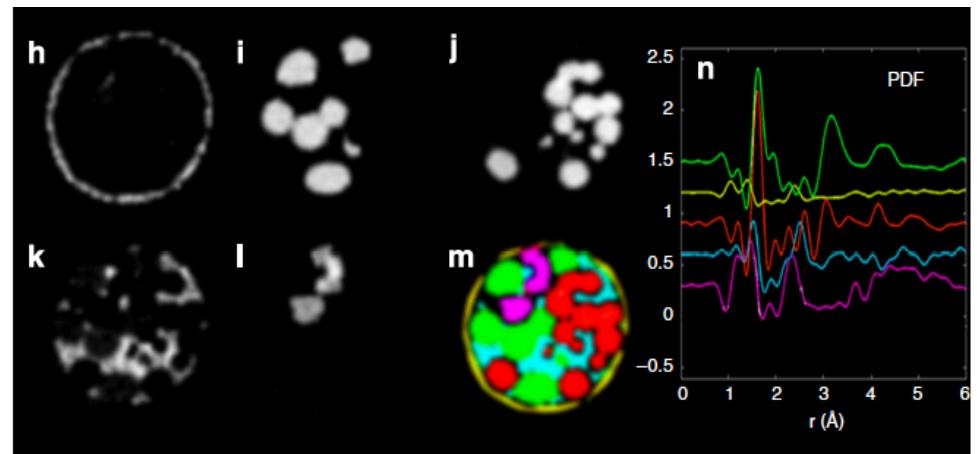
J.-D.Grunwaldt et al.
J. of Phys. Chem. B **110**, 8674 (2006)

Powderdiffraction



Bleuet et al. *Nature Mat.* **7**, 468 (2008)

PDF

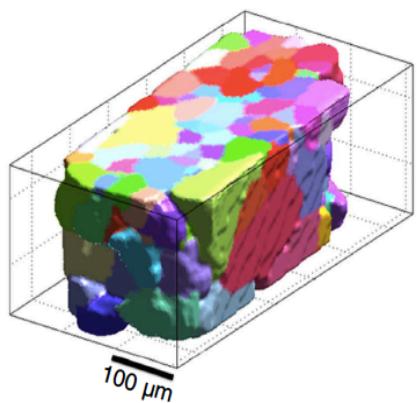
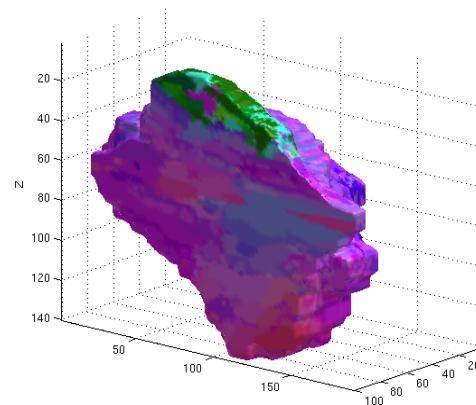
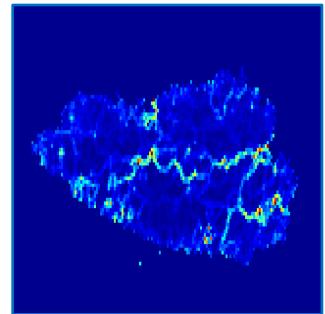


J.D. Jacques et al. *Nature Comm.* **4**, 2536 (2013)

Mikroskopi i 3D

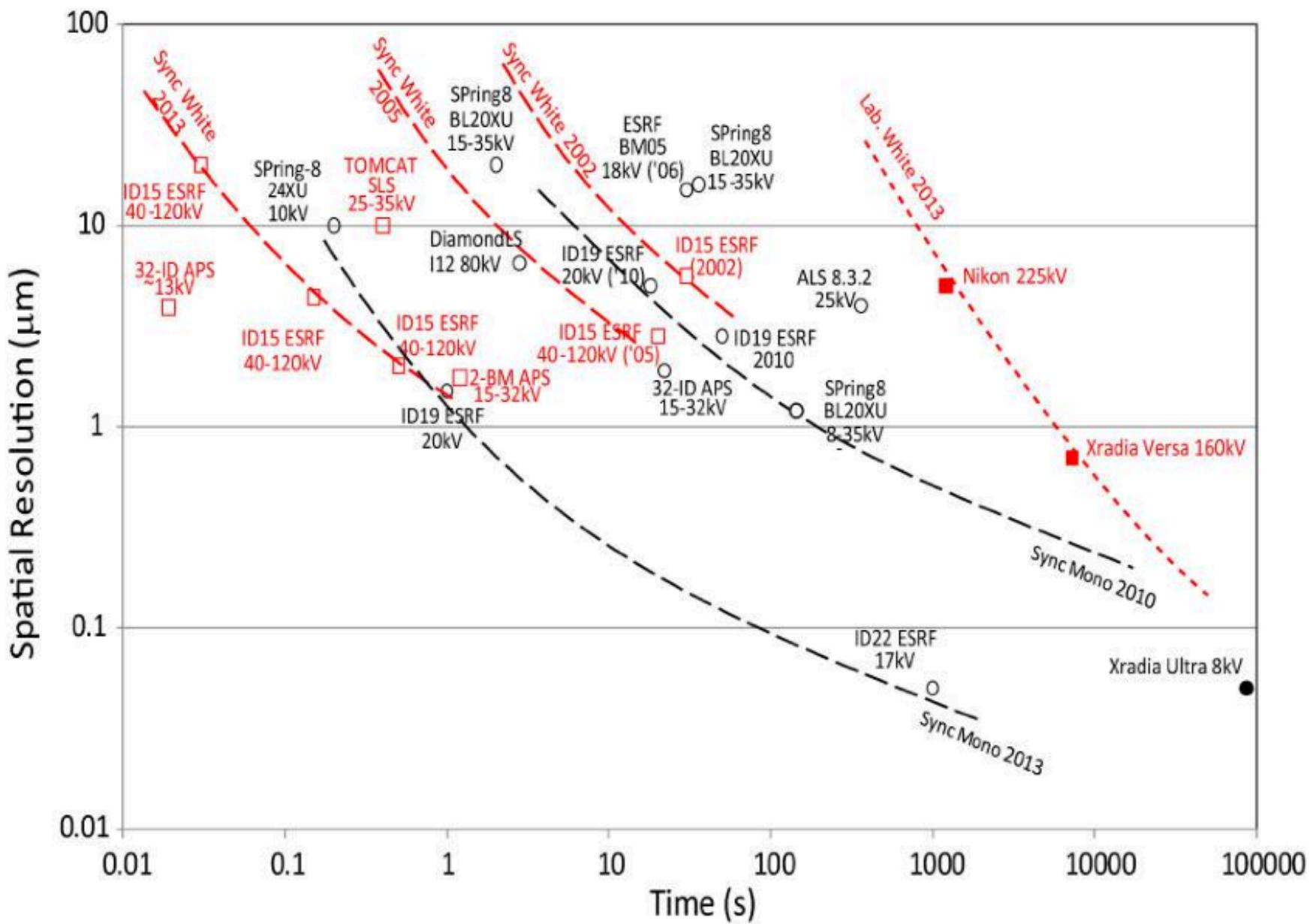


1 cm

100 μm 10 μm 

DTU: H. Simons, S. Ahl, A. Jacobsen, F. Stöhr, Y. Zhang, S. Poulsen, S. Schmidt, W. Pantleon, H.F. Poulsen

ESRF: P. Cook, . Detlefs, A. King, I. Snigireva, A. Snigirev INSA-Lyon: W. Ludwig And others....

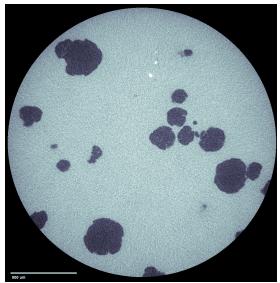


Lokalt udstyr

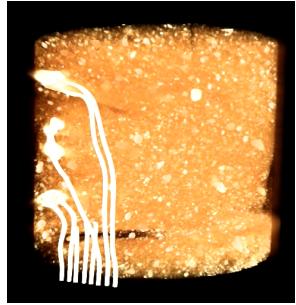
Fire instrumenter, 4 institutter på DTU + NBI, Indviet 27 Januar 2014



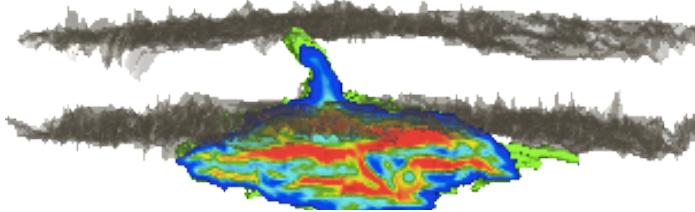
Samarbejde med virksomheder:



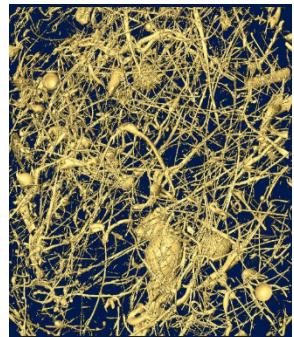
Vestas



Amminex



Novo

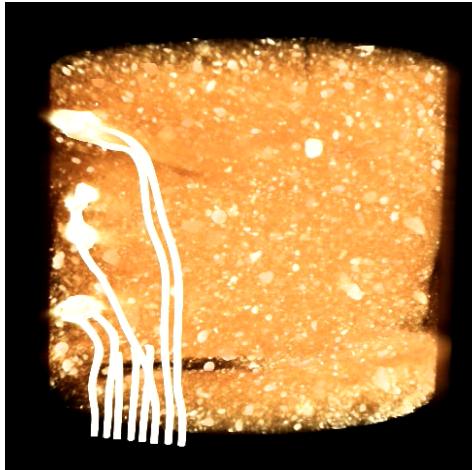


Rockwool

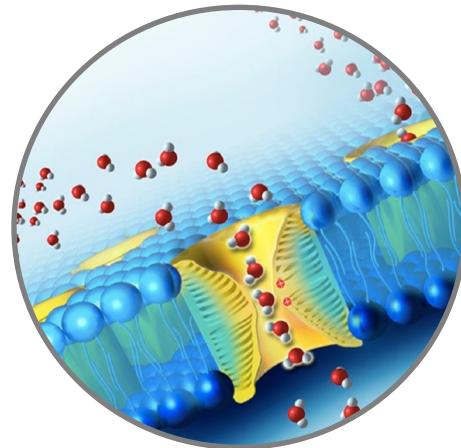
samt Siemens, LM-Windpower, Struers, Biomar, Hempel, Trifolium, Tetrapak,

NKT-Flexibles, Densofit, Mærsk, JJ-Xray, Xnovo, ... ialt 27 virksomheder

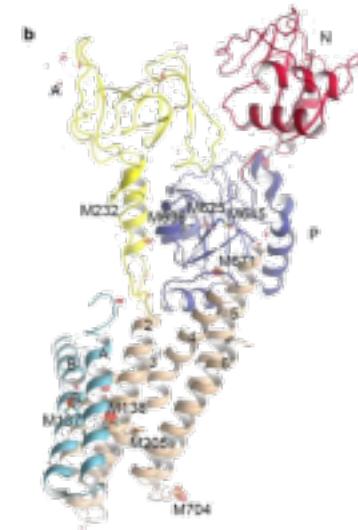
LINX: Linking Industry to Neutrons and X-rays



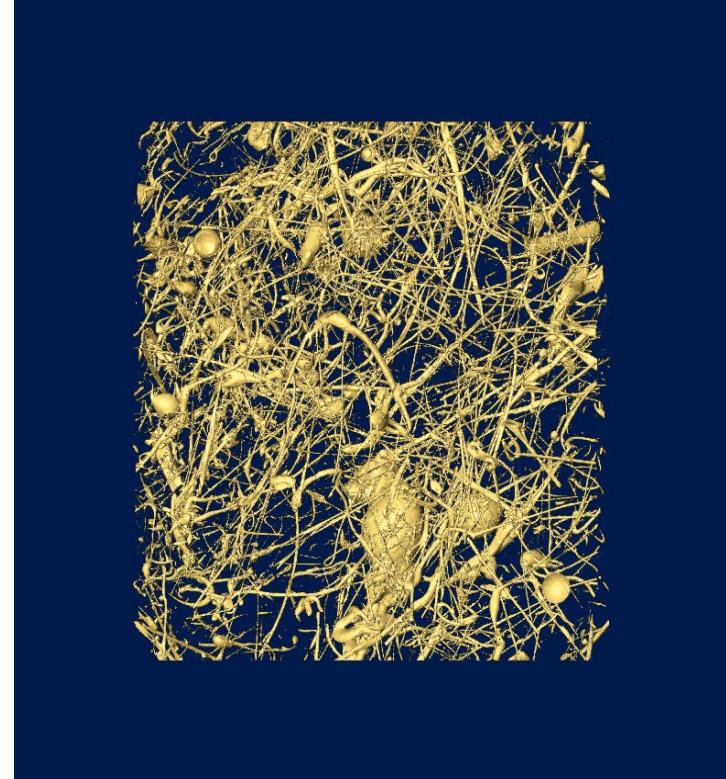
3D Imaging på DTU



SAXS/SANS på KU



Diffraktion på AU



- Mere realistiske simuleringer af varme- lyd- og brand-isolering

Scanner til håndbagage



Spin off:

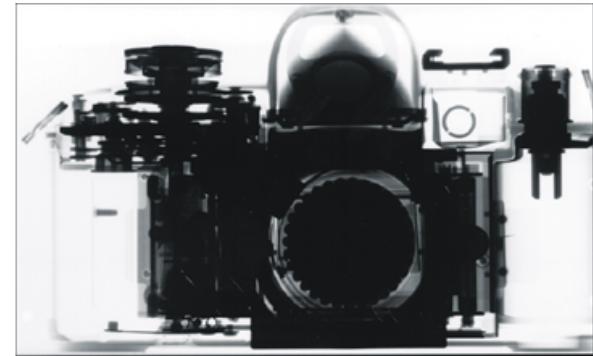
~~exruptive~~



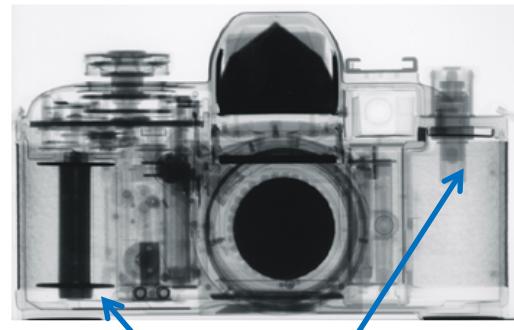
Neutronkilden ESS i Lund



Røntgen



Neutroner



plastik