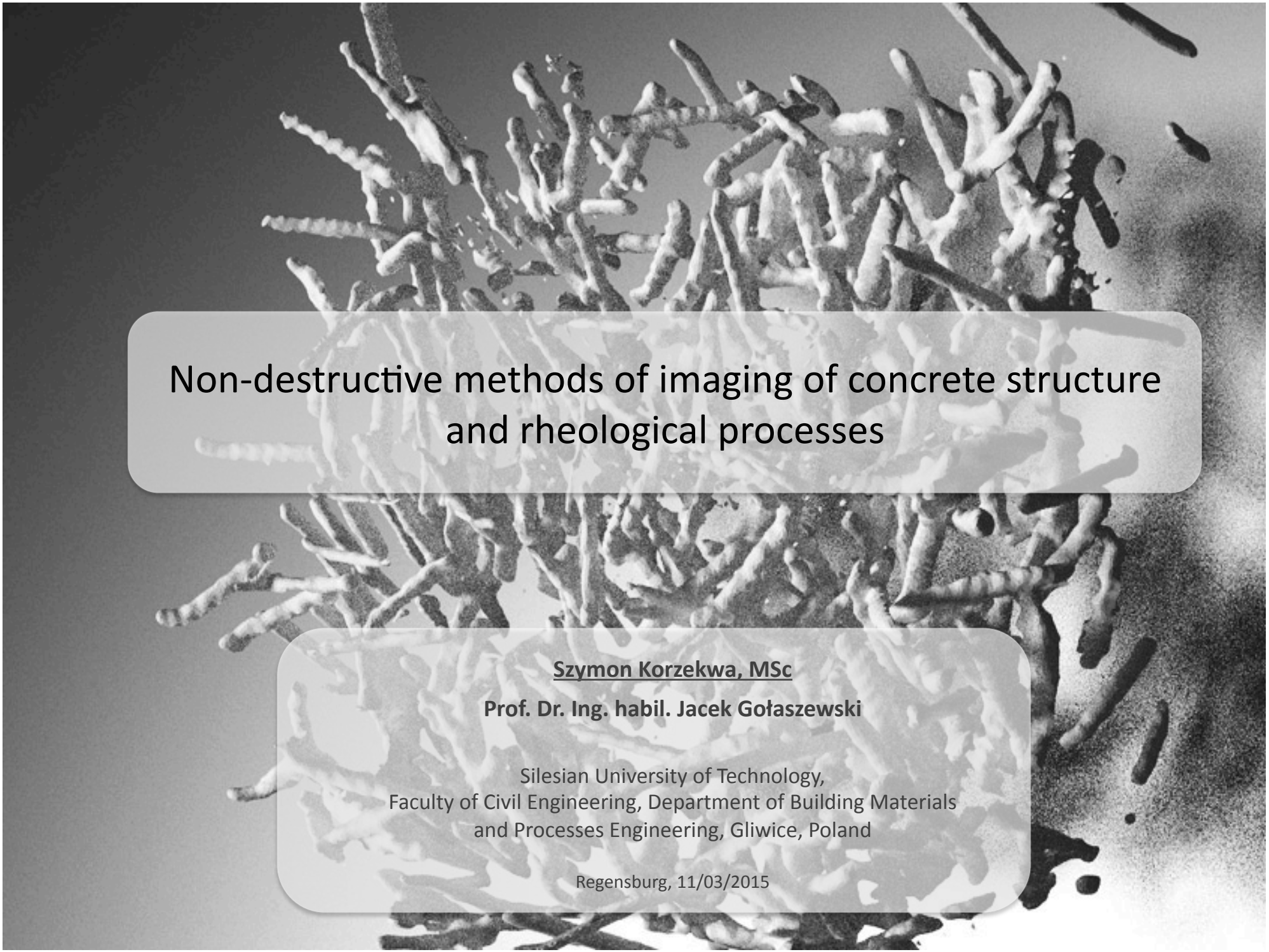

Non-destructive methods of imaging of concrete structure and rheological processes

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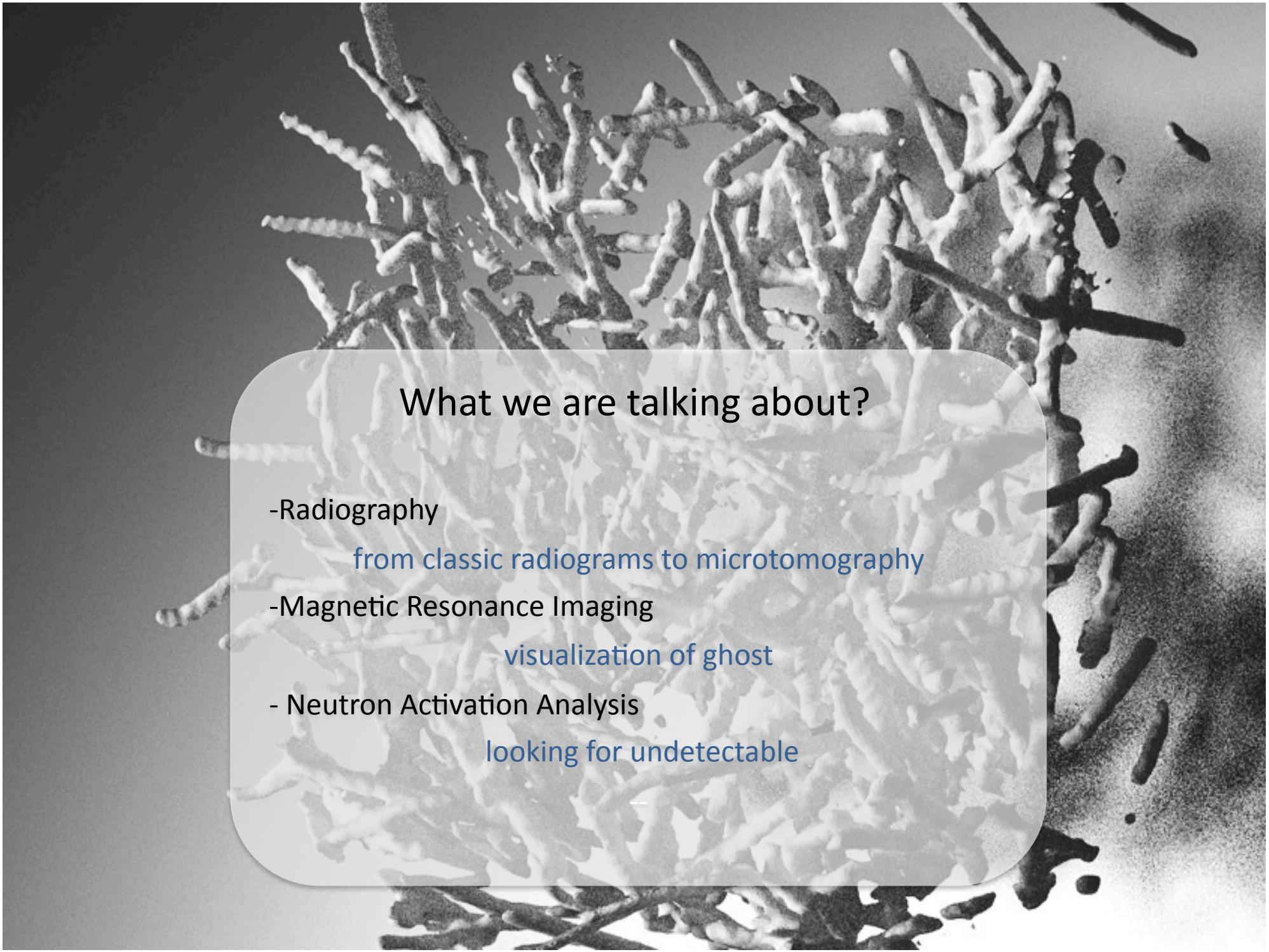
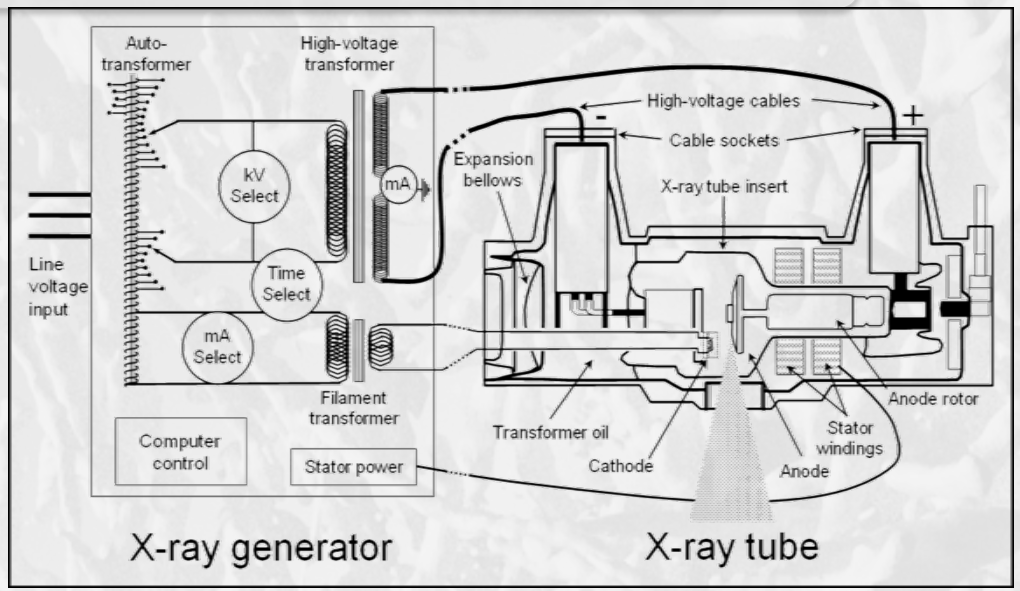
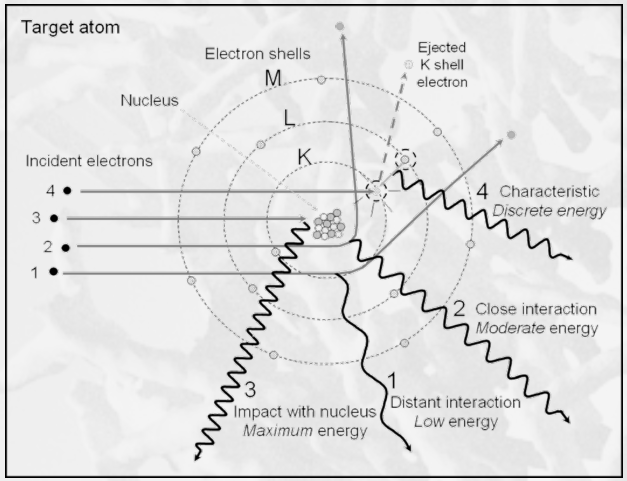
Regensburg, 11/03/2015


What we are talking about?
-Radiography
from classic radiograms to microtomography
-Magnetic Resonance Imaging
visualization of ghost
- Neutron Activation Analysis
looking for undetectable

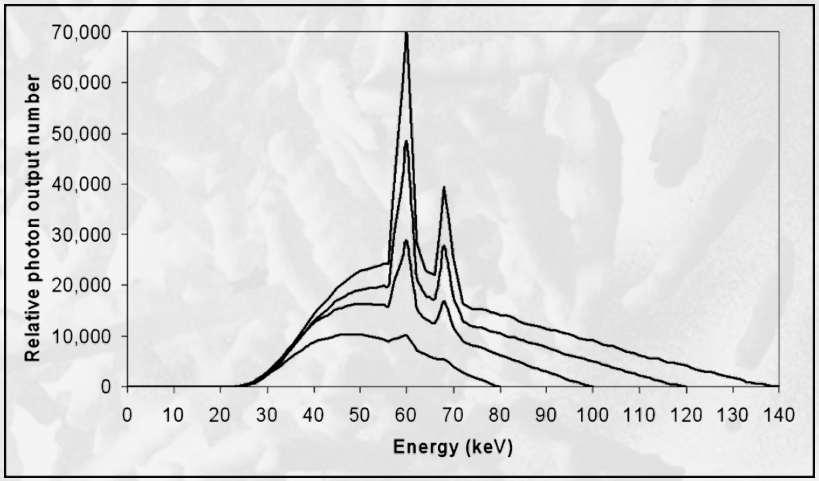
Radiography- how it works?



If you use very simple device like X-ray tube and connect it with the high voltage generator (very high voltage about 300 000 volts) in the little spot on the anode small miracle appears...



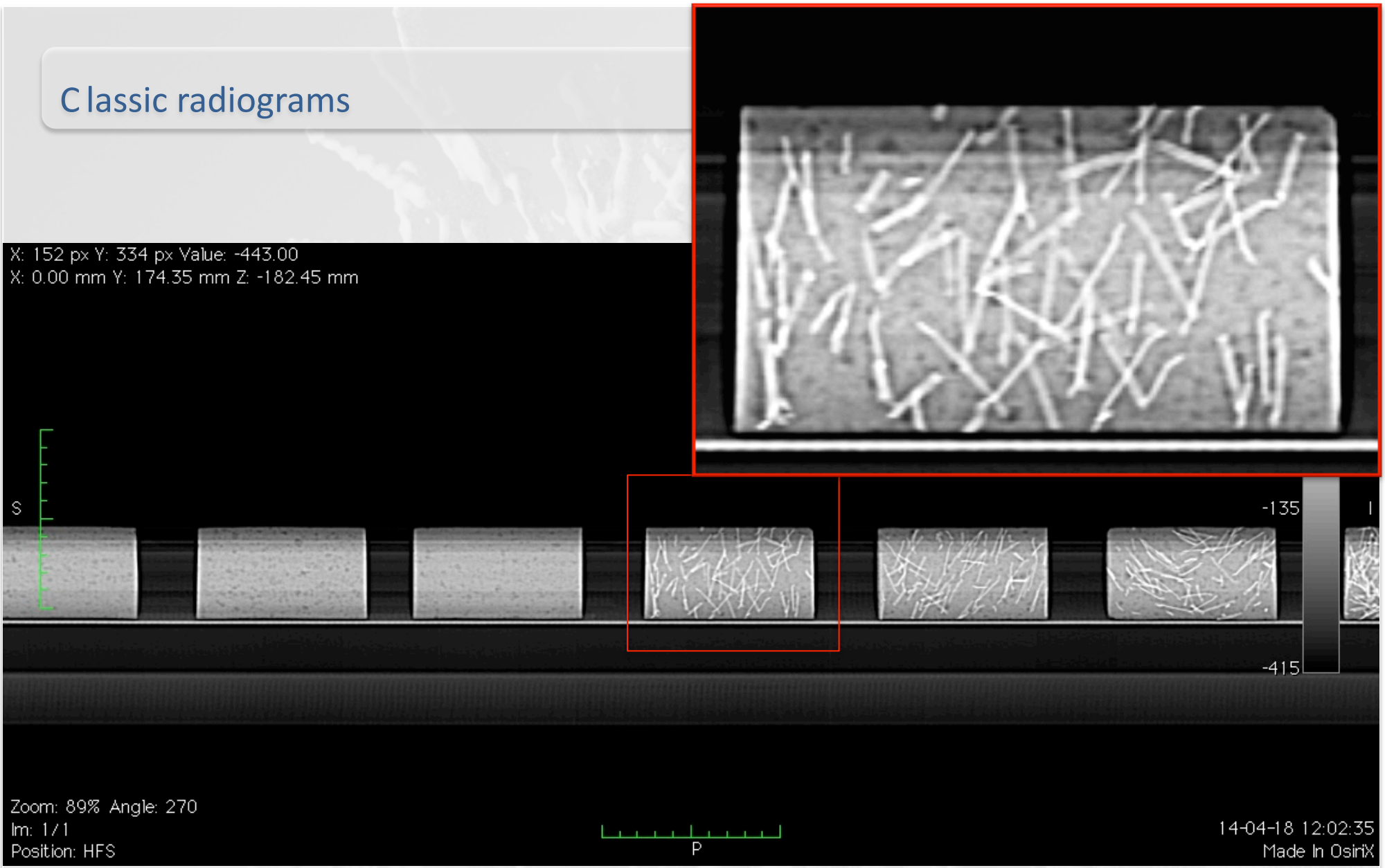
Electrons in the field of nucleus producing X-rays!



With bremstrahlung and characteristic radiation with that spectrum we can see almost everything inside the specimen of building material

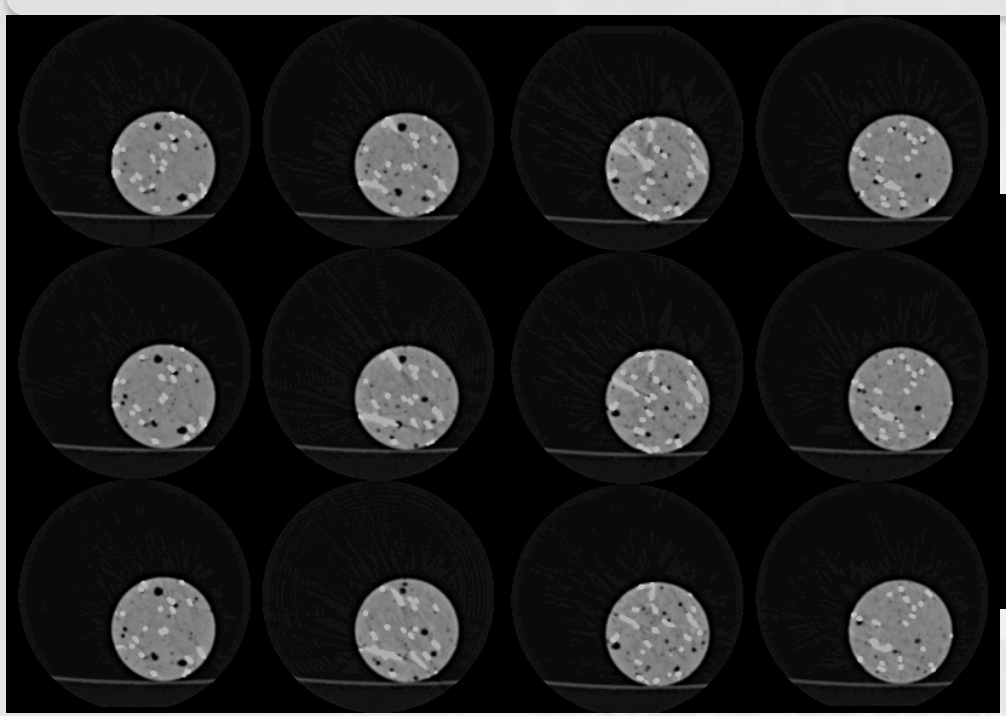
.J. Anthony Seibert J. Nucl. Med. Technol. 2004;32:139-147

C lassic radiograms

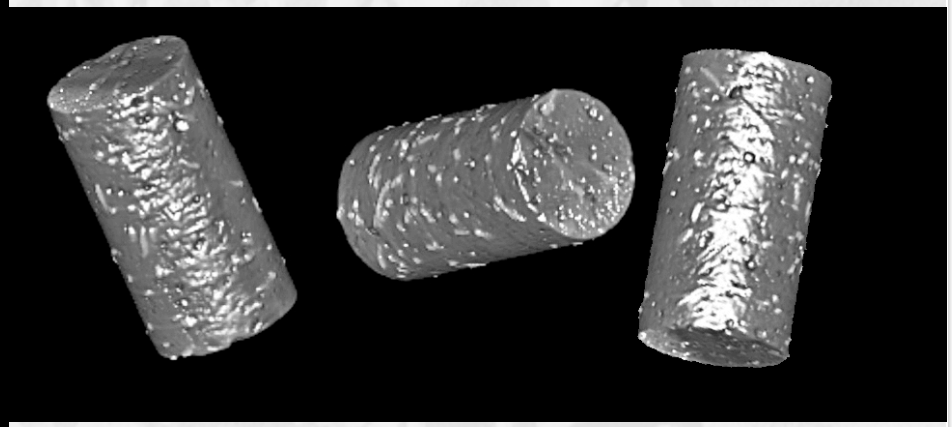


Classic radiogram of different specimens showing structure and reinforcement fibers distribution

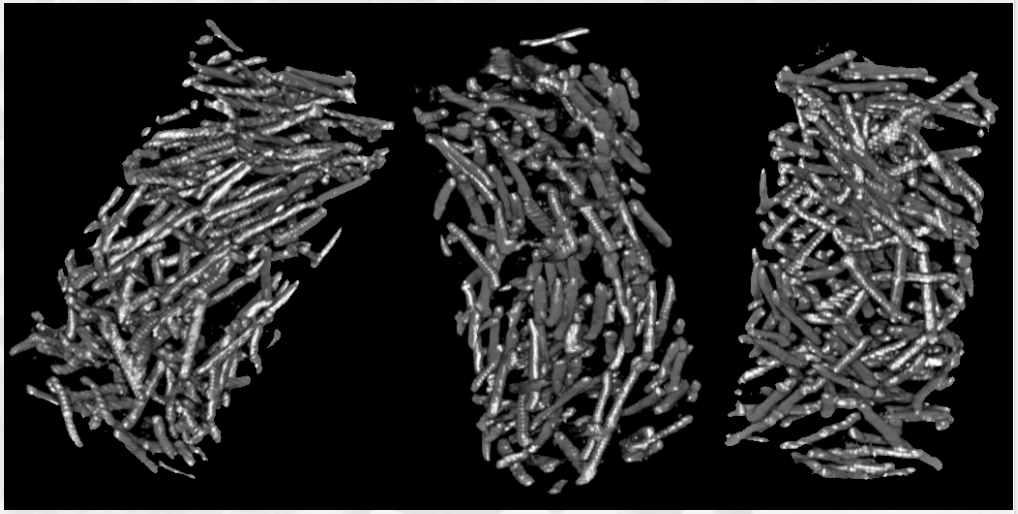
Medical Computed Tomography



Using medical CT- Computed tomography, we can imaging object slice by slice

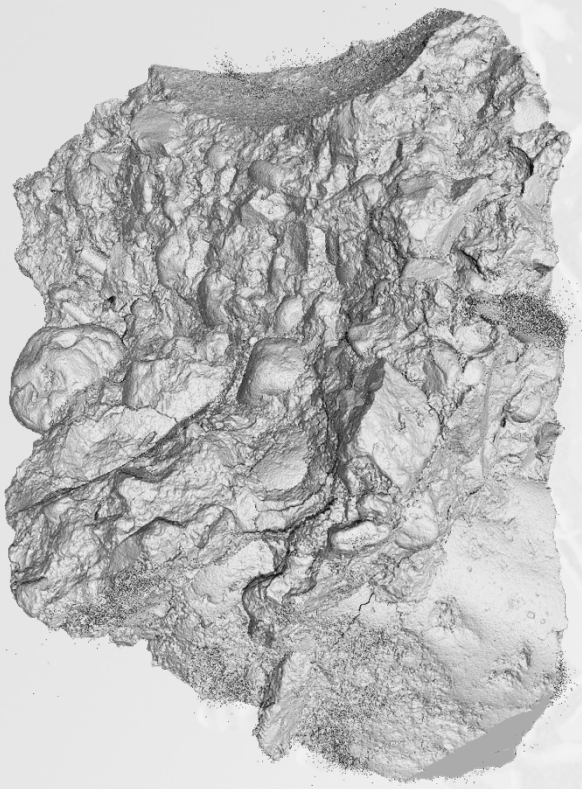


Moreover we can reconstuct 3D model of surface...

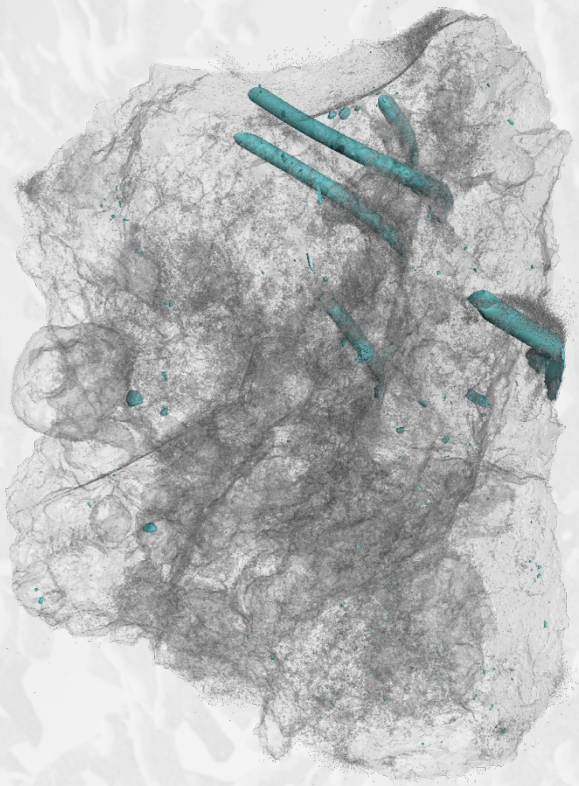


..or even internal arrangement of fibers

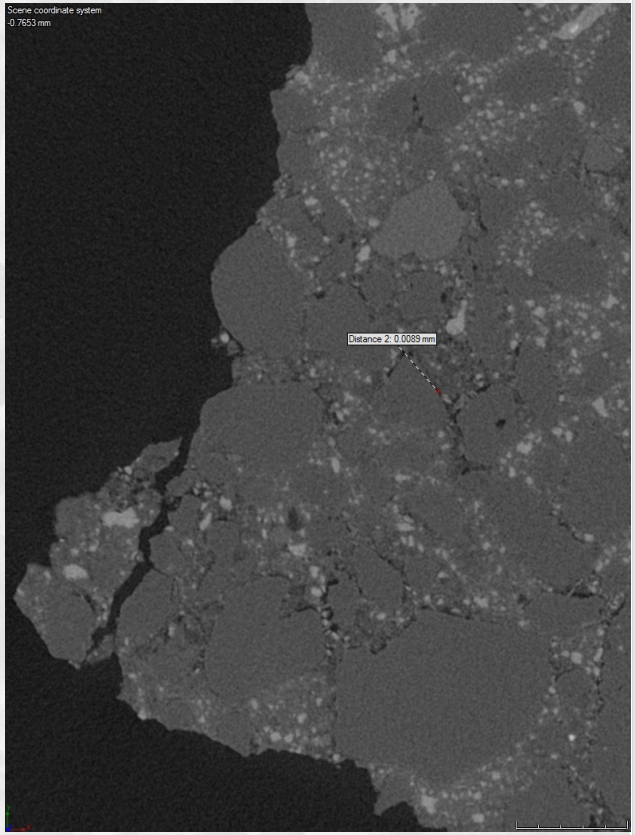
Microtomography



Surface



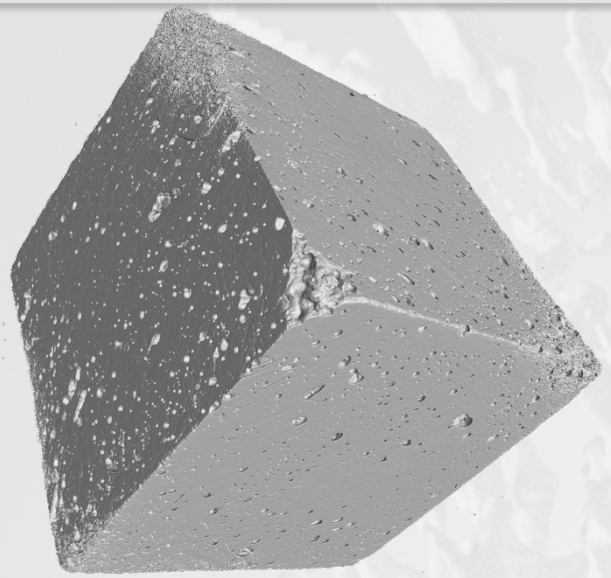
Fibers



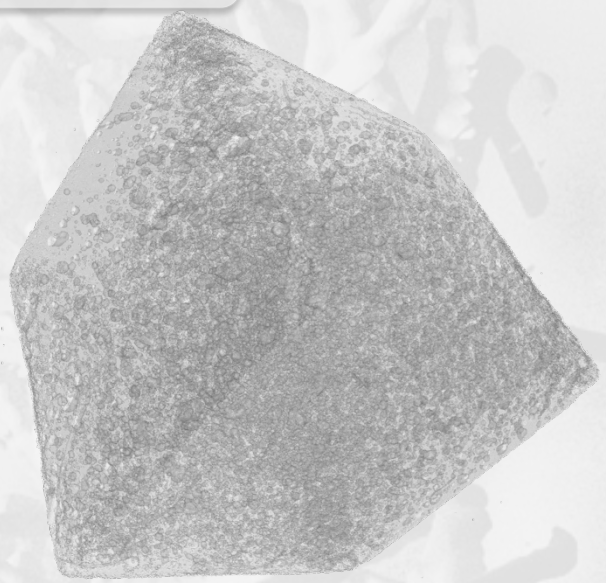
Crack 8,9 microns wide

3D reconstruction of concrete sample with resolution 3,8 microns

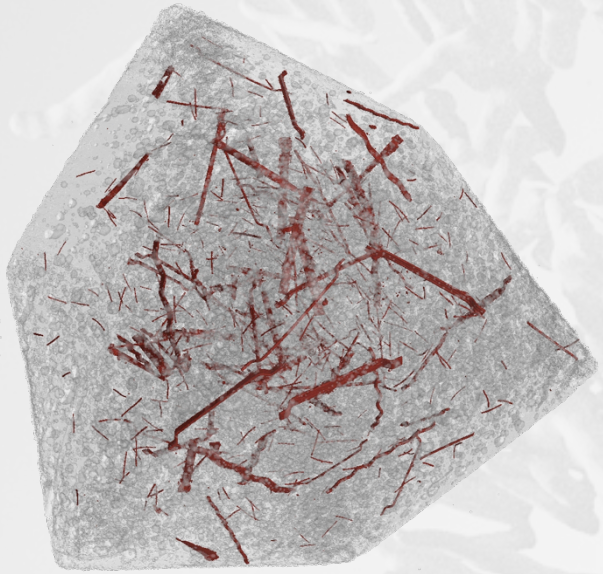
Microtomography



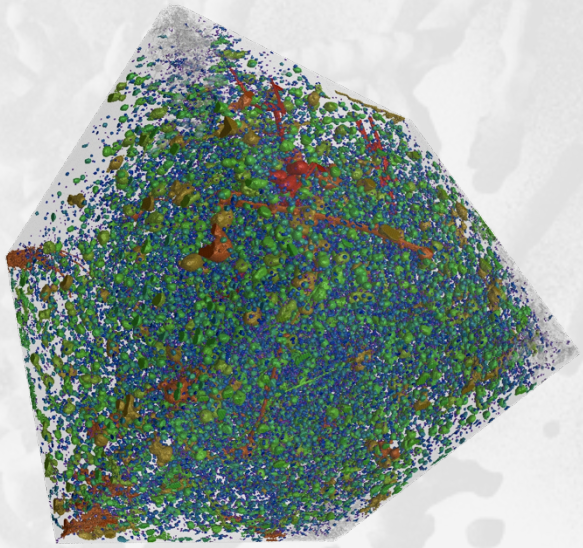
Surface



Pores

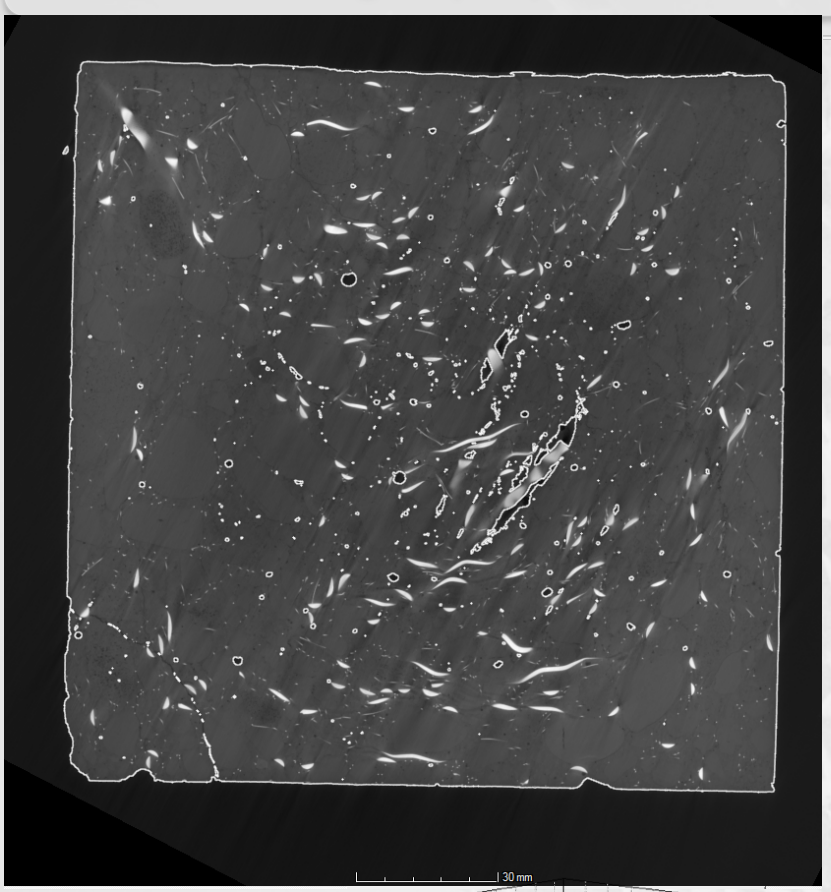


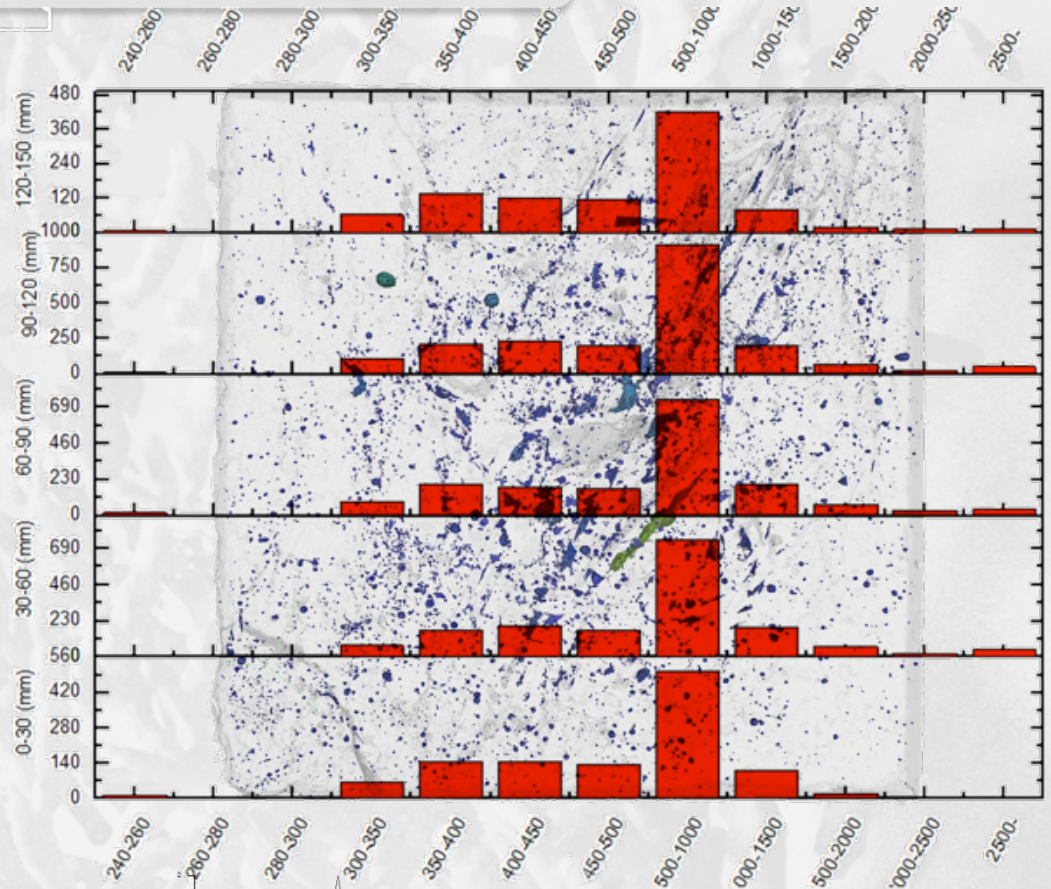
Fibers

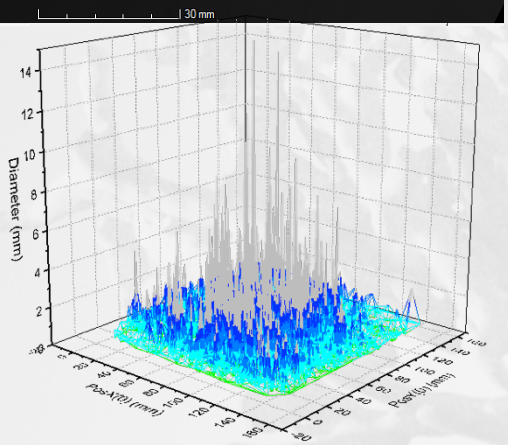


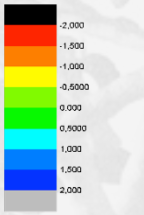
Pores grouped by volume according color table

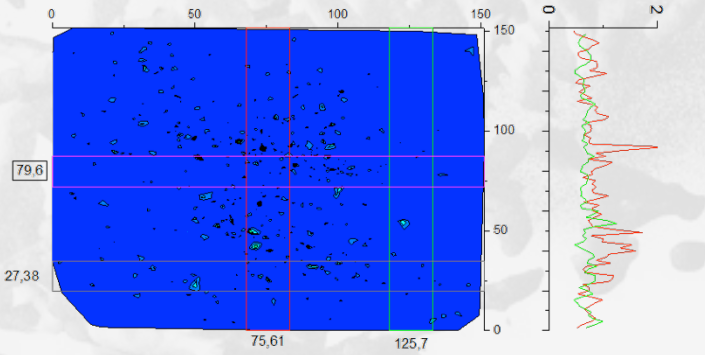
Microtomography- statistics and calculations





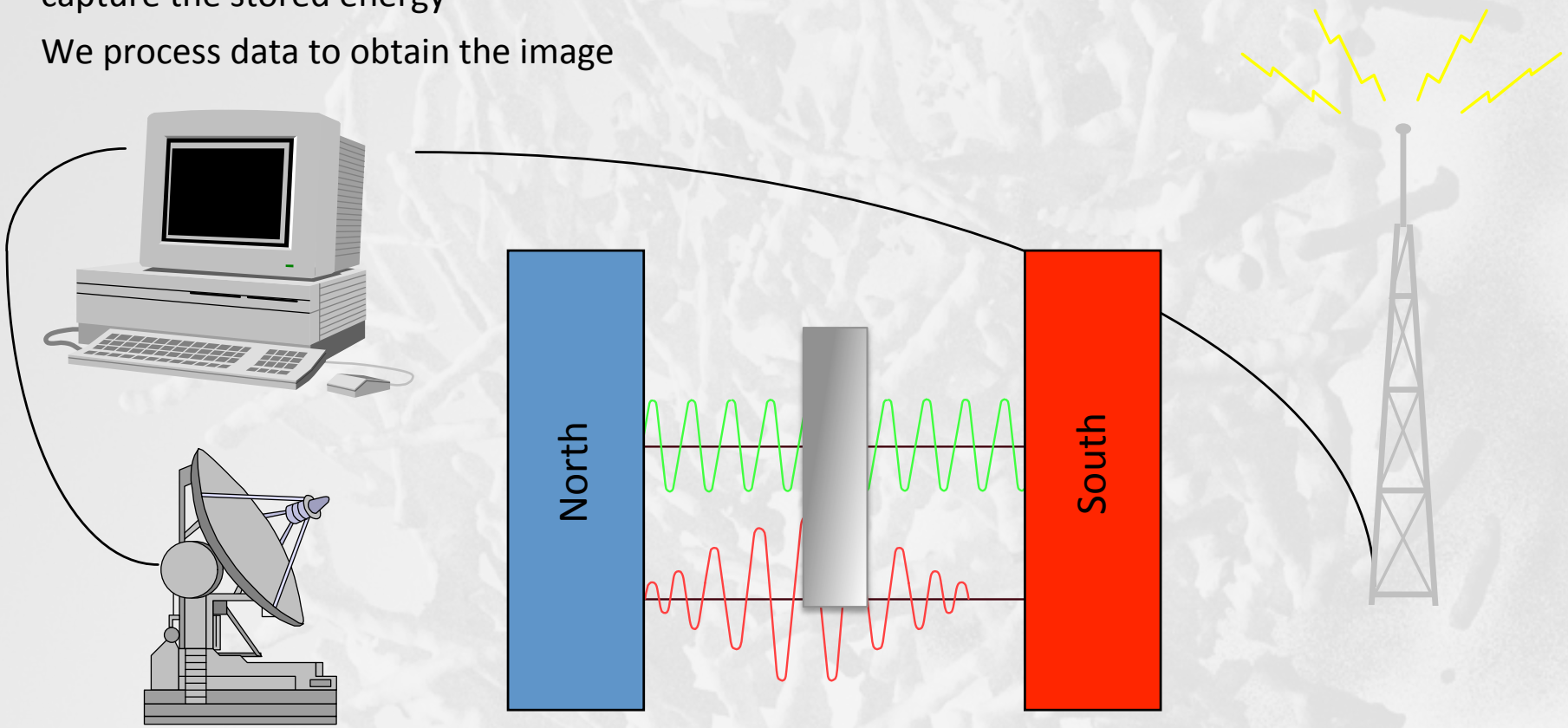




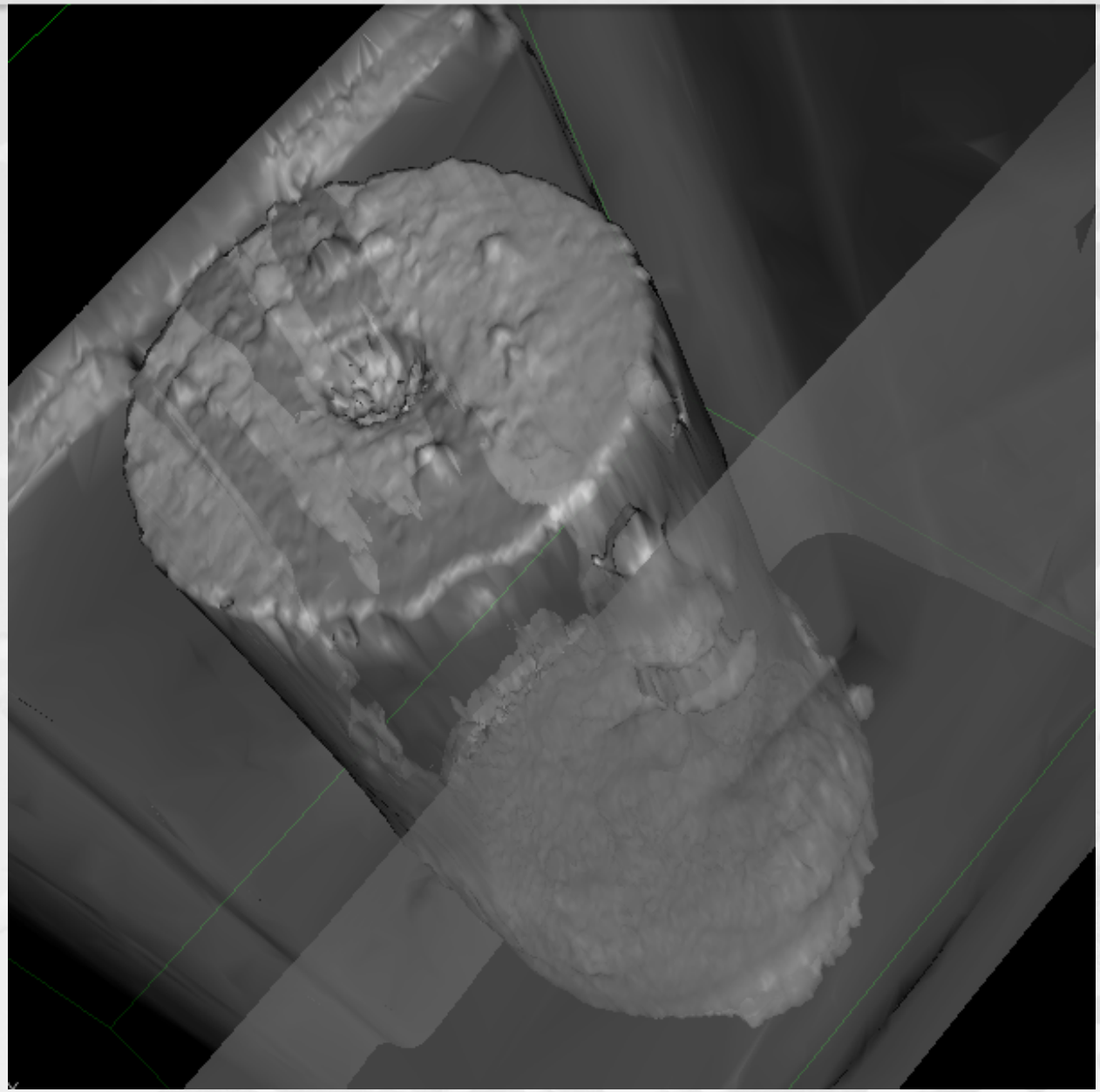


Magnetic Resonance- methodology

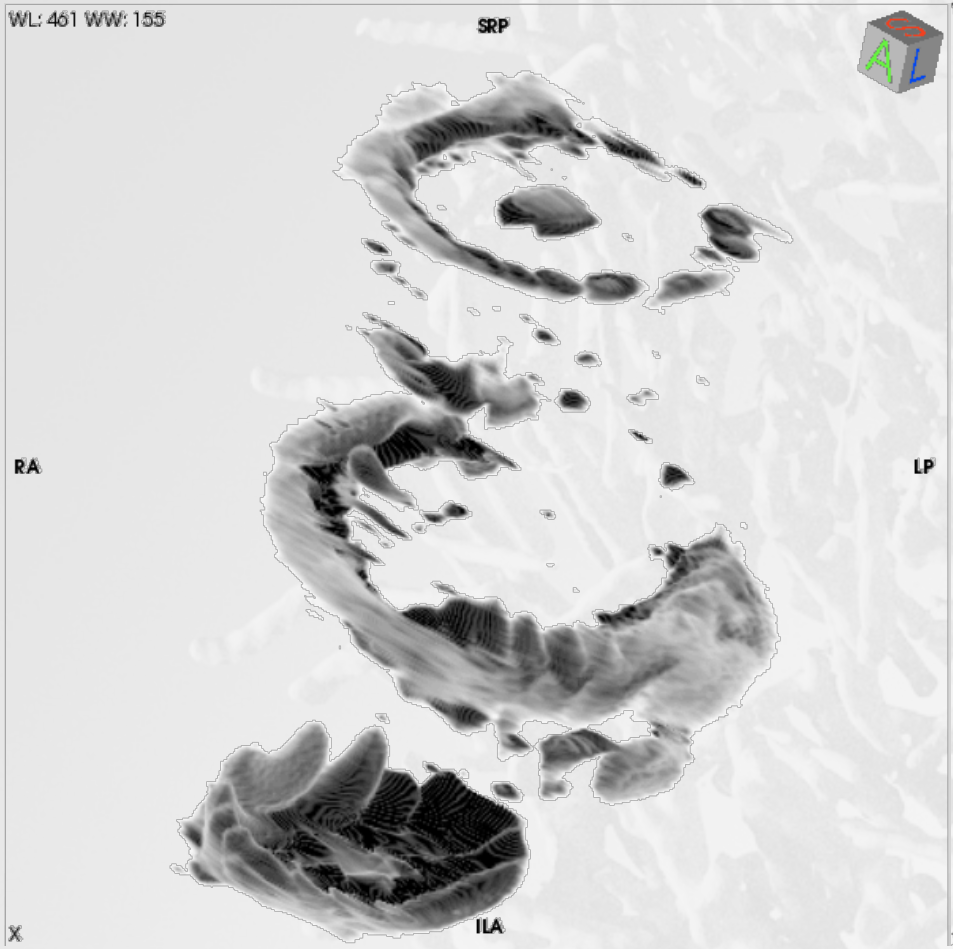
- Position the sample in the magnet
- We give an RF signal to transmit energy to protons
- We use the gradient field variables
- We pick up the signal transmitted by the protons that capture the stored energy
- We process data to obtain the image

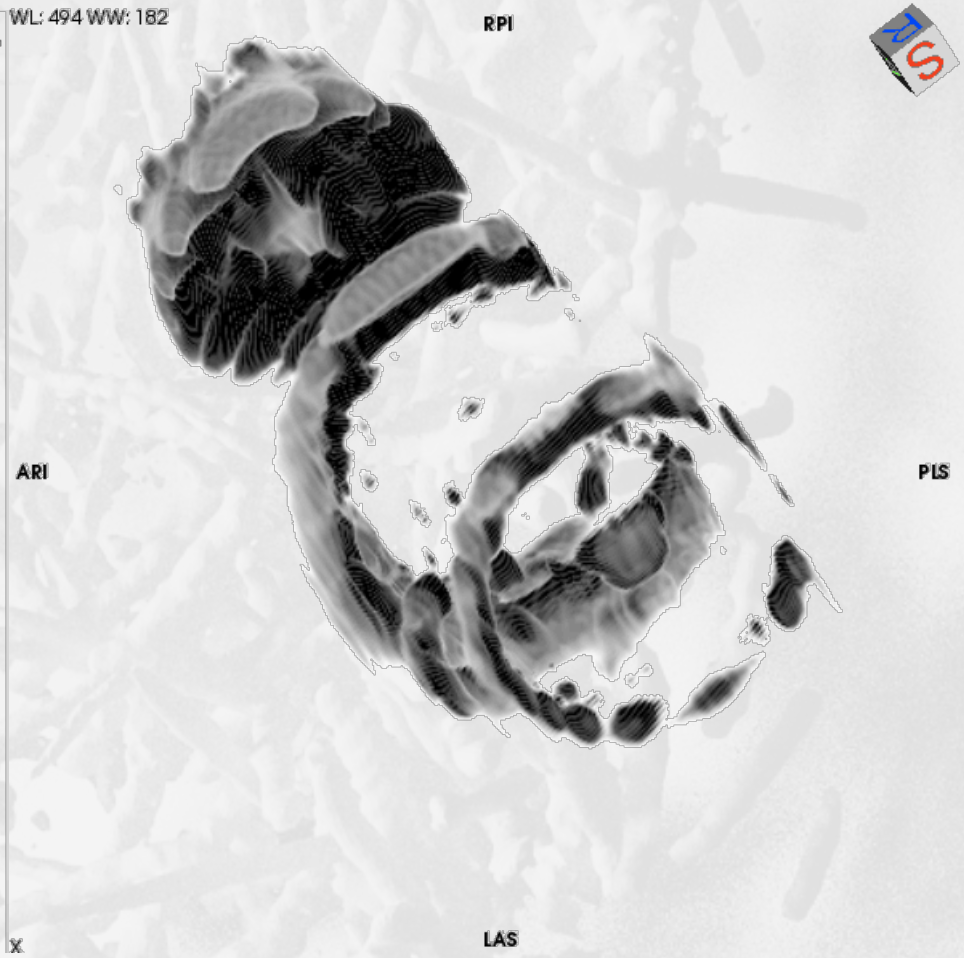


Magnetic Resonance- 3D reconstruction of surface

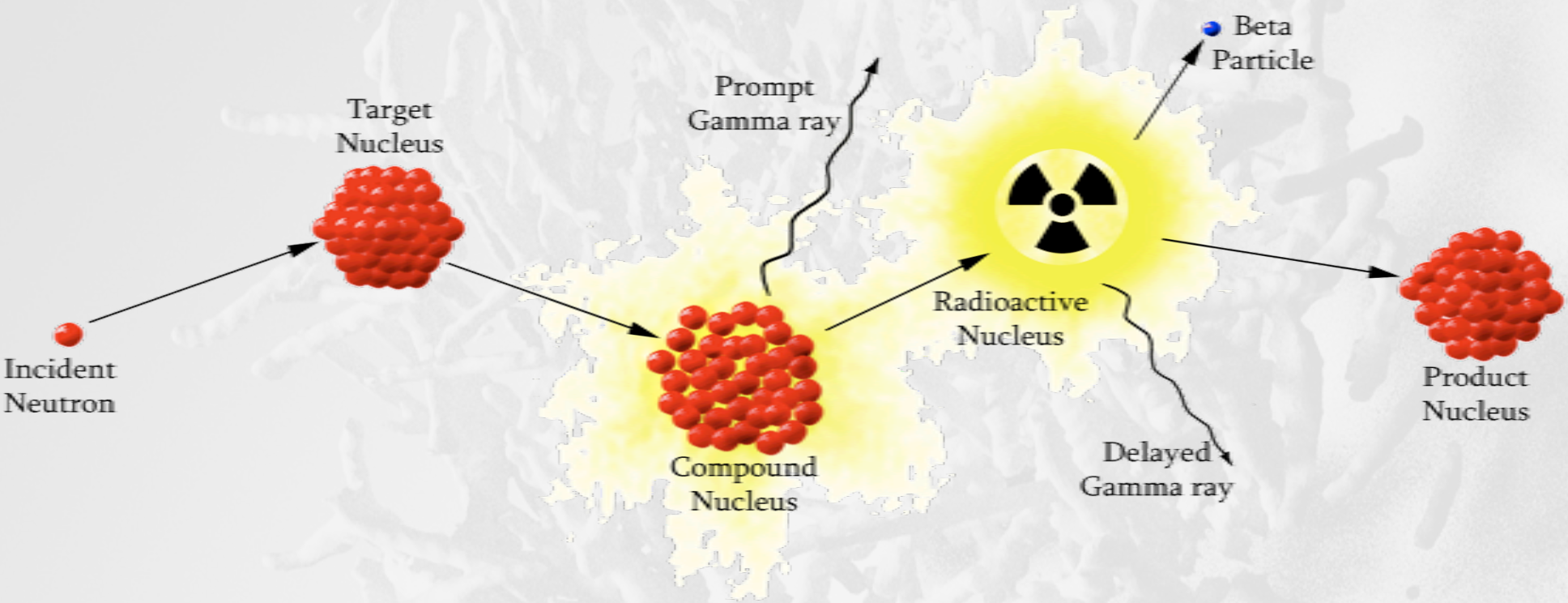


Magnetic Resonance- water distribution in the specimen





Neutron Activation Analysis



Neutron activation analysis (NAA) is one of the most precise non-destructive methods for determining the concentrations of elements in any kind of materials. It is extremely interesting to use that method for identify trace or rare earth elements in building materials.
The method is based on nuclei activation as a result of the collision with neutron and therefore requires a very efficient source of neutrons like nuclear reactor.

Neutron Activation Analysis

Estimated Detection limits for INAA using decay gamma rays (assuming irradiation in a reactor neutron flux of $1x10^{13}$ n cm^{-2} s^{-1})

Sensitivity (picograms)	Elements
1	Dy, Eu
1–10	In, Lu, Mn
10–100	Au, Ho, Ir, Re, Sm, W
100–1000	Ag, Ar, As, Br, Cl, Co, Cs, Cu, Er, Ga, Hf, I, La, Sb, Sc, Se, Ta, Tb, Th, Tm, U, V, Yb
1000–10^4	Al, Ba, Cd, Ce, Cr, Hg, Kr, Gd, Ge, Mo, Na, Nd, Ni, Os, Pd, Rb, Rh, Ru, Sr, Te, Zn, Zr
10^4–10^5	Bi, Ca, K, Mg, P, Pt, Si, Sn, Ti, Tl, Xe, Y
10^5–10^6	F, Fe, Nb, Ne
10^7	Pb, S

Thank you.

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