MicroCT at University of Helsinki

Collaborative Visions and Opportunities

GTK X-Ray Tomography Launch Meeting

X-RAY SCIENCE AT UNIVERSITY OF HELSINKI

X-ray Laboratory at the Department of Physics

- Active unit on X-ray related research, 10 – 20 persons
- X-ray *method development* and X-ray *applications*

Chemical Composition and Atomic Structure

- Diffraction
- Scanning micro-beam diffraction
- XANES

Microstructure

- Micro-CT
- In situ / in vivo / in operando imaging
- Phase contrast imaging (in development)

Elemental composition

- Fluorescence

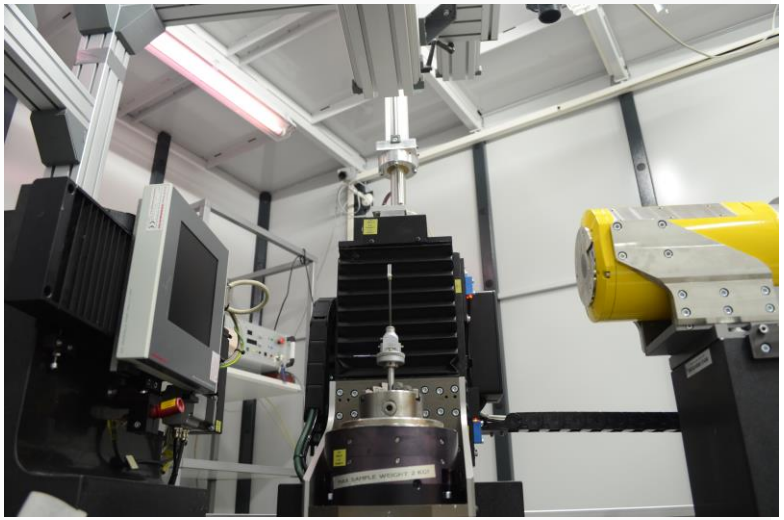
EXAMPLES OF APPLICATIONS AT X-RAY LABORATORY

- Materials science
  - Clean energy materials, wood and paper structure
- Materials physics
  - Water properties
- Biology and medicine
  - Evolution-development, pre-clinical studies, plant morphology
- Paleontology
- Micrometeorites
- Soil science

MICROCT EQUIPMENT AT X-RAY LABORATORY

GE nanotom | s

- 30 kV to 180 kV
- Achievable resolution ~1 µm
- Allows building of large custom setups
- Complemented by X-ray microbeam diffraction → the sample can be characterized from the atomic scale to micron scale in the same setup

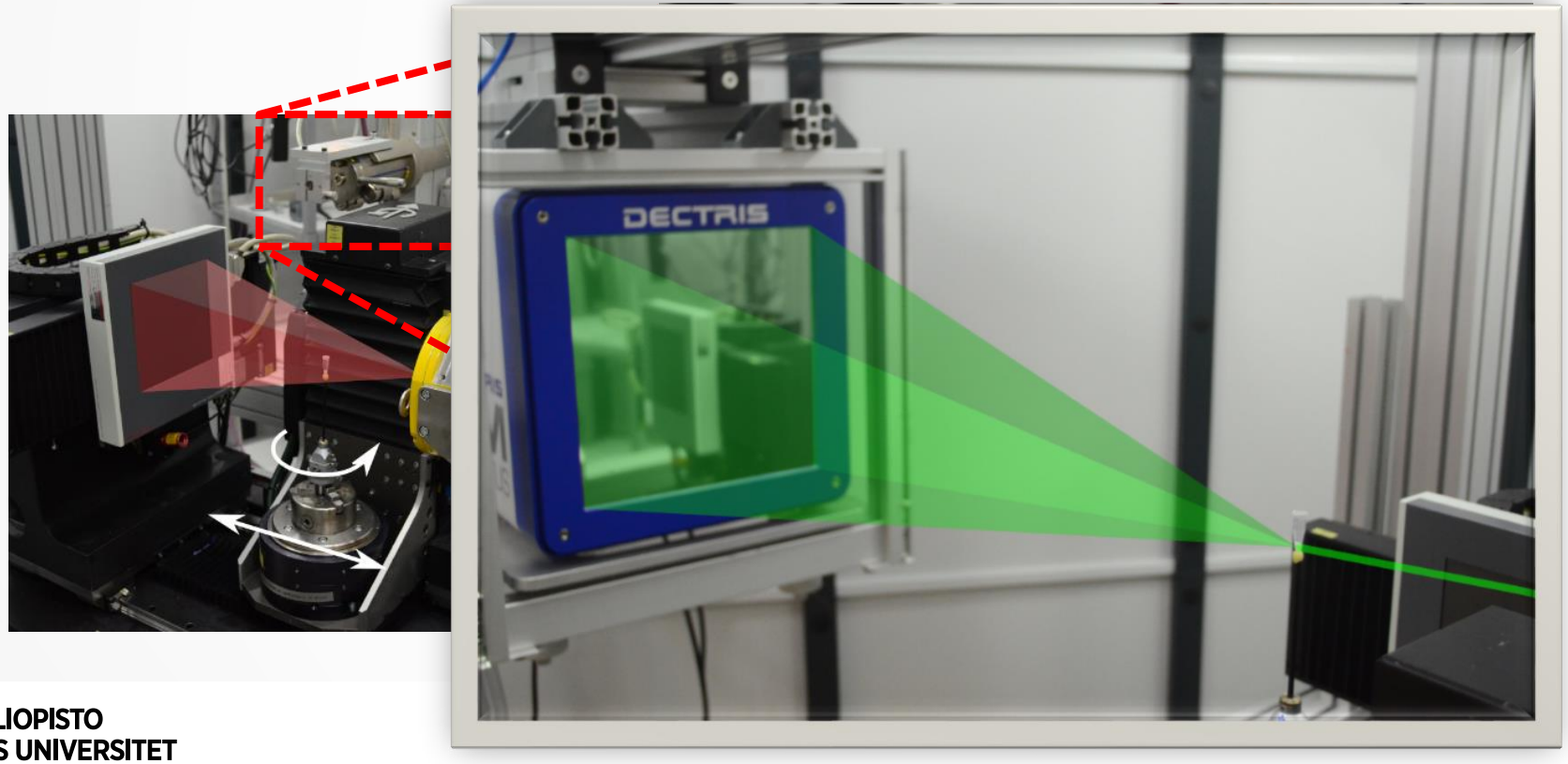


Bruker Skyscan 1272

- 20 kV to 100 kV
- Achievable resolution ~1 µm
- Automatic sample changer for high throughput
- Easy to use with small training
- Low maintenance

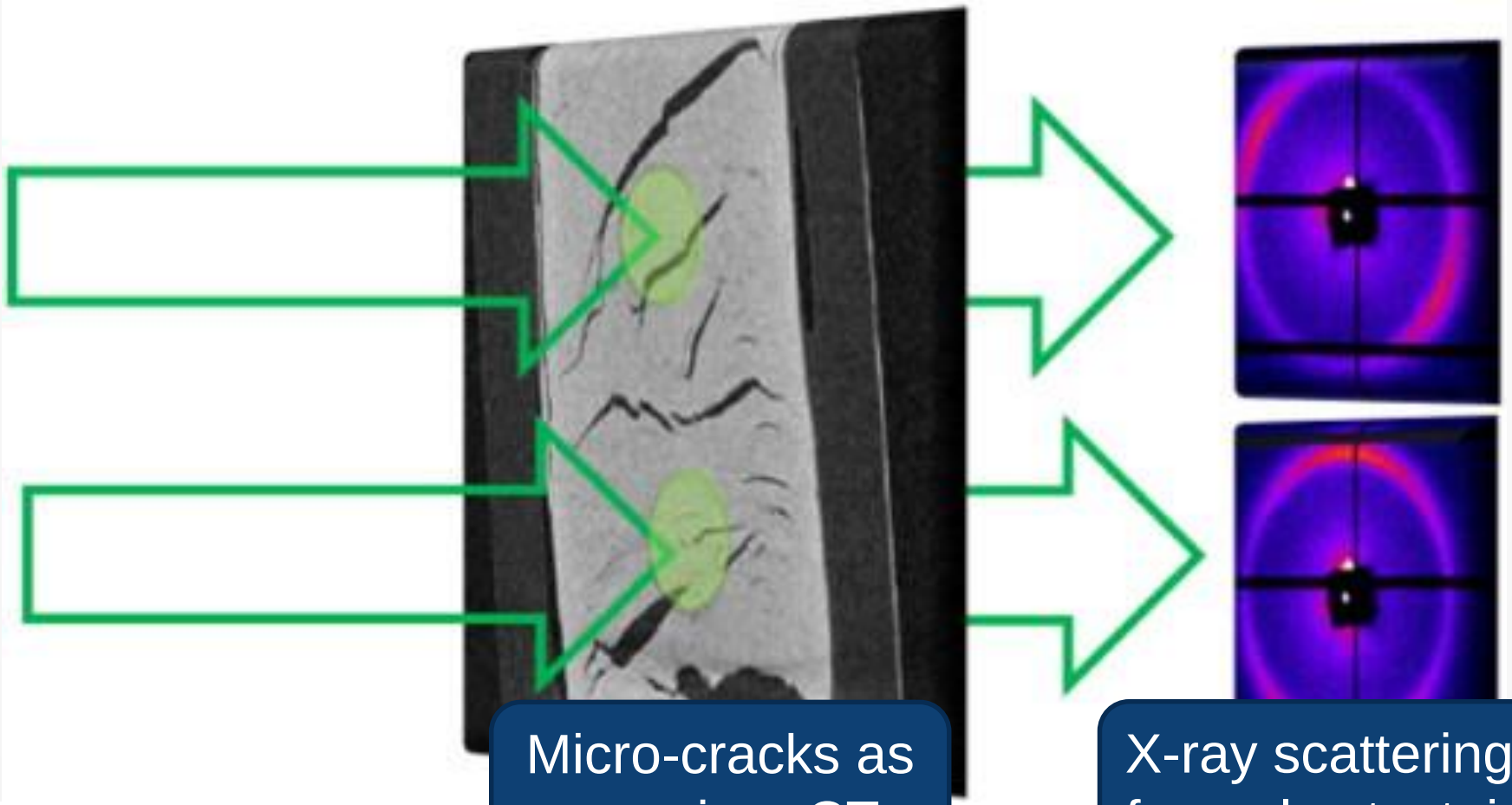
COMBINING X-RAY MICROCT AND MICRO-DIFFRACTION

- Mo-target tube with focusing optic: 100 µm beam at sample, E=17.4 keV, $\Delta E/E = 10^{-2}$
- Pilatus 1M Detector



MICRO-DIFFRACTION EXAMPLE: BENTONITE ANISOTROPY

(JP SUURONEN ET AL. APPLIED CLAY SCIENCE, 101 (2014), DOI: 10.1016/J.CLAY.2014.08.015)



Micro-cracks as seen in µ-CT

X-ray scattering from clay tactoids

LAB + SYNCHROTRONS

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Elemental composition

- Fluorescence

- Diffraction imaging
- Scanning diffraction with nano-probe
- RIXS, nRIXS
- Time-resolved studies

- nano-CT with phase contrast or coherent imaging
- Ultra-fast imaging (sub-µs 2D images, 100 ms 3D images)

- Micro-probe and nano-probe for scanning fluorescence
- K-edge subtraction imaging

COLLABORATIVE VISIONS

Having more µCT machines is good for for Finnish researchers. How can we maximize the potential for good research outcomes?

- Complementary research profiles
- Combining efforts for problem solving
- Combining efforts for new developments:
  - In situ device design and implementation
  - Developments in quantitative imaging and elementally sensitive imaging
- Joint µCT workshops
- Joint applications for infrastructure funding, e.g. compact source

COLLABORATIVE VISIONS

At University of Helsinki X-ray Laboratory we can help you in your studies in the following ways:

- To go beyond basic µCT
  - Combination of µCT and diffraction
  - Complementary analysis with XANES and fluorescence
- To have high throughput µCT for large sets of similar samples
- To develop and use in situ rigs for imaging
- To do advanced studies with synchrotron radiation
- Understanding of fundamental physics for materials

CONTACT US FOR MORE DETAILS

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