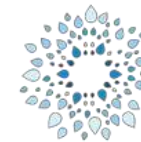




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**Fenágua
2018**
FEIRA NACIONAL DA ÁGUA

TIME-RESOLVED SYNCHROTRON X-RAY COMPUTED TOMOGRAPHY AS A TOOL FOR GROUNDWATER REMEDATION

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Agenda

- The Brazilian Center for Research in Energy and Materials (**CNPEM**)
- The Brazilian Synchrotron Light Source and the **Sirius Project**
- **Time resolved X-ray tomography**
- Application for **Groundwater remediation:** in-situ reaction between TCE and nZVI

National Laboratory

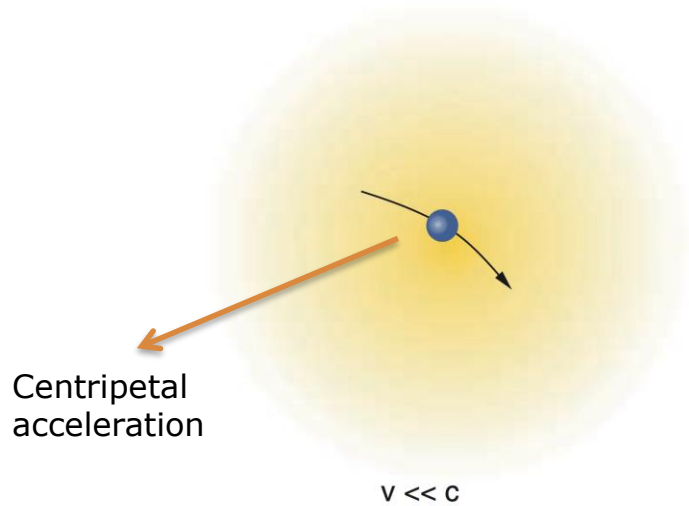
- Free for academic users
- Partnership with private company



The Brazilian Synchrotron Light Source

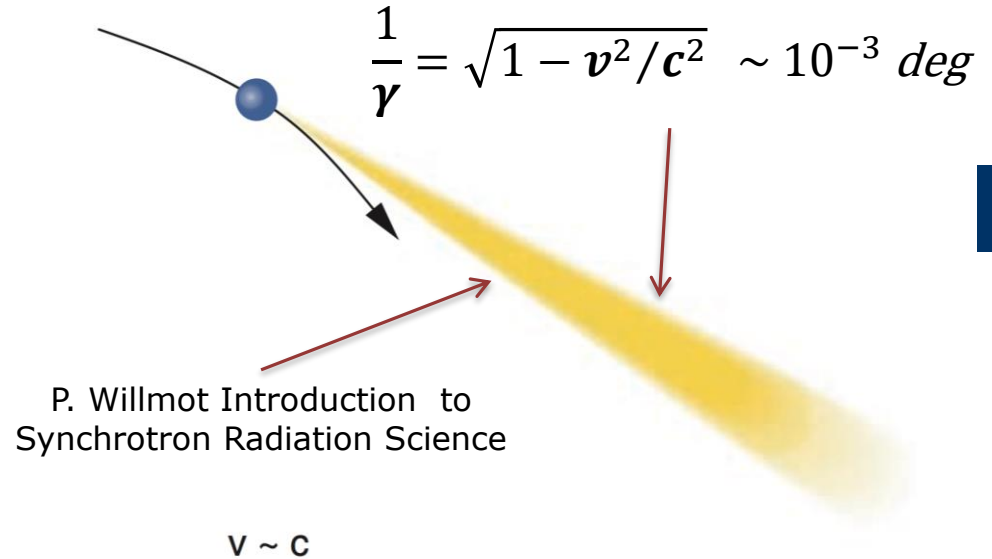
a particle accelerator

Classic Model



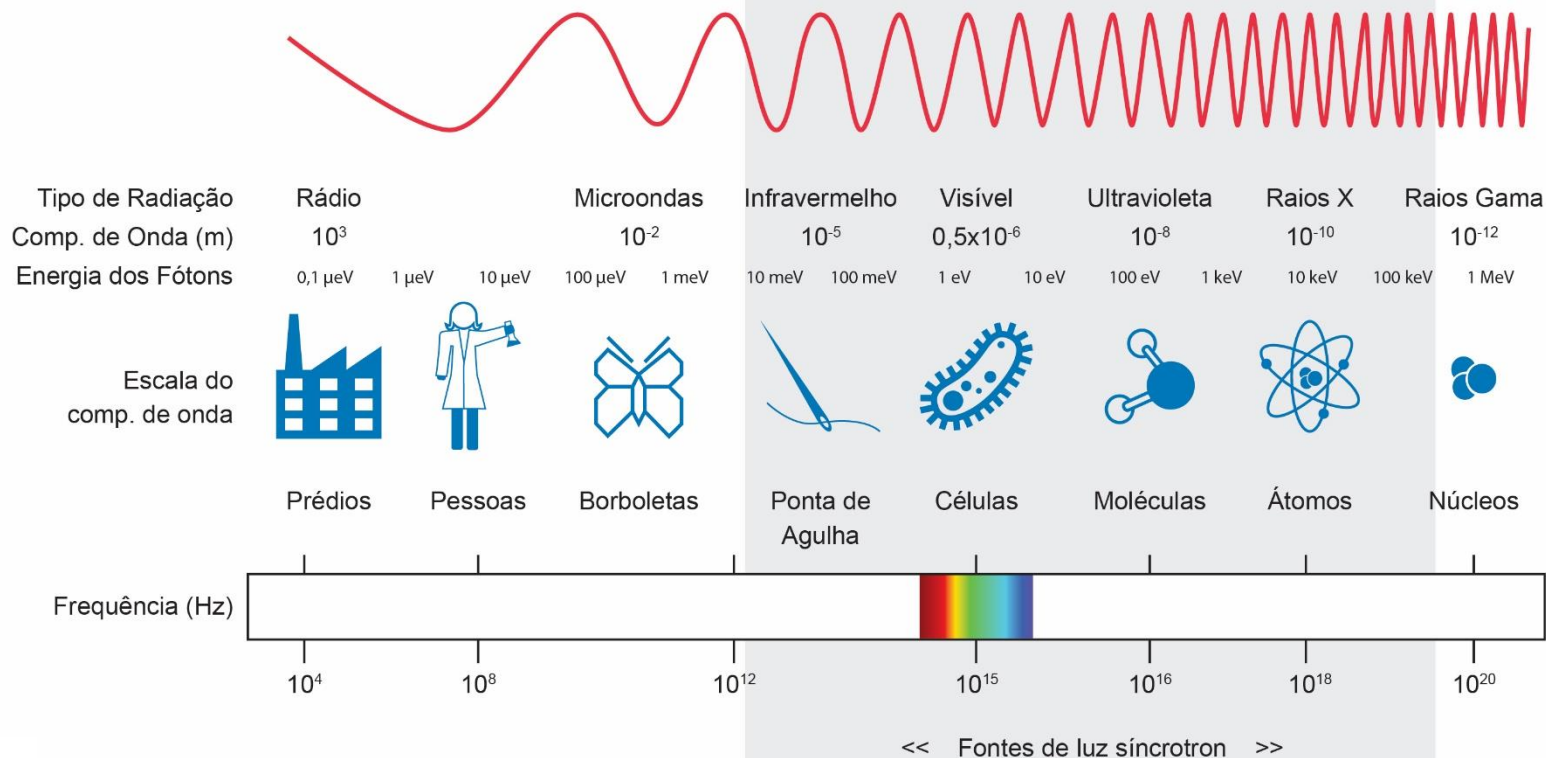
Isotropic emission

Relativistic Model



Cone emission

Wavelength?



And what is the impact?



**RADIO
WAVE**

MICROWAVE

**LONGWAVE
IR**

**SHORTWAVE
IR**

NEAR IR

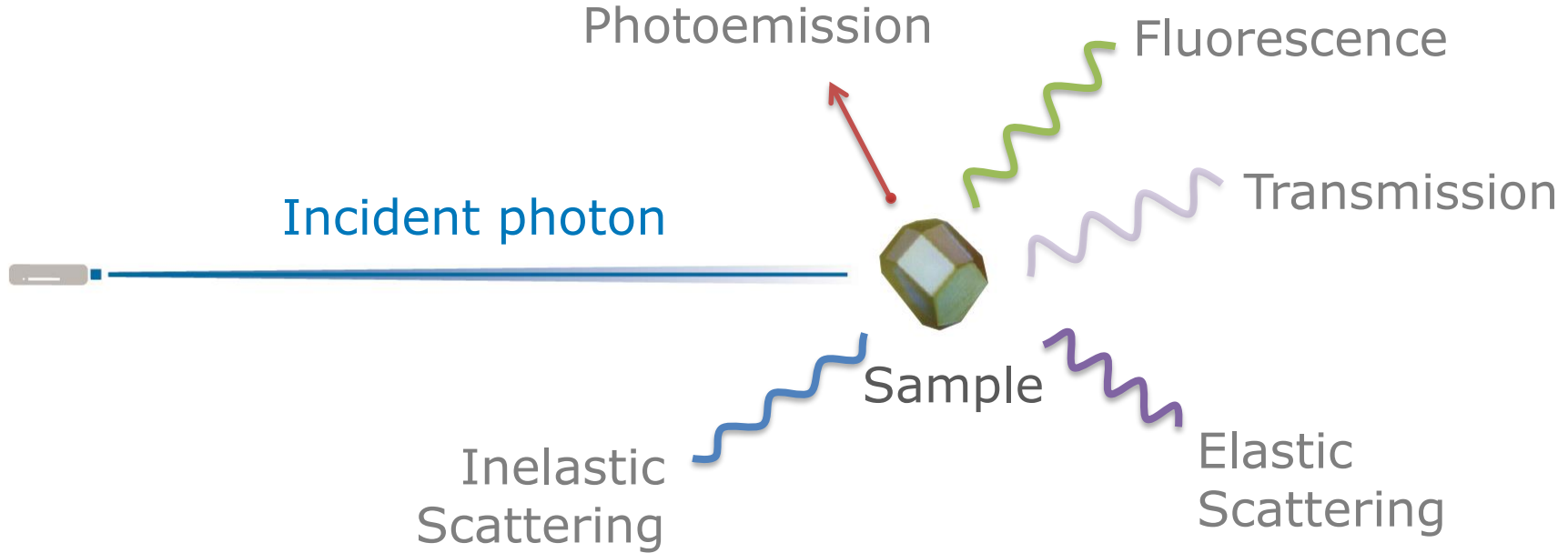
VISIBLE

UV

X-RAY

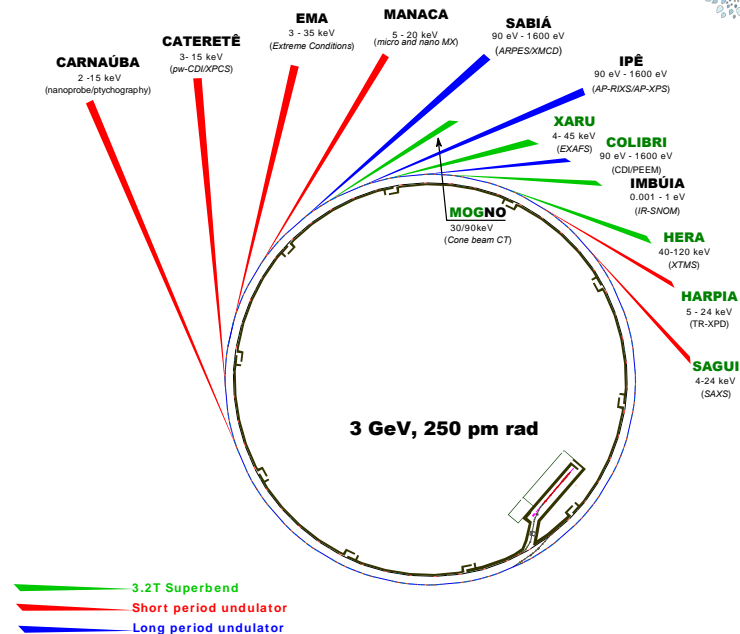
Higher energy, smaller wavelength

Electromagnetic Radiation



The Sirius Project

Large Microscope: most interesting/challenging materials, with nanometric resolution and several contrast mechanisms

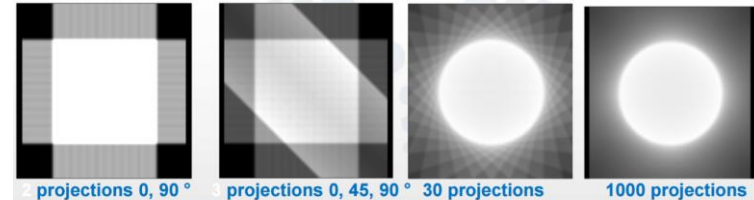
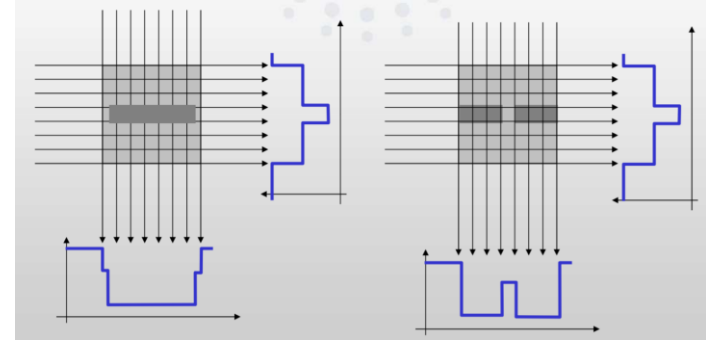
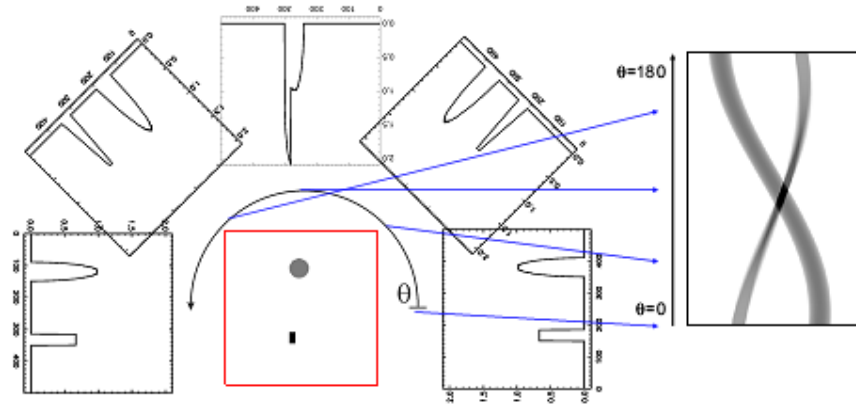
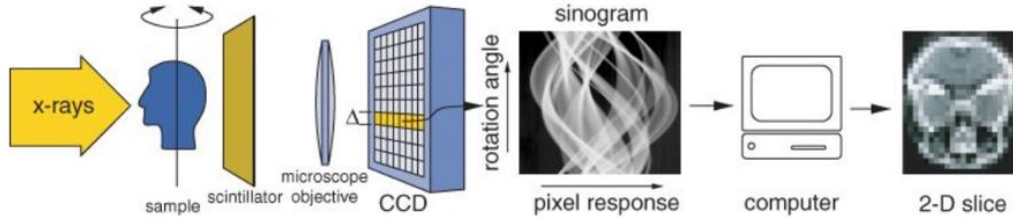
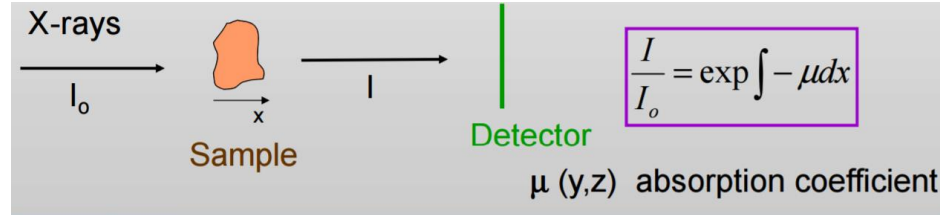


Experimental Programs

Tender nano-probe for spectro-ptychography; Large FOV (40 μm) coherent diffraction imaging; Bragg CDI/XRD/XAFS under extreme conditions; Serial micro and nano MX; Tender x-ray RIXS; Time resolved powder diffraction; High-throughput SAXS ARPES/XMCD; AP-RIXS/XPS; CDI/PEEM

Cone beam high energy tomography; EXAFS; High energy X-Ray diffraction; Nano-FTIR

X-ray computed tomography

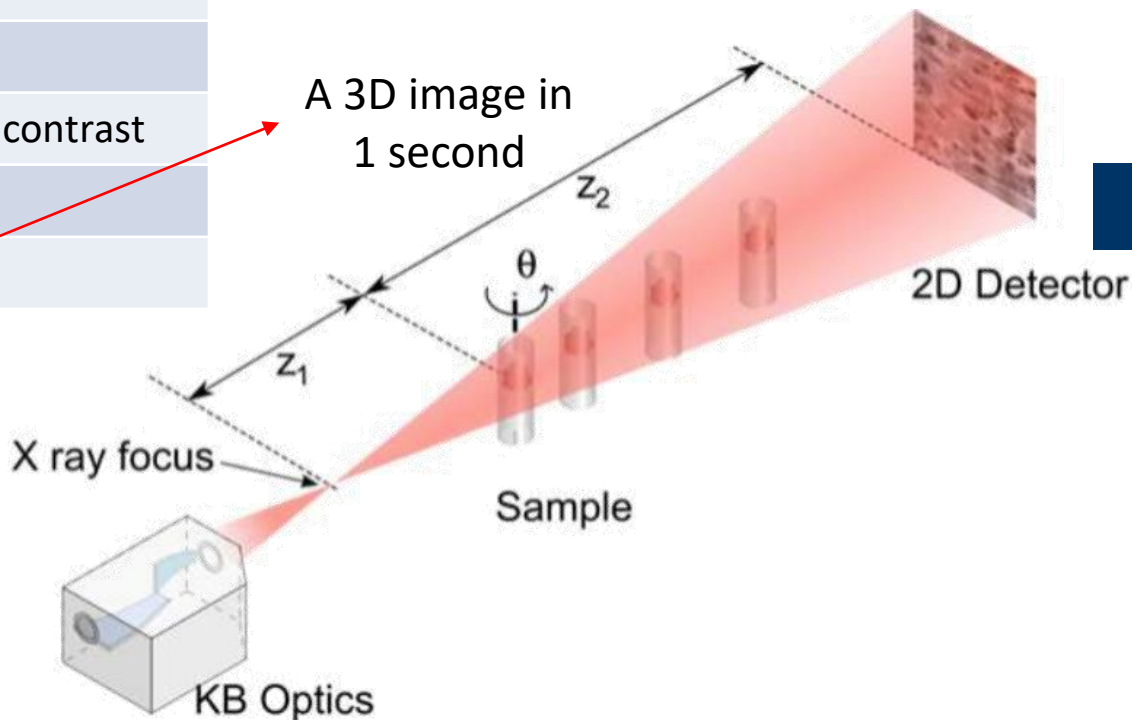


Mogno Beamline @Sirius

Cone beam x-ray imaging	
Energy Range	~20, 40 and 70 keV
Resolution	~ 100 nm to 55µm
Field of View	up to 85 mm (zoom-in)
Contrast	Electron density, phase contrast
Dose	Very efficient
Speed	Fast (~1 µCTs/s)

1.5" rock and soil samples

A 3D image in
1 second

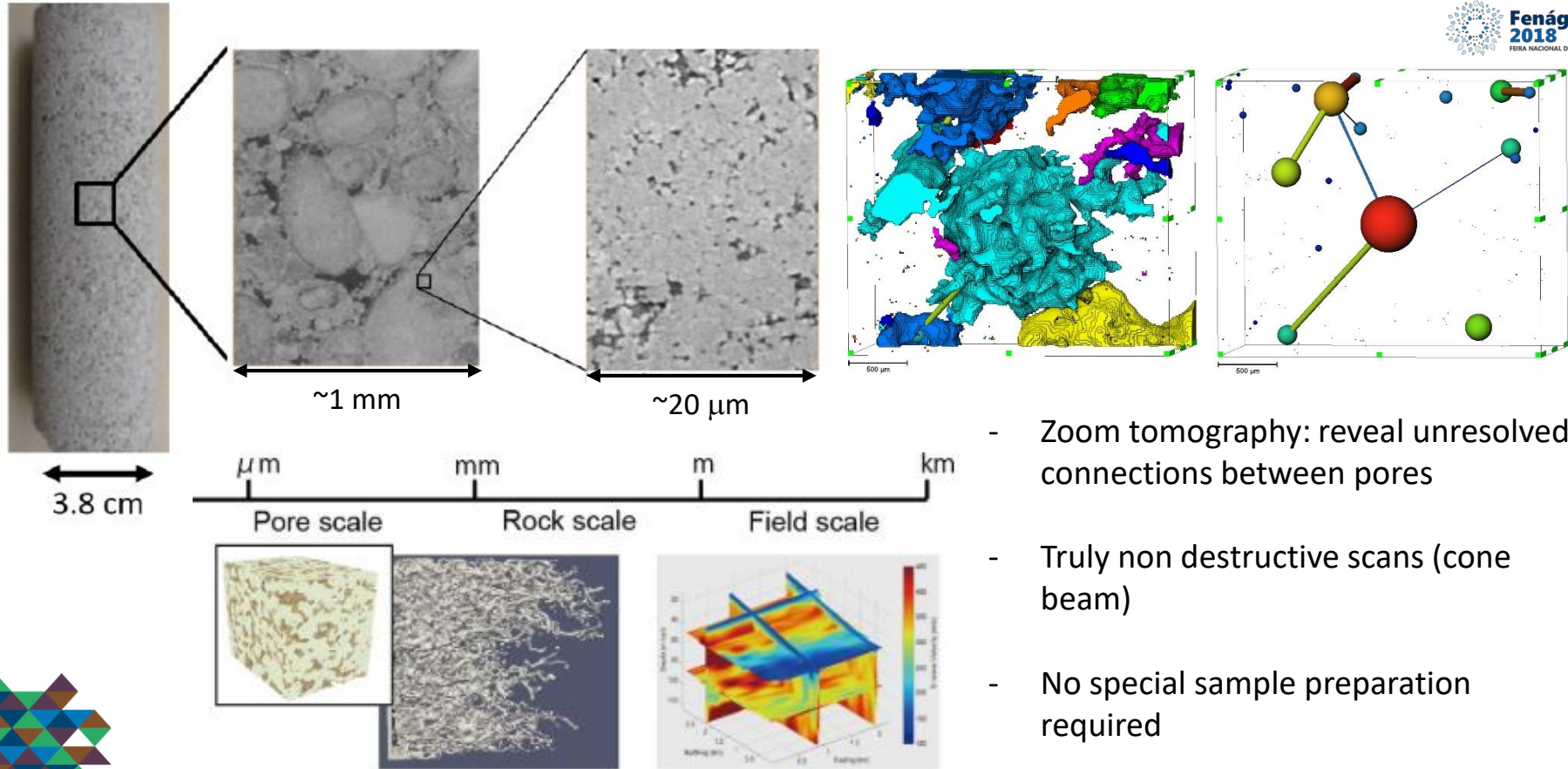


Equivalent to parallel beam with:

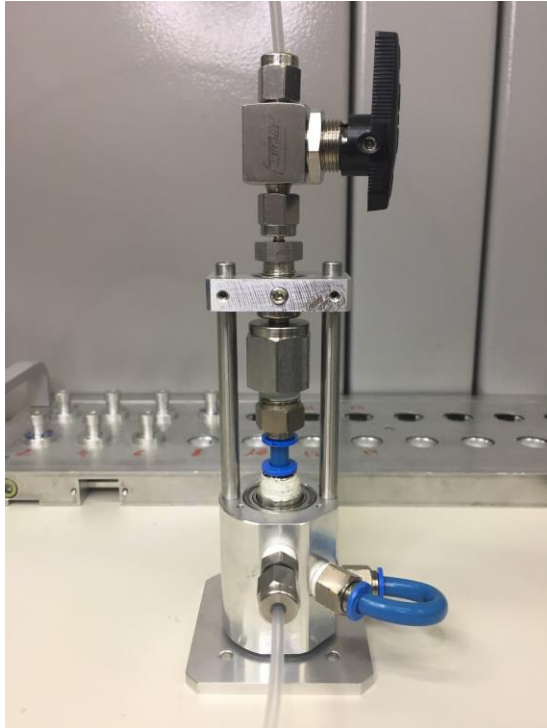
Magnification:
$$M = \frac{z_1 + z_2}{z_1}$$

Applications – zoom tomography

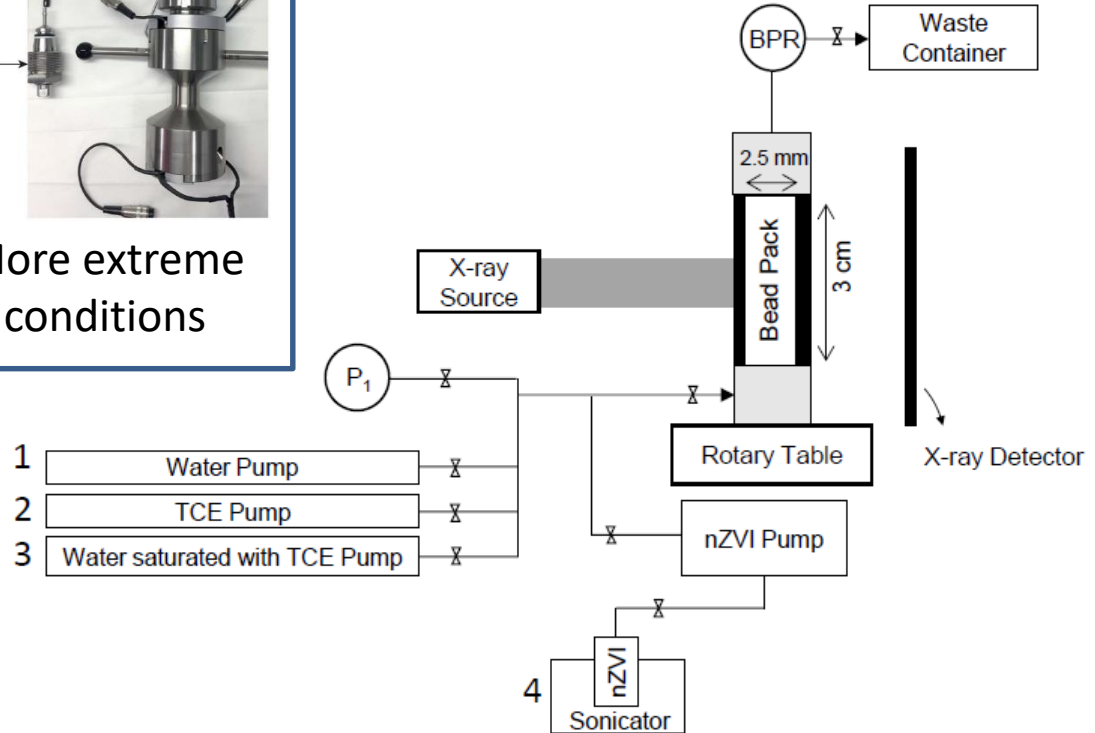
from hundreds of nm to dozens of micrometers



Application: time-resolved XCT

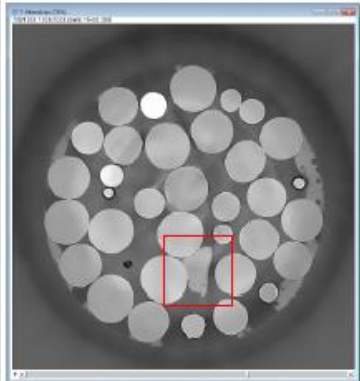
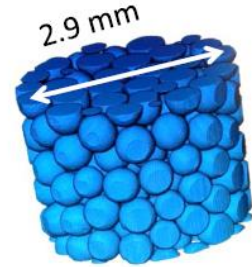
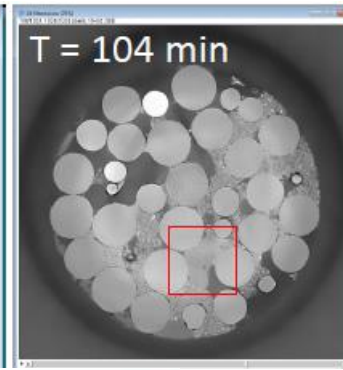
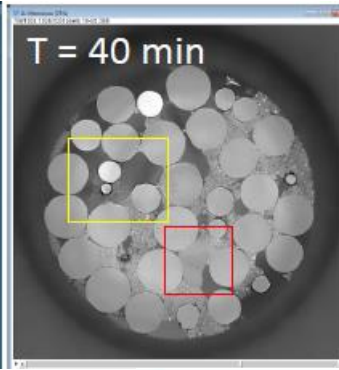
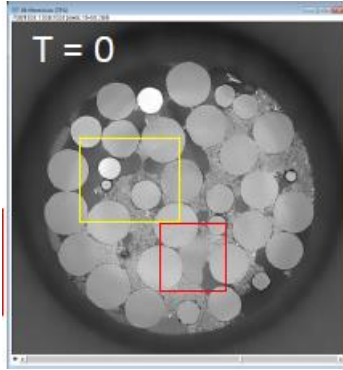
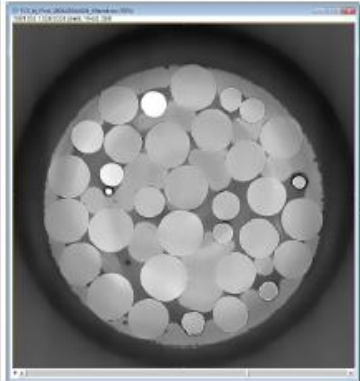


More extreme
conditions

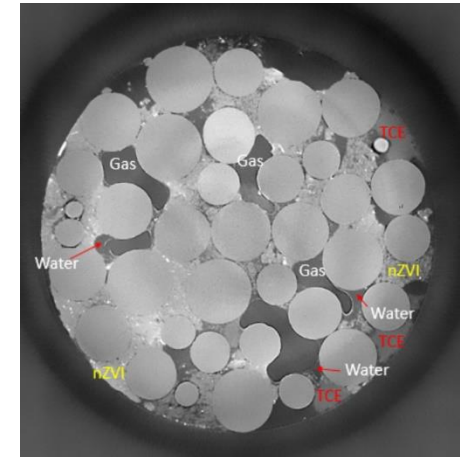
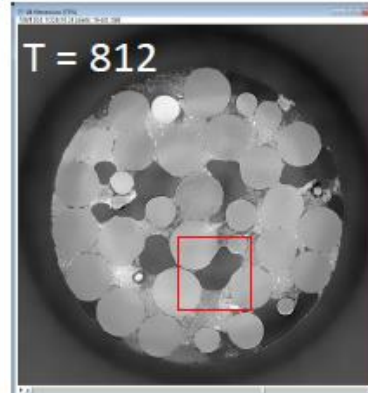
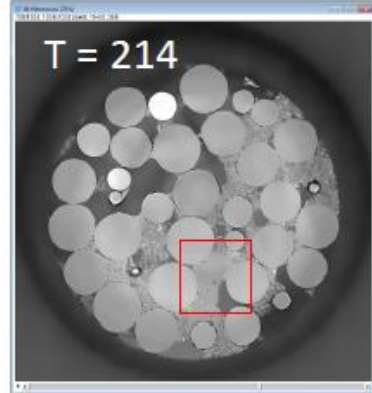


Application: In-situ degradation of TCE using nZVI nanoparticles

2- TCE injection

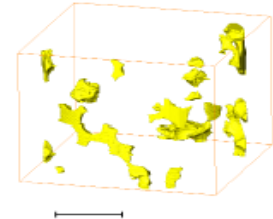
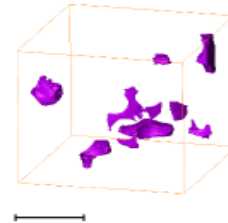
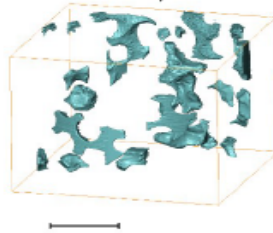
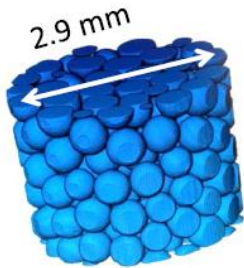
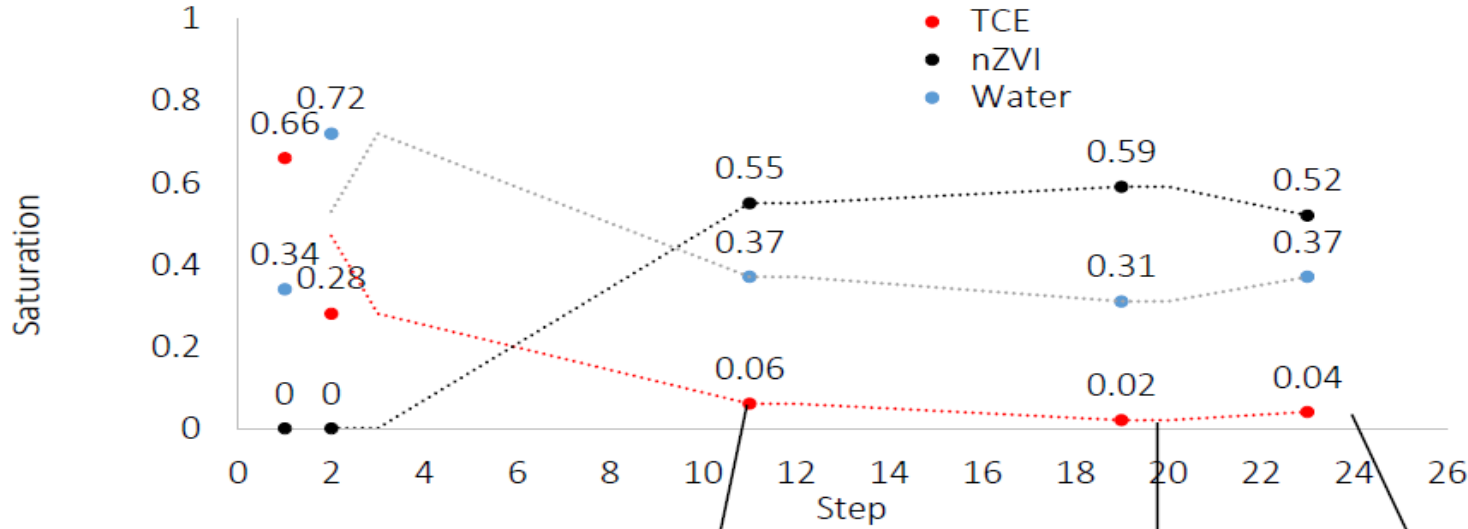


3- Water injection



Application: In-situ degradation

of TCE using nZVI nanoparticles





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Questions?

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Photo by Everton Bonturim - Sirius - 09/27/2017

