Fast X-ray micro-tomography with a multi-scale approach at the ALBA synchrotron

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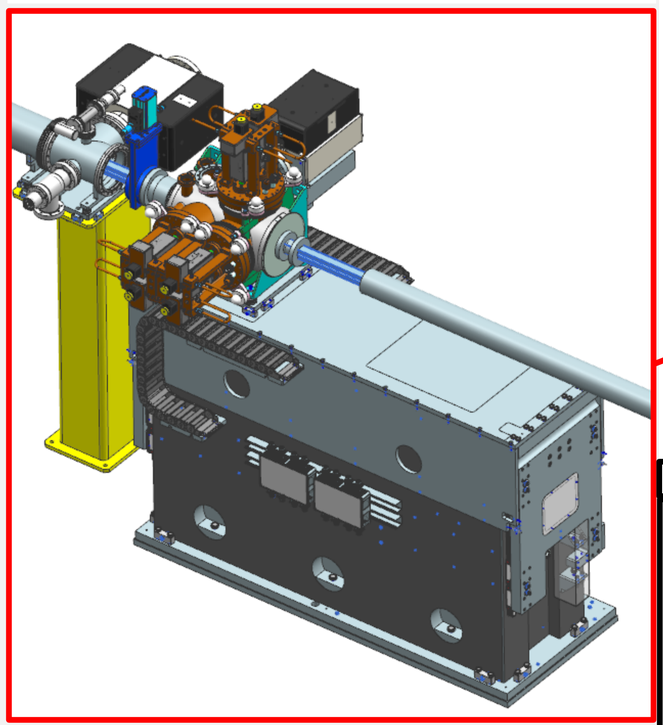
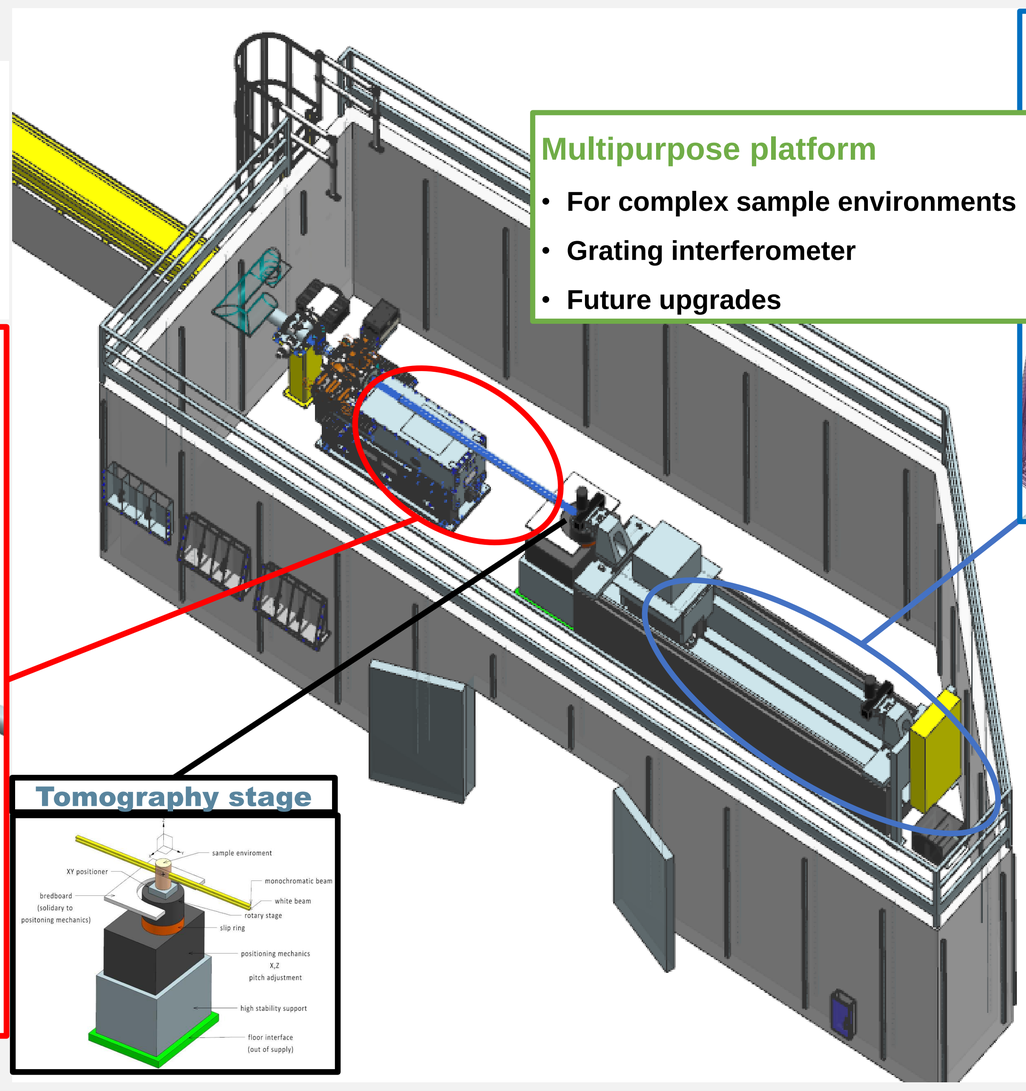
The FAXTOR beamline at the Spanish synchrotron ALBA will be dedicated to fast X-ray micro-tomography. The beamline will be fed by an in-vacuum short multipole wiggler with a maximum magnetic field of 2.5 T and a critical energy of 14.7 keV. It will operate in white and mono-beam configurations. The last one will be provided by a double multilayer monochromator with energy ranging between 8 and 50 keV.

End-station

Beam conditioning elements table.

- Sample slits: 4-blade slits
- CVD window
- Fast shutter: *in-house design*
- Movable low vacuum pipe

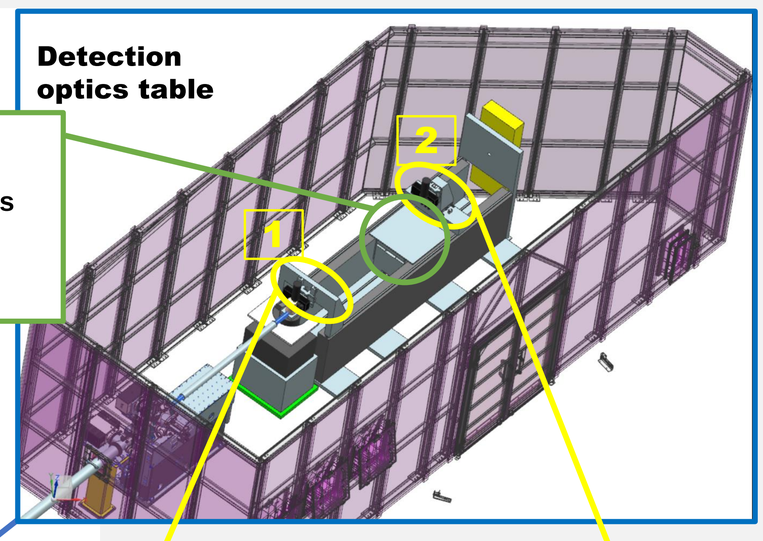




Multipurpose platform

- For complex sample environments
- Grating interferometer
- Future upgrades

Tomography stage



Two detection optics in series

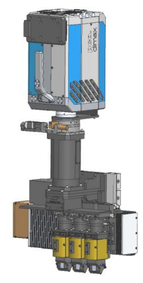
Simultaneous acquisition at two different spatial resolutions

Detection stage 1:
Pixel size: 0.7-6.5 µm
Field of view: 8x12 mm²

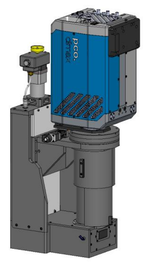
Detection stage 2:
Pixel size: 3-15 µm
Field of view: 35x12 mm²

Microscopes: OPTIQUE PETER

Triple magnifications



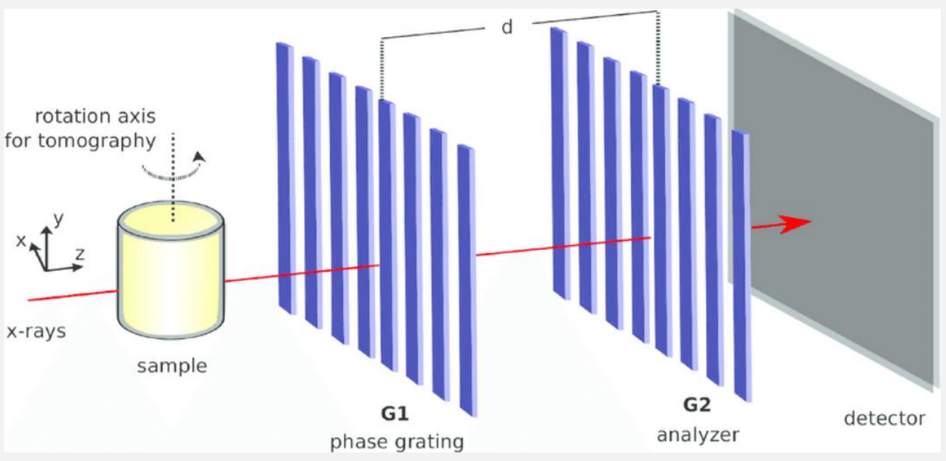
Low resolution



Rotation camera, stroke $\pm 90 mrad$

M	2x	5x HR	10x	1x	2.1x (0.476x tandem)
NA	0.055	0.21	0.28	0.225	0.13
Lens-type	Mitutoyo			Hasselblad	

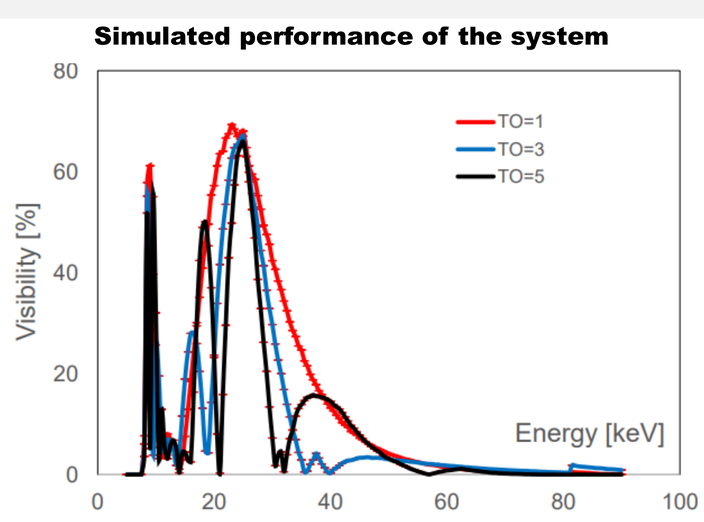
Grating interferometer at FAXTOR for a range of applications



Design parameters

Design Energy = 25 keV
Talbot Orders = 1, 3, 5
p1 = 2.29 µm
p2 = 1.15 µm
Duty cycle = 0.5
Size (active area) = 45×15 mm²

Simulated performance of the system



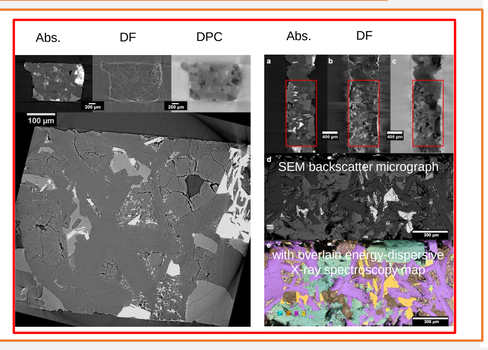
Visibility has been calculated at three different Talbot orders: first, third and fifth.
The maximum visibility is observed around the design energy, i.e. 25 keV

Users Community: material, medicine, food science

Material Science

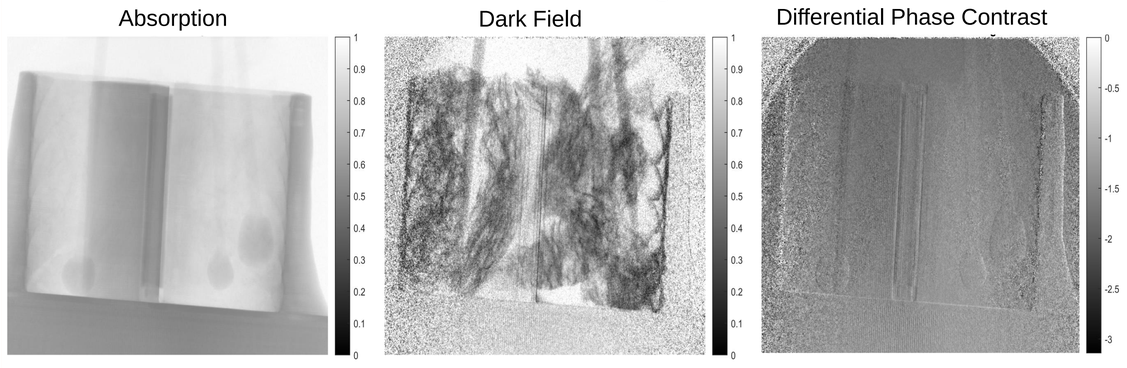
DPC imaging and absorption-based X-ray tomography to observe crystalline basalt with clay alteration

Moore, Patera et al, 2022. Front. Earth Sci., Sec. Earth and Planetary Materials



Pre-clinical investigations

Absorption | Dark Field | Differential Phase Contrast

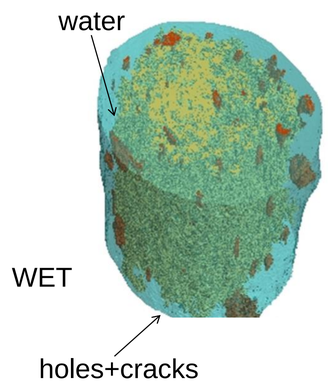


Dynamic anthropomorphic lung phantom

Dark field signal reveals the structure of alveoli (simulated in a phantom with a sponge) and the ribs.

Patera et al., 2022 J. Phys. D: Appl. Phys. 55 045103

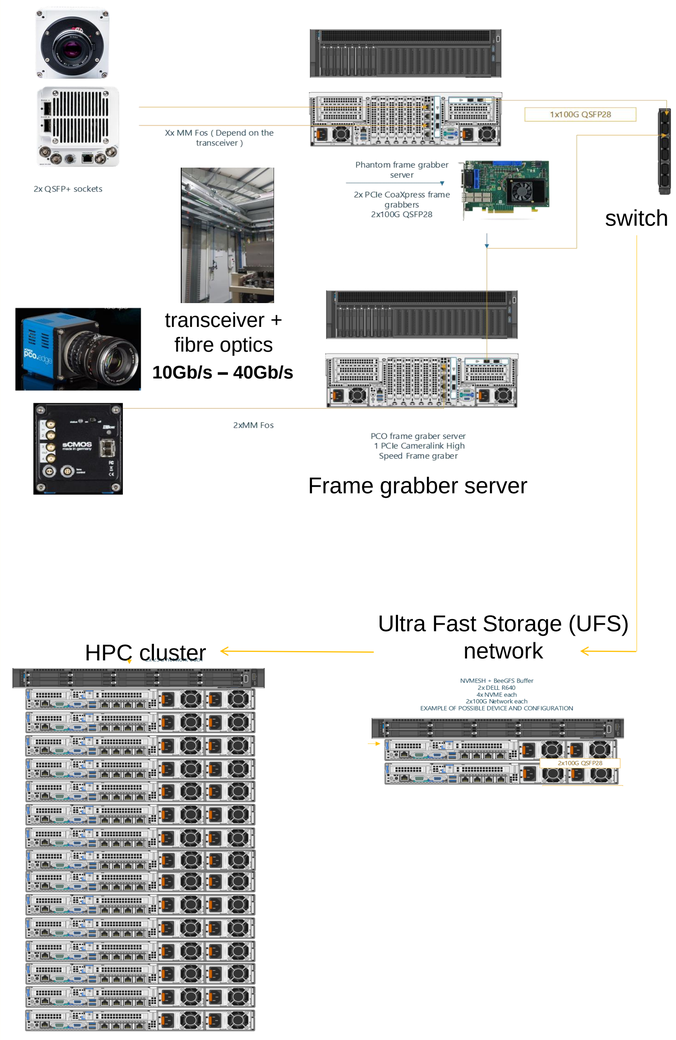
Food science



Water content in spaghetti for controlling the product quality. The dark-field (DF) contrast gives info on the size, shape, number and content of the pores in the spaghetti.

Data Flow

High speed /high resolution cameras



FAXTOR parameters

Energy range	**8 – 50 keV (mono); 20 – 70 keV (Filtered white)**
Temporal resolution	**100 ms - 1000 s (full CT)** **100 µs - 1 s (Radiography)**
Spatial resolution	**0.7 – 15 µm (image pixel size)**
Max beam size	**35x12 mm² (at sample level)**
Techniques	**Phase contrast, Absorption-based, multi-resolution**

The beamline will serve different communities, including material science, biomedical, palaeontology, earth science, cultural heritage etc.

Project timeline

- Starts of installations: summer 2022
- Starts of commissioning: mid of 2023
- Friendly users: end 2023
- Starts of user operation: Beginning of 2024

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