

ForMAX Endstation

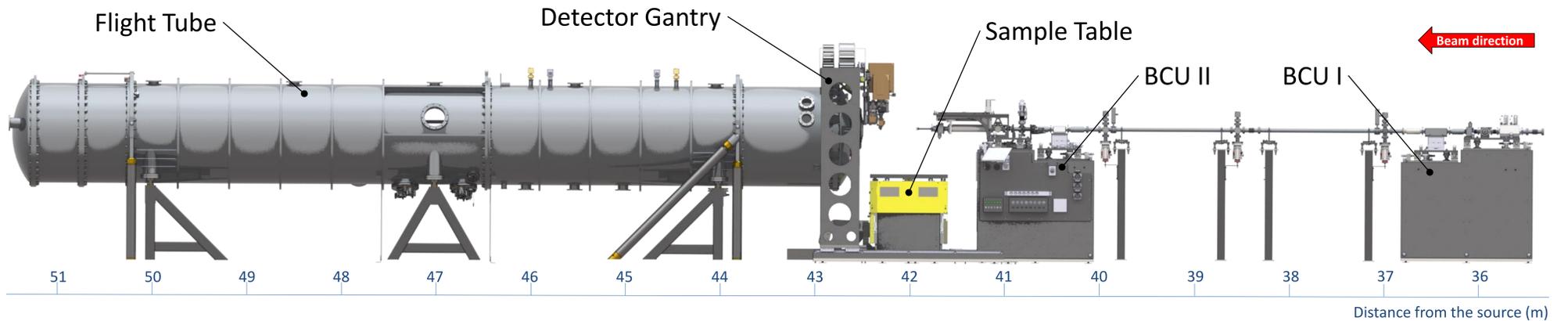
A novel design combining full-field tomography with small- and wide-angle x-ray scattering



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Abstract

ForMAX is a new beamline at the MAX IV Laboratory for multi-scale structural characterization of hierarchical materials from nm to mm length scales with high temporal resolution. This is achieved by combining full-field microtomography with small- and wide-angle x-ray scattering (SWAXS) in a novel manner. The principal components of the endstation consist of two units of beam conditioning elements, a sample table, an evacuated flight tube and a detector gantry. The beam conditioning units include a diamond vacuum window, an attenuator system, a fast shutter, a slit collimation system, two sets of compound refractive lenses, three x-ray beam intensity monitors, a beam viewer and a telescopic vacuum tube. The sample table has been optimized with respect to flexibility and load capacity, while retaining sub-micron resolution of motion and high stability performance. The nine metre long and one metre diameter evacuated flight tube contains a motorised detector trolley, enabling the sample-detector position for small-angle x-ray scattering (SAXS) to be easily adjusted under vacuum conditions. Finally, a two metre high and two metre wide granite gantry permits independent and easy movement of the tomography microscope and wide-angle x-ray (WAXS) detector in and out of the x-ray beam. To facilitate propagation-based phase-contrast imaging and mounting of bulky sample environments, the gantry is mounted on motorized floor rails. All these characteristics will allow to combine multiple complementary techniques sequentially in the same experiment with fast efficient switching between setups. The ForMAX endstation is presently in the design and construction phase, with commissioning expected to commence early 2022.



WAXS Detector

- Novel windmill concept with a central hole passing through.

Tomography Microscope

- 2x cameras.
- 3x objectives.

Diagnostic Module

- YAG screen.
- Transmissive diode.
- Scattering diode.

| Axis ¹ | Range | Resolution ² |
|-------------------|-------|-------------------------|
| Y | 75 mm | 0.508 μm |

Microfocus CLR

- Microfocusing for SWAXS.

| Axis ¹ | Range | Resolution ² |
|-------------------|--------|-------------------------|
| X | ±15 mm | 10 μm |
| Y | ±15 mm | 1.725 μm |
| Z | ±5 mm | 10 μm |

Flight Tube

- SAXS Detector 7.5 m range along the beam.
- Rails girder decoupled from vessel.

Detector Gantry

- Granite gantry.
- WAXS detector.
- Tomography microscope.

| Axis ¹ | Range | Resolution ² |
|-------------------|---------|-------------------------|
| Gantry Z | 1500 mm | 10 μm |
| WAXS X | 670 mm | 10 μm |
| WAXS Y | ±10 mm | 10 μm |
| Microscope X | 670 mm | 1 μm |
| Microscope Y | ±15 mm | 1 μm |

Sample Table

- Granite block.
- Flexure hinges.
- Max. load 200 kg.

| Axis ¹ | Range | Resolution ² |
|-------------------|----------|-------------------------|
| X | ±100 mm | 0.3125 μm |
| Y | ±105 mm | 0.3125 μm |
| Pitch | ±10 mrad | 0.42 μrad |

Telescopic Tube

- For minimizing air gap.
- Slits.
- Transmissive diode.

| Axis ¹ | Range | Resolution ² |
|-------------------|--------|-------------------------|
| Z | 400 mm | - |

Tomography CLR

- Beam expansion.

| Axis ¹ | Range | Resolution ² |
|-------------------|--------|-------------------------|
| X | ±15 mm | 10 μm |
| Y | ±5 mm | 1.725 μm |

Fast Shutter

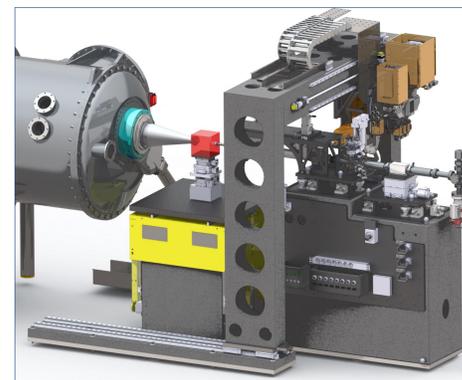
Slits

Attenuators

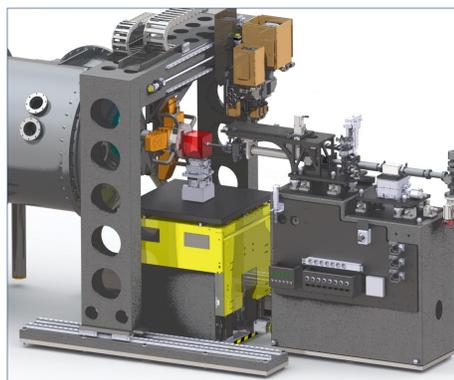
Techniques / Configurations:

¹ With Z axis following beam direction, Y axis vertical direction and X axis perpendicular to both.
² Resolution defined as minimum incremental motion per full step.

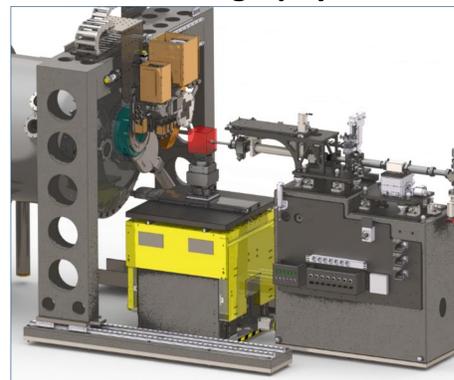
SAXS



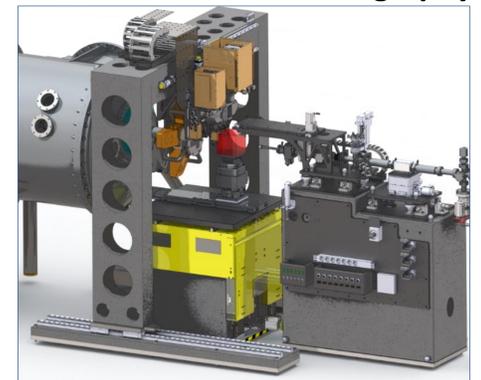
SWAXS



Full-field Tomography



SWAXS + Full-field Tomography



Contacts

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