# A NOVEL FLEXIBLE DESIGN OF THE FaXToR END STATION AT ALBA

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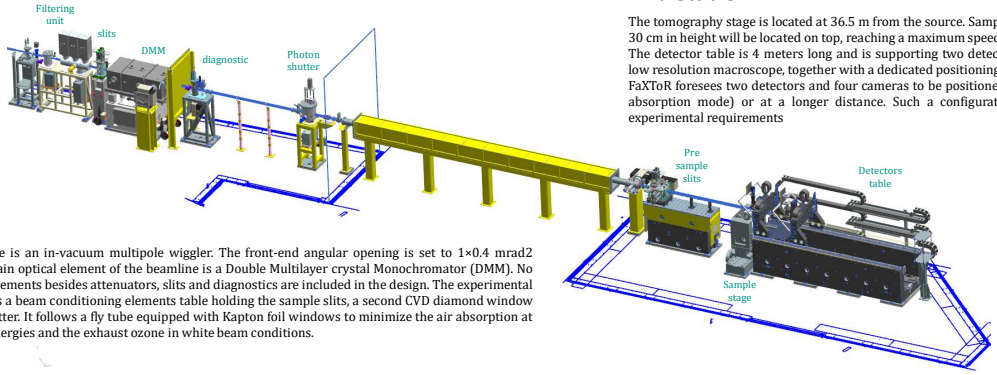
## ABSTRACT

FaXToR is one of the beamlines that is currently in construction and commissioning phase at ALBA, dedicated to fast hard X-ray imaging. It will offer absorption and phase contrast imaging to users. Possible applications of the beamline include 3D static and dynamic inspections in a wide range of applications. FaXToR aims to provide both white and monochromatic beam of maximum 36x14 mm (HxV) at sample position with a photon energy up to 70 keV. The optical layout of the beamline will tune the beam depending on the specific experimental conditions.

Among the required optical elements, there is a multilayer monochromator, the cooled slits, the filtering elements, the intensity monitor and the beam absorption elements. The end station will be equipped with a rotary sample stage and a detector system table to accommodate a dual detection thus simultaneously scanning the samples with high spatial and temporal resolutions. On top of it, a motorized auxiliary table dedicated to complex sample environment or future upgrades will translate along the total table length, independently from the two detector system bridges. The design of the end station will be presented.

### Faxtor Layout



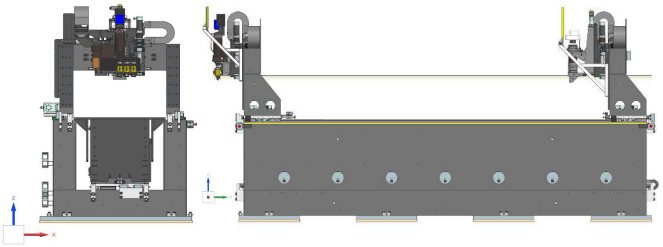

### End station

The tomography stage is located at 36.5 m from the source. Samples of different dimensions up to 5 cm in diameter and 30 cm in height will be located on top, reaching a maximum speed of 750 rpm. depending on the sample weight.
The detector table is 4 meters long and is supporting two detection systems: a triple magnification microscope and a low resolution macroscope, together with a dedicated positioning stage and a multipurpose auxiliary table.
FaXToR foresees two detectors and four cameras to be positioned at a short distance from the sample (for scanning in absorption mode) or at a longer distance. Such a configuration is easily interchangeable according to the user experimental requirements

### Optics

FaXToR source is an in-vacuum multipole wiggler. The front-end angular opening is set to 1×0.4 mrad2 (H×V). The main optical element of the beamline is a Double Multilayer crystal Monochromator (DMM). No other optics elements besides attenuators, slits and diagnostics are included in the design. The experimental hutch includes a beam conditioning elements table holding the sample slits, a second CVD diamond window and a fast shutter. It follows a fly tube equipped with Kapton foil windows to minimize the air absorption at lower x-ray energies and the exhaust ozone in white beam conditions.

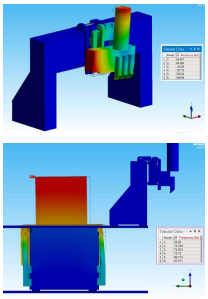
### Detector table architecture and specs



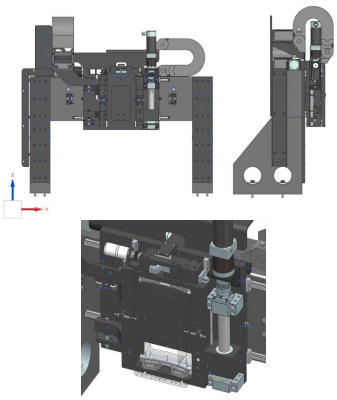
The detector table consists of two detector positioners and an auxiliary table. The detector positioners are bridge shaped and are designed to accommodate the two microscopes equipped with scintillators and CMOS cameras on top. Furthermore, an auxiliary table is integrated in the design to be positioned along the full detector longitudinal range and to be aligned in height accordingly to the beam position.
The auxiliary table is embedded into the detector table which can move independently from the detector positioners.

| parameter | value | comments |
|---|---|---|
| Detectors positioning in Y | 3225 mm | |
| Detector positioning in X | +/-50 mm | |
| Detector positioning in Z | 0/+100 mm | To position depending on bean height and to put detector fully apart from beam path |
| Resolution Y<br>Accuracy Y | 100 µm<br>50 µm | Along the beam<br>Guiding accuracy in full length |
| Resolution X, Z | 2 µm | Transversal to the beam, |
| Auxiliary table Y range | 3500 mm | |
| Auxiliary table Z range | 350 mm | Height of top surface from 1000 to 1350 mm |
| Auxiliary table max. supported weight | 95 kg | |

### FEA

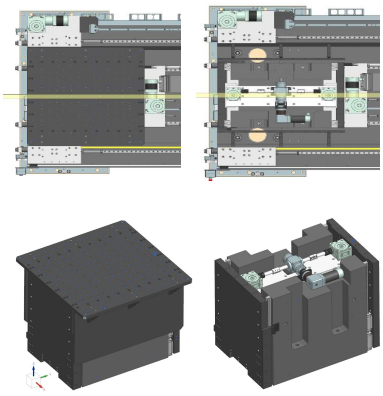


### Detector bridges



The detector bridge design is identical for both detectors. The guiding in Z and X has been solved with recirculating ball linear guides, and force transmission for their movements is by ball spindles. In order to maximize vibration stability a matched pairs of roller linear guides are chosen for the guiding of the bridge direction along the beam. In the case of the force transmission, a rack and pinion system were considered optimal, due to its long stroke and because the resolution requested for this axis is not as high as needed in the transversal plane.
The detector plane perpendicular to the beam can be aligned in yaw with the use of a goniometer designed to be guided by circular guides and driven by a linear movement actuated by spindle. The transmission of the force is given by a flexure.

### Auxiliary table



The auxiliary table, which is integrated into the main detector table is able to be displaced along the beam direction independently of the position of the two detectors. It has been designed to be stable enough to support in-situ sample devices, or other setups that require high stability. The top interface of the table is 800 mm2 with a standard hole pattern to provide flexibility on the preparation of different setups.
The height is variable from 1000 to 1350 mm and is driven by a double actuator driven by ball linear guides and spindles. Both actuators are driven with a single motor and a derivation. The system is designed to be irreversible when no power is holding the torque of the motor.
the auxiliary table is moved along beam direction by roller linear guides and a rack and pinion system for transmission.

## CONCLUSIONS

A flexible design for the tomography end station has been conceived, as the detector position can be independent of the position of the auxiliary table.

both detectors can be moved in three linear axis and can rotate on the vertical axis

The triple magnification microscope and the macroscope can be interchangeable as well as the four cameras.

The components of the detector table are being procured, and will be assembled and commissioned on the first half of 2024.

All the motorized axis will be tested in terms of guiding accuracy and repeatability.

FaXToR will provide light to the users on the second half of 2024.