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NCD-SWEET Beamline Upgrade and Realignment

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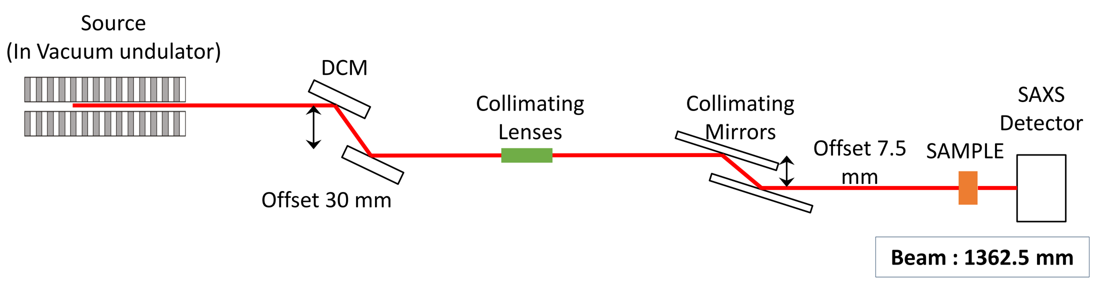
Abstract

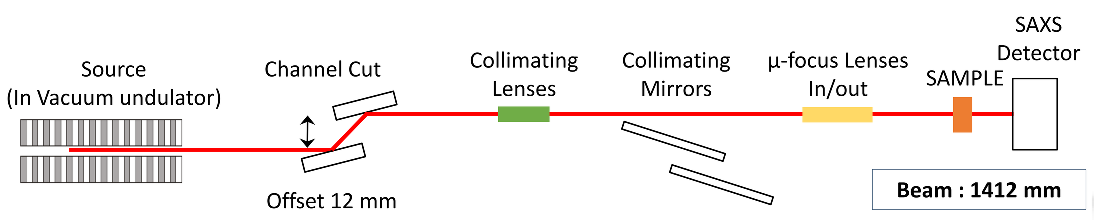
The SAXS/WAXS Experimental End sTation Beamline (NCD-SWEET) at ALBA Synchrotron has undergone a comprehensive upgrade and a full realignment in order to perform demanding Small Angle X-ray Scattering (SAXS) and Wide Angle X-ray Scattering (WAXS) experiment requirements. The former Double Crystal Monochromator (DCM) has been replaced by a new Channel-Cut Monochromator (CCM) which improves the beam stability and reduces the vibration amplitudes under 1% of the beam size. In the recently installed CCM the diffracted beam is 12 mm upward unlike the DCM, in which the exit beam was 30 mm downward. This entails to realign the beamline components to a new beam height. The SAXS/WAXS end station has been also upgraded by introducing improved mechanical elements like a sample table and a SAXS detector table with sub-micron resolution movements. The beam conditioning optics has been also enhanced adding new in vacuum components like an on axis sample viewing system or a set of refractive beryllium lenses for micro focusing the beam. The new optical layout and the new equipment installation required a complete characterization, consisting in metrology and fiducialization processes, as well as survey and alignment at the final installation place according to the reference network maintaining the beamline consistency and the coherence with the accelerator machine.

New beamline setup

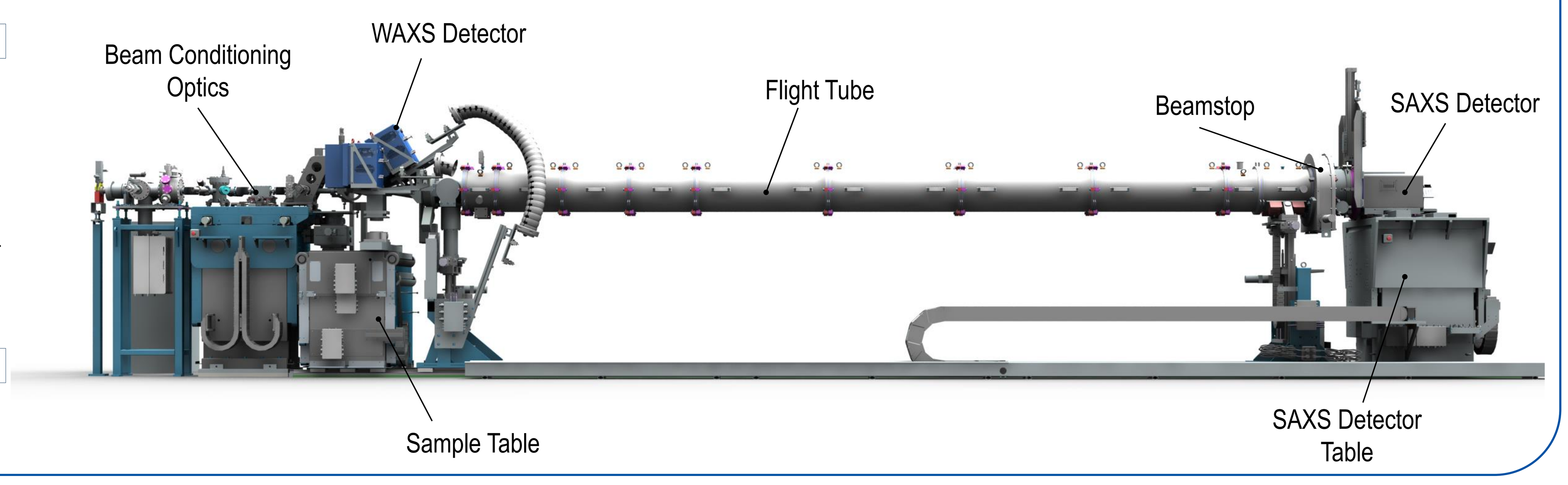
Previous



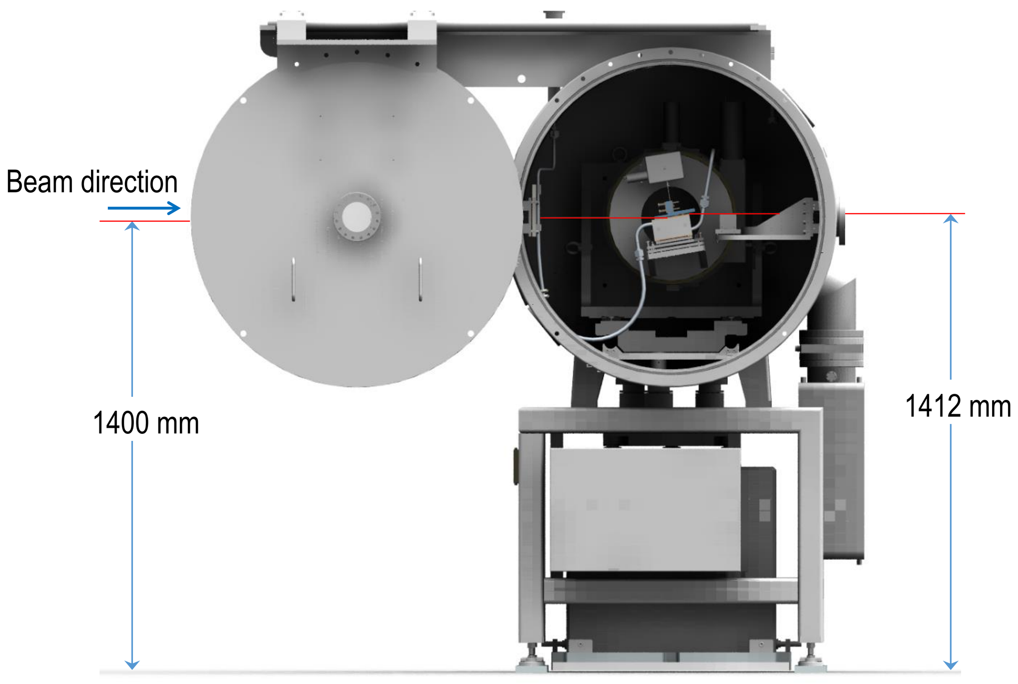
Later



- In the previous setup, poor beam stability due to undesired vibrations in the DCM.
- The former DCM exit beam was 30 mm downward.
- Beam path downstream of new Channel-Cut monochromator is now upwards by 12 mm.
- Optimize, repurpose and align beamline equipment to the new beam height.



Channel Cut Monochromator



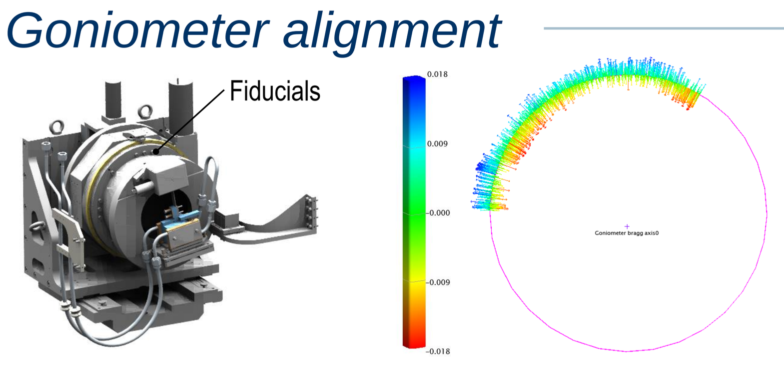
Support

- Rubber legs

- New plates

- Replace rubber legs (≈10mm) by new spacers.
- Realignment vacuum chamber by means of the structure.

Goniometer alignment



- Characterize Bragg axis scanning the circular goniometer path.
- Adjust Bragg Goniometer height and planimetric position.

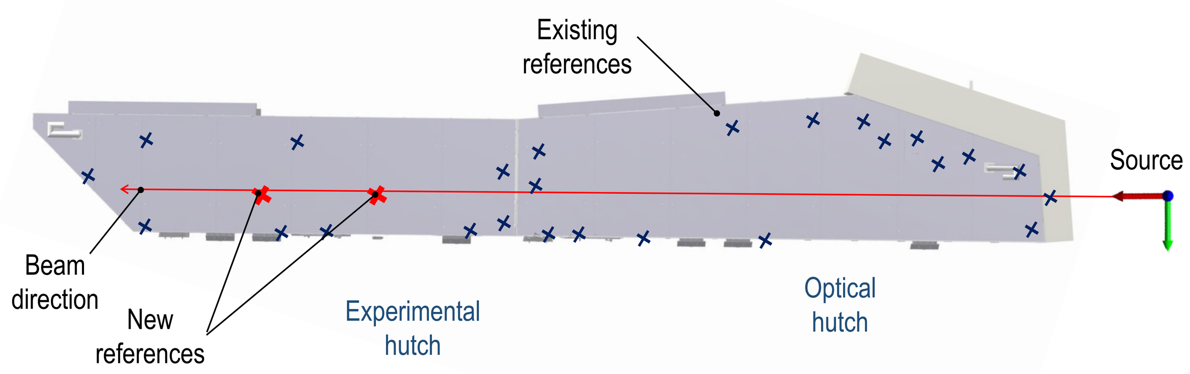
Channel cut alignment

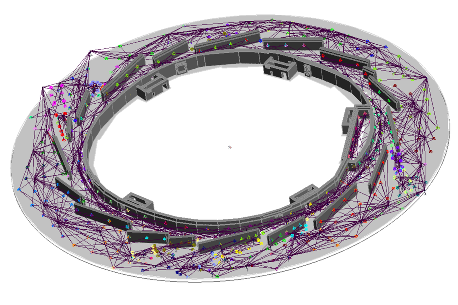
- Place the crystal base in horizontal position with motors.
- Adjust kinematical mount height, pitch/roll.
- Mount the crystal.
- Verify roll with optical level.
- Verify axis height with the crystal edge.
- Adjust the tungsten block after the crystal.

Local network

- Beamline local network formed by 25 known references + 2 new references
- Local network connected with machine tunnel network to maintain the beam path coherence.
- Network composed by wall and ground points.
- Coordinate system along beam, according the source exit beam.

- Alignment network references



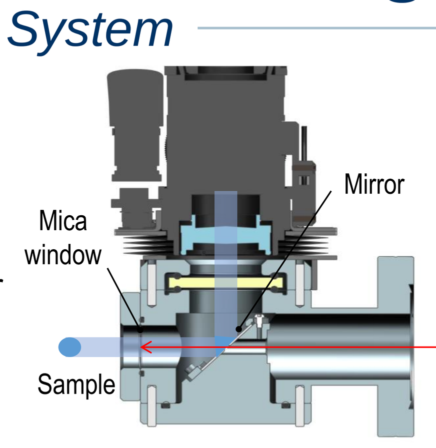


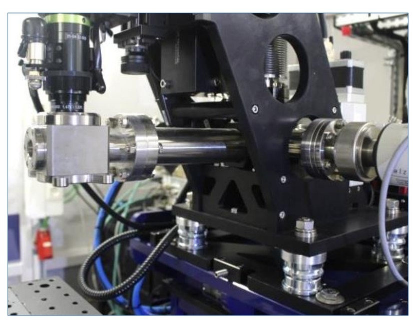
- Total network

Beam Conditioning Elements

On Axis Viewing System

- Mirror at 45 º with an Ø 1 mm aperture.
- CCD camera to register the sample image.
- Aperture final positioning error < 0.12 mm.



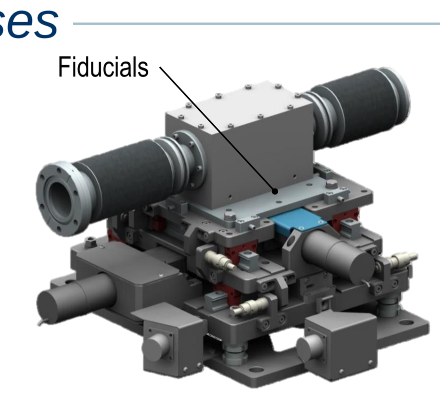


- OAV positioning system

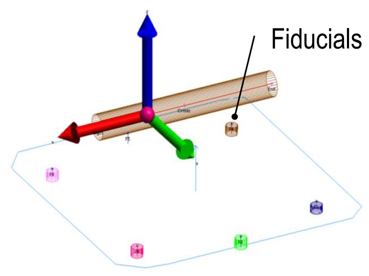
- 45°Mirror

Microfocusing lenses

- 35 Beryllium lenses to micro focus the beam.
- Lenses aperture is 0.6 mm.
- Angular tolerance <3 mrad.
- Fiducialize Beryllium lenses.
- Final angular error < 0.4 mrad.



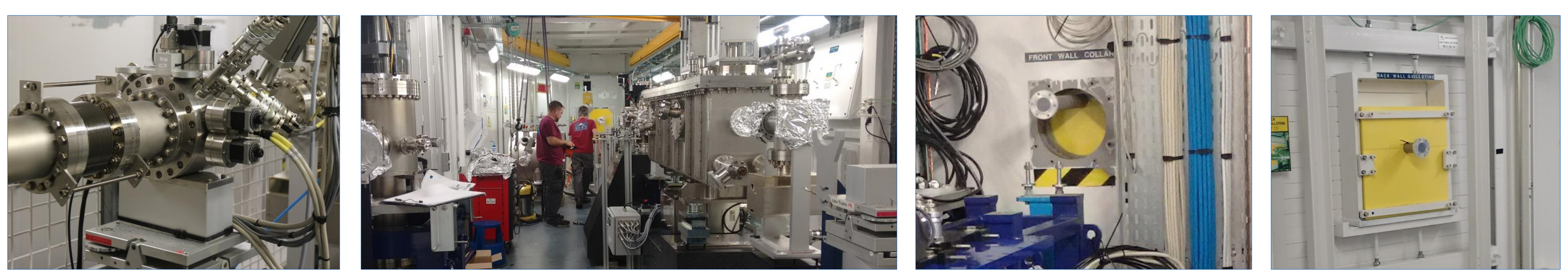
- Beryllium lenses



- Lenses fiducialization

Backbone

- Exchange the spacer in Slits and Photon Shutter to gain extra 49.5 mm.
- Adjust legs on attenuators supports .
- Exchange transfer pipe and adapt the back wall guillotine between Optical and Experimental hutch.



Results

- Beam on sample
- Installation, realignment and commissioning satisfactorily performed in two months.
- Alignment errors enclosed in tolerances.

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