Current developments of the new μ-focus MX beamline at the ALBA synchrotron

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MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD
Fondo Europeo de Desarrollo Regional
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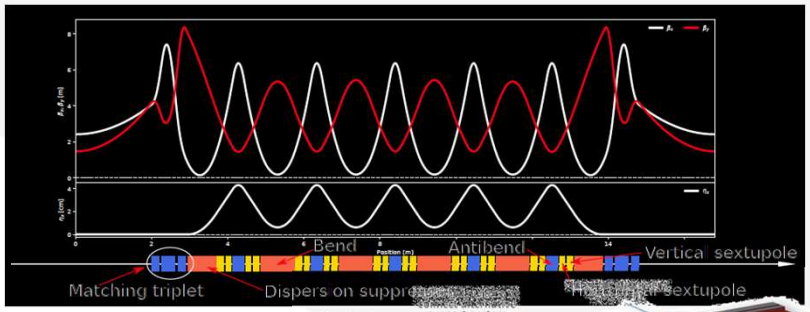
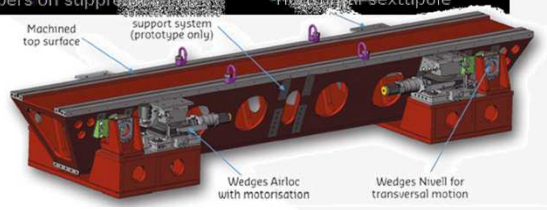
ALBA synchrotron

- User operation since 2012
- 270 m circumference, 3 GeV
- 8 operating beamlines, 5 in construction (1 for European Space Agency)
- 1 MX beamline, **XALOC** (115 PDB struct w/out SBDD program)
- 4 nm·rad emittance

Green light to design ALBA-2

- To design a 4th generation source
- Please do not ask for time lines
- *Research centers on Materials Science and Biosciences*
- *2 MX beamlines*
  - *Upgraded **XALOC**, high E, "standard"*
  - ***μMX XAIRA**, low E, "not so standard"*





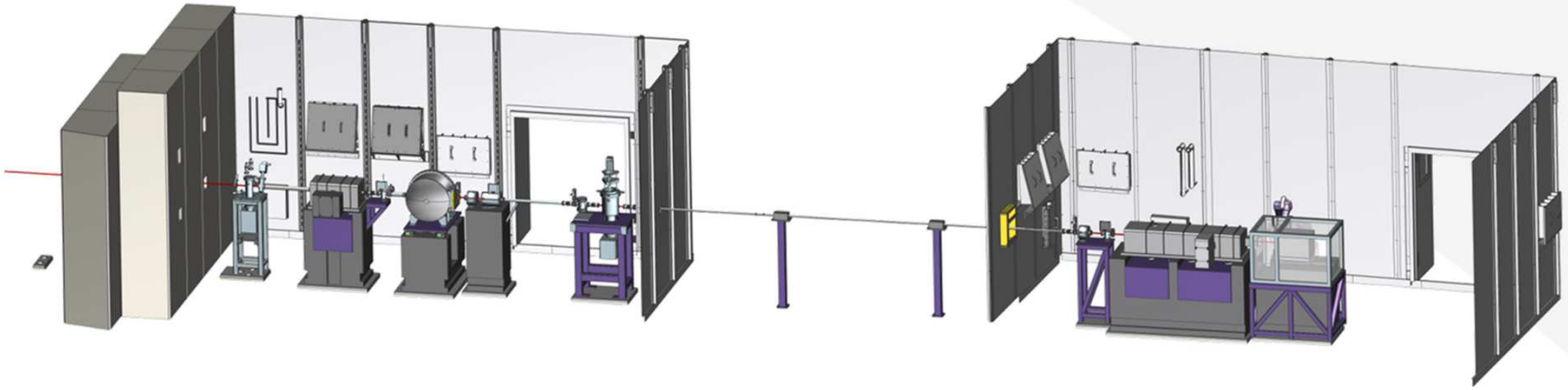
BL06-XAIRA µMX BEAMLINE

Scientific cases

Microcrystal diffraction
(Fixed-target) serial MX
Native phasing at 4 keV (3.1 Å)
Chemical single-crystal microcrystallography

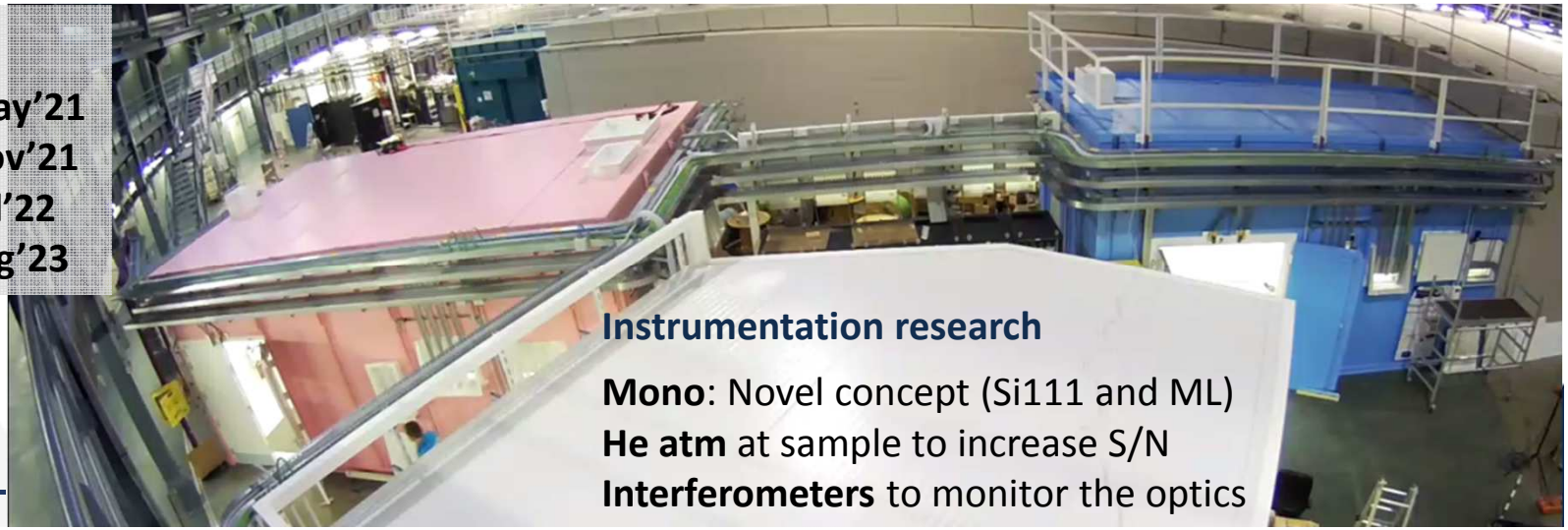
Beamline characteristics

Beam size of 1 ×1 µm² at 1 Å (full beam 3×1 µm
Beam defocusing up to **10×10 µm²**
High flux
Energy range of **4**–14 keV



Schedule

Install optics: May'21
First beam OH:Nov'21
First beam EH: Jul'22
First users: Beg'23



Instrumentation research

Mono: Novel concept (Si111 and ML)
He atm at sample to increase S/N
Interferometers to monitor the optics

Optics: Dual monochromator
Changing optical surface like photon energy

Anomalous data collection → low energies (< 6 keV)

High resolution data → high energies (>12 keV)

Serial Crystallography → high fluxes (> 10^{13} ph/s)

Channel-cut Si(111) mono (CCM)

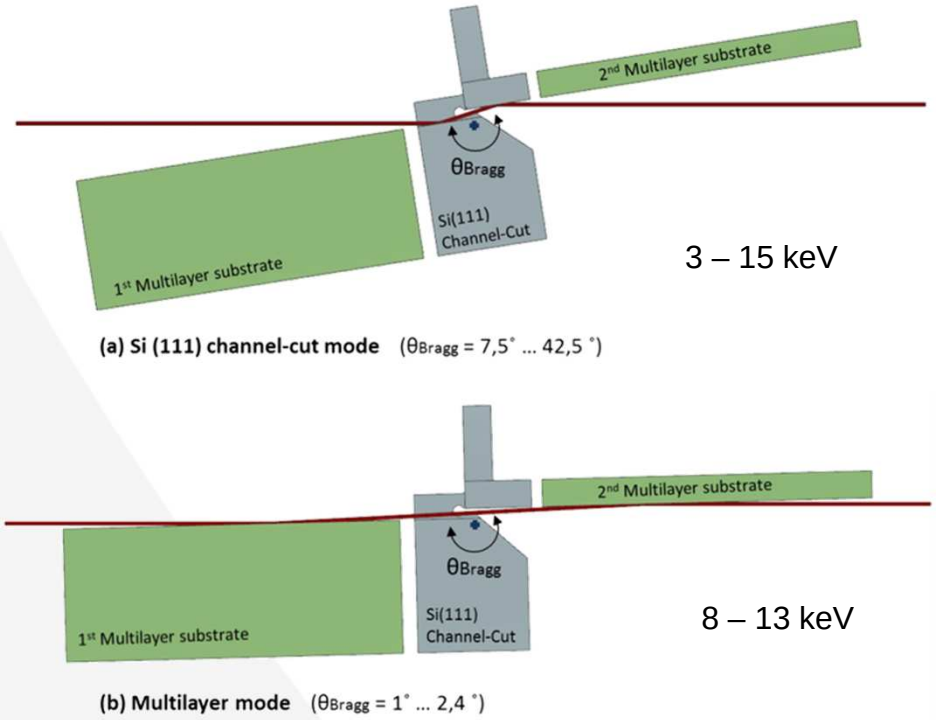
Double Multilayer monochromator (DMM)

2-in-1 CCM+DMM

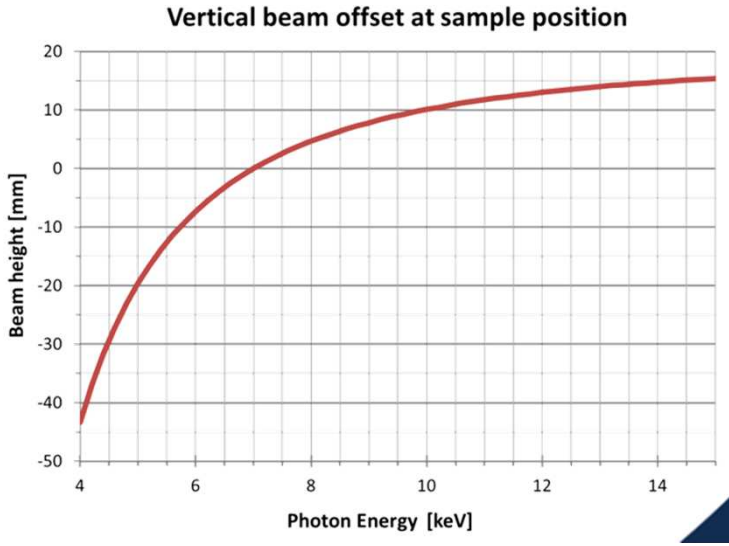
NOVEL CONCEPT

2 operation modes - 1 movement

Install June 2021



- Rotation center below the surface
- Beam height changes by 1.18mm upon E at the exit of the mono, but just **60 µm at sample pos**

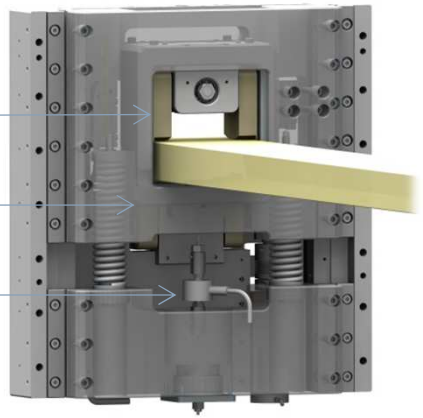


Optics: mirror benders with correctors

Nanobender

Compression springs bend the mirror ensuring the required resolution, repeatability and stability

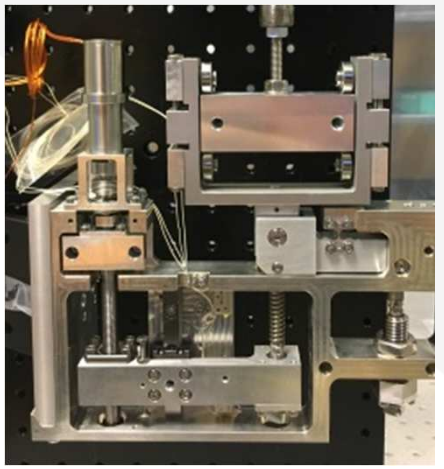
New algorithms for surface optimization including thermal load

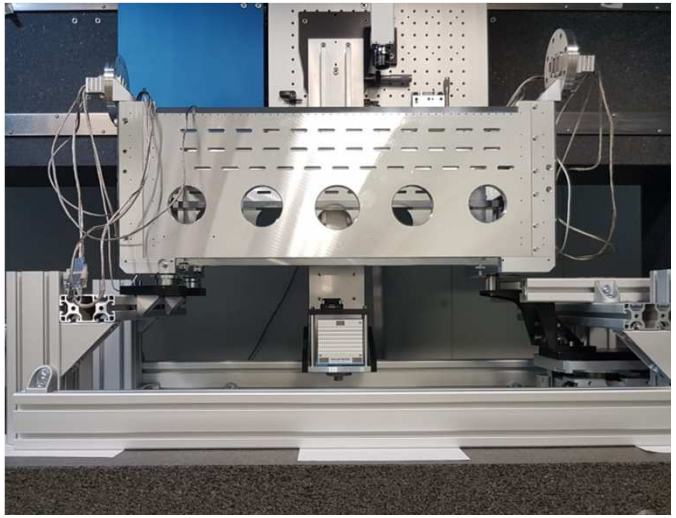


Shape correctors

To correct gravity sag AND slope errors

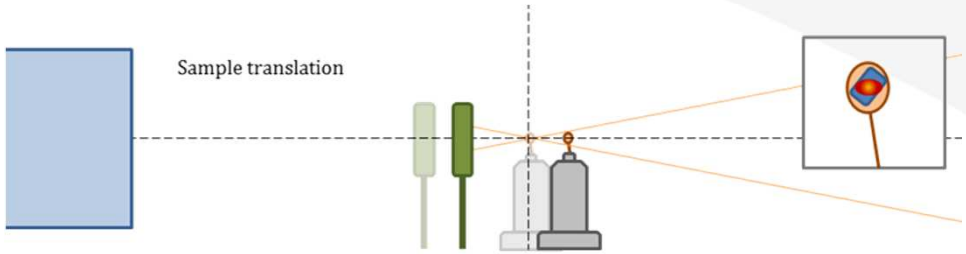
Dynamically or manually adjustable





Nanobender at ALBA NOM

End station: some

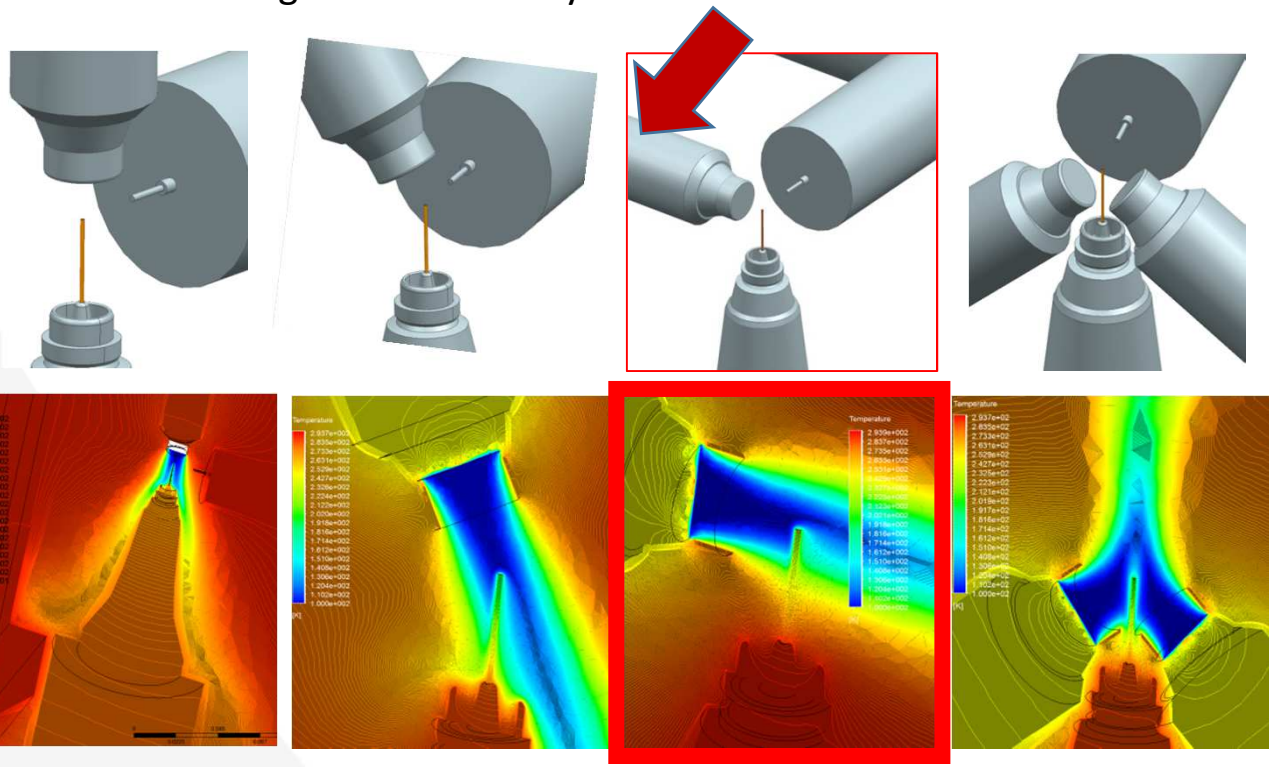


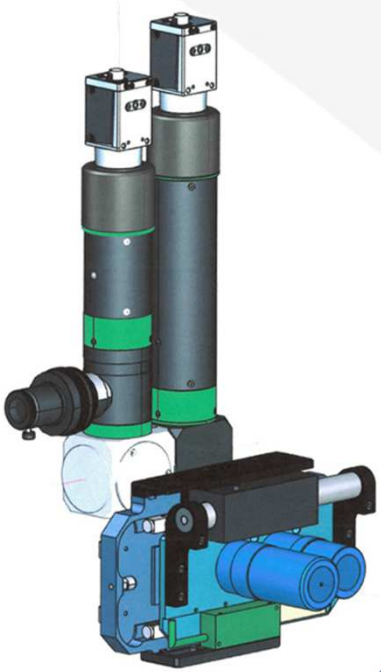
beam @ 5 mm translation: 14×4 μm^2

Simple operation

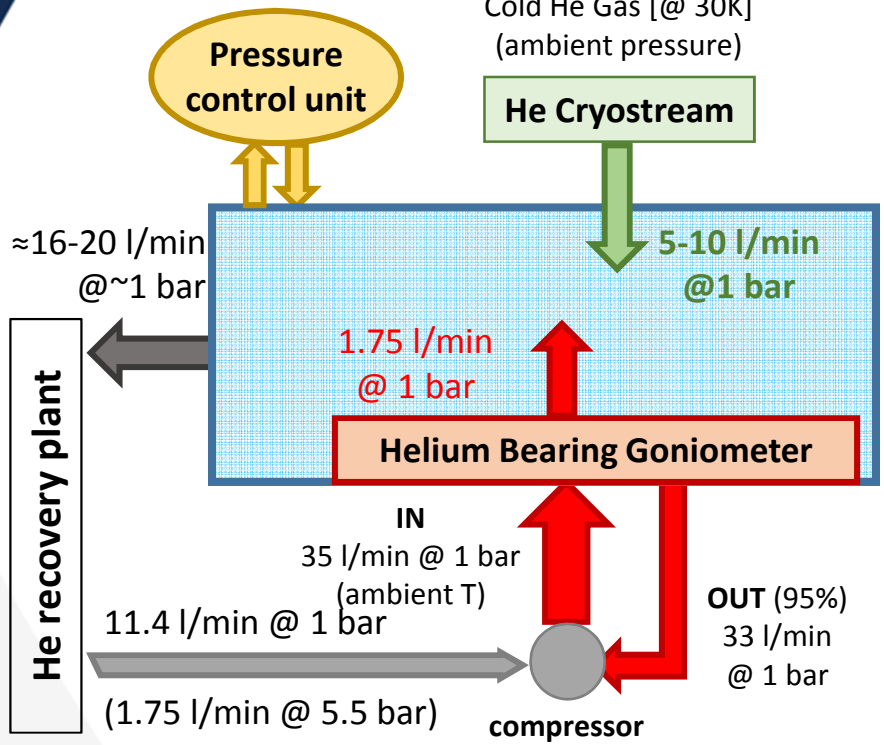
Requires solidary movement of OAV, cryostream, beamstop, …

CFD on He/N2 cryostream flow to check sample conditions when defocusing the beam as cryostream is not moveable





He chamber (compatible with air operation)

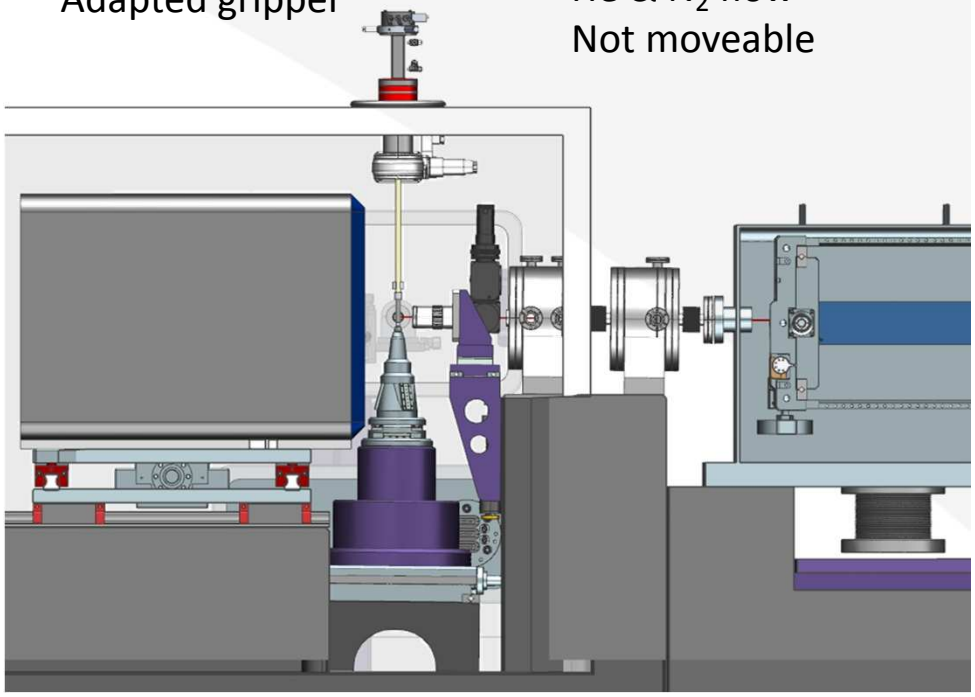


Robot operation

Adapted gripper

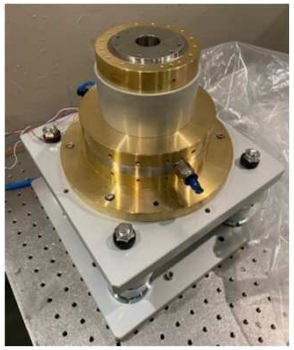
Cryostream

He & N_2 flow
Not moveable



He/air bearing

He & air @5.5bar
95% recirculationCompatible
Custom design



Vacuum window

Diamond 10 µm
Only one in BL

BL instrumentation and control

Detector: To be awarded

Frame rate : >500 Hz (FIRST High frame rate detector at ALBA)

Robot: To be tendered, compatible gripper with He chamber required.

On axis view: Double objective, double optics and camera

OS platform: Linux Debian9 + conda for clients

Beamline control: Sardana/Taurus4 + Tango 9.

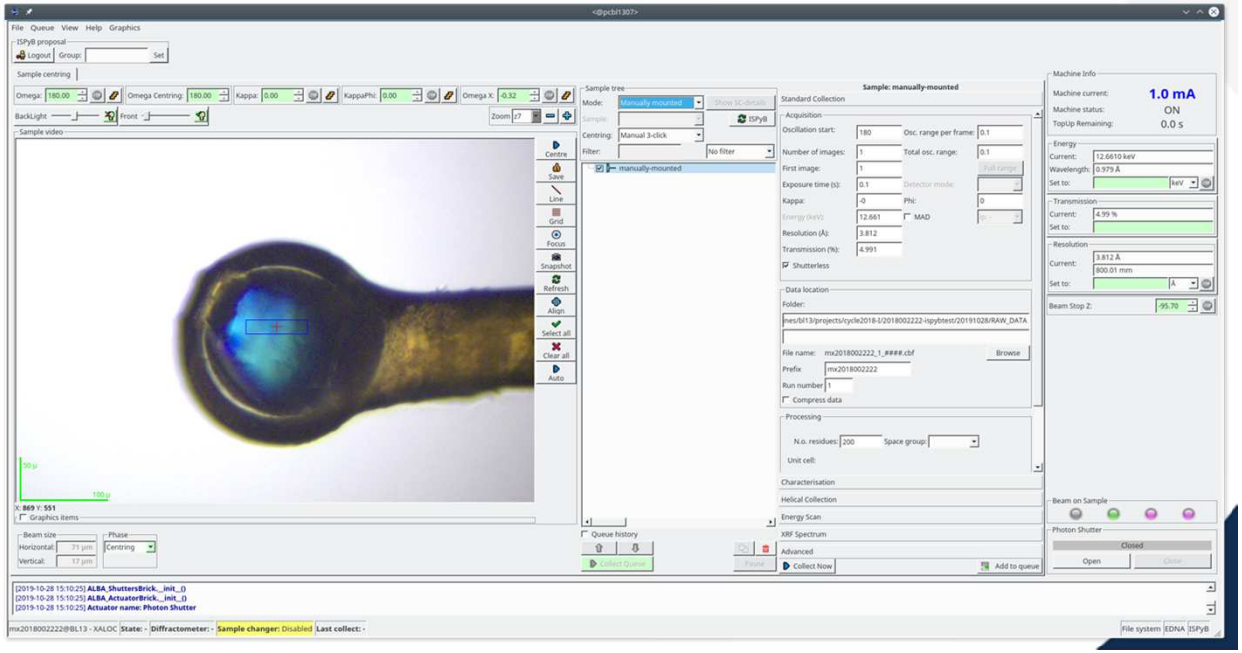
Autoindex: AuctoPROC via EDNA plugin.

Non-trivial data collections: Integrated into Sardana Scan Framework (det must be also controlled)

UI: Currently in XALOC bl: MXCuBE2/Qt4, next to come with XAIRA is MXCuBE3/(Qt5+)

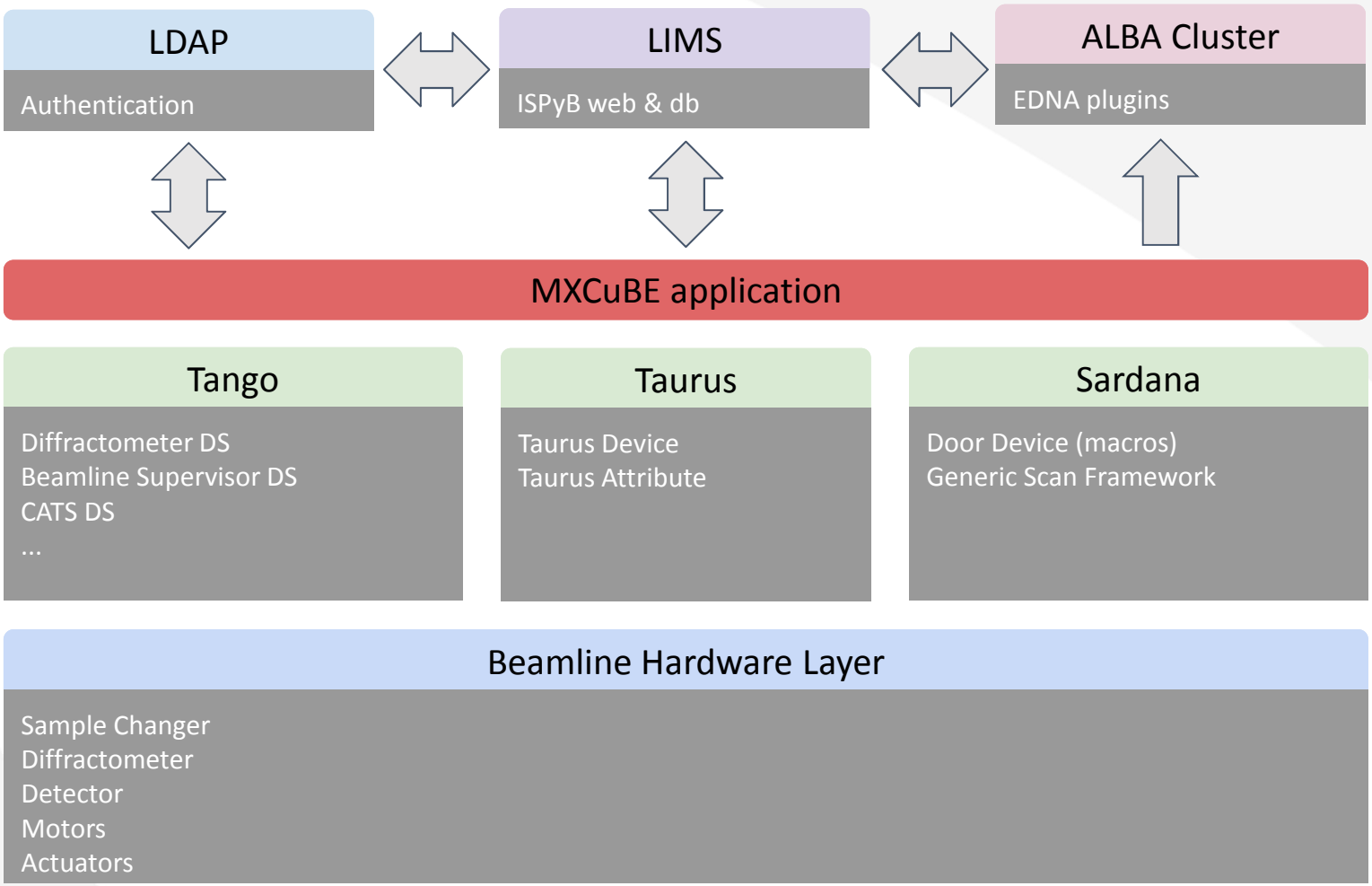
LIMS: ISPyB, following developments

Remote connection: NX



MXCuBE2 as implemented at ALBA

- MXCuBE2 Qt4

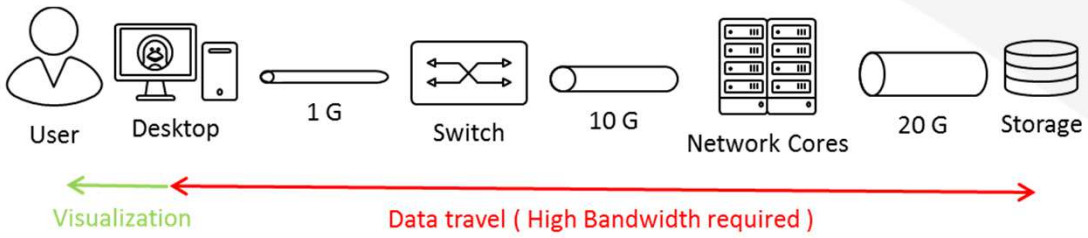


ALBA cluster

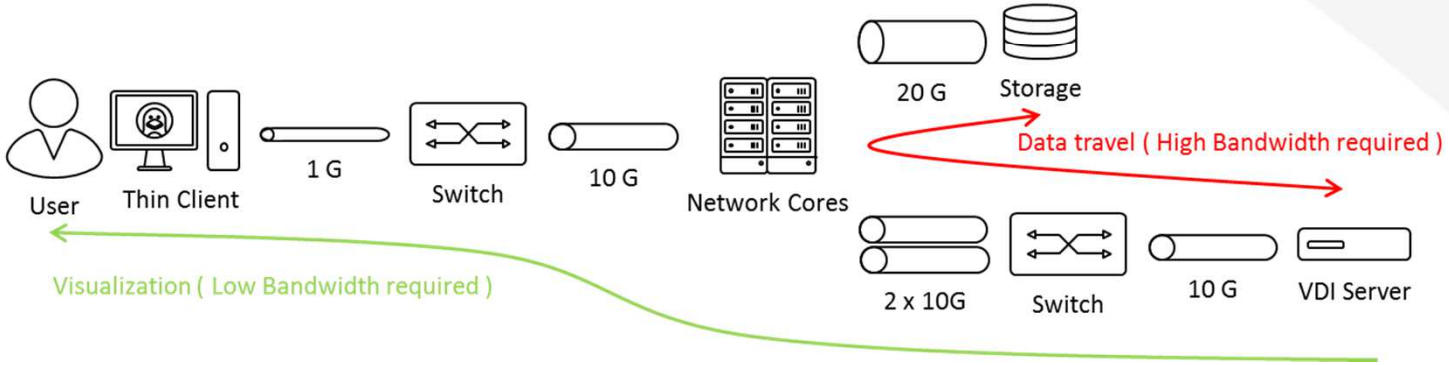
Exiting Beamlines: Data is stored (< 100MB/s) into Central Storage and travels from the beamlines through the standard network (10GbE).

New approach: Data is stored (XAIRA: 1,3 GB/s, Tomo: 11.5 GB/s) into the Ultra fast Storage and travels from/to the beamlines through the low latency Storage Network (100GbE).

Current Beamlines



µMX
HXR tomography

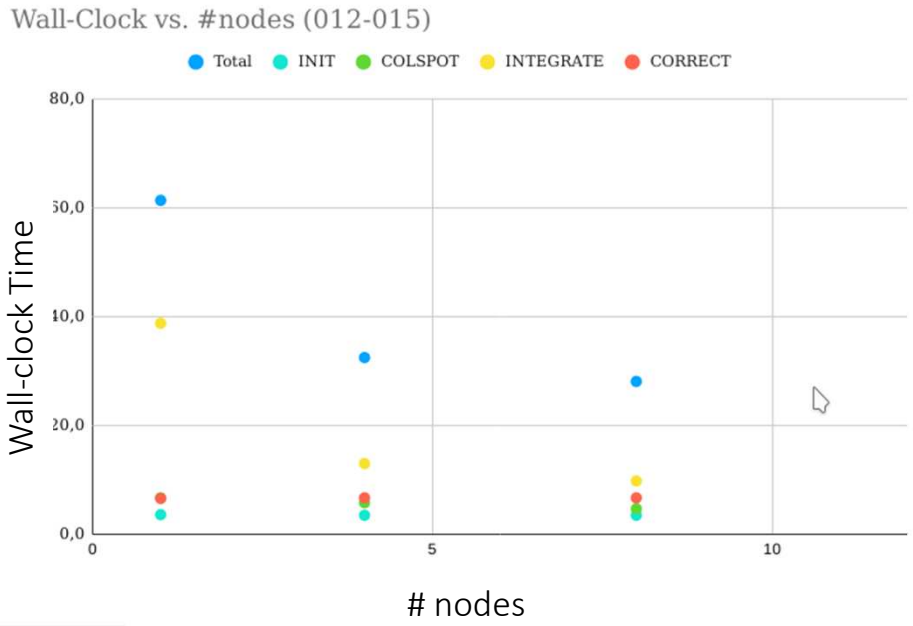


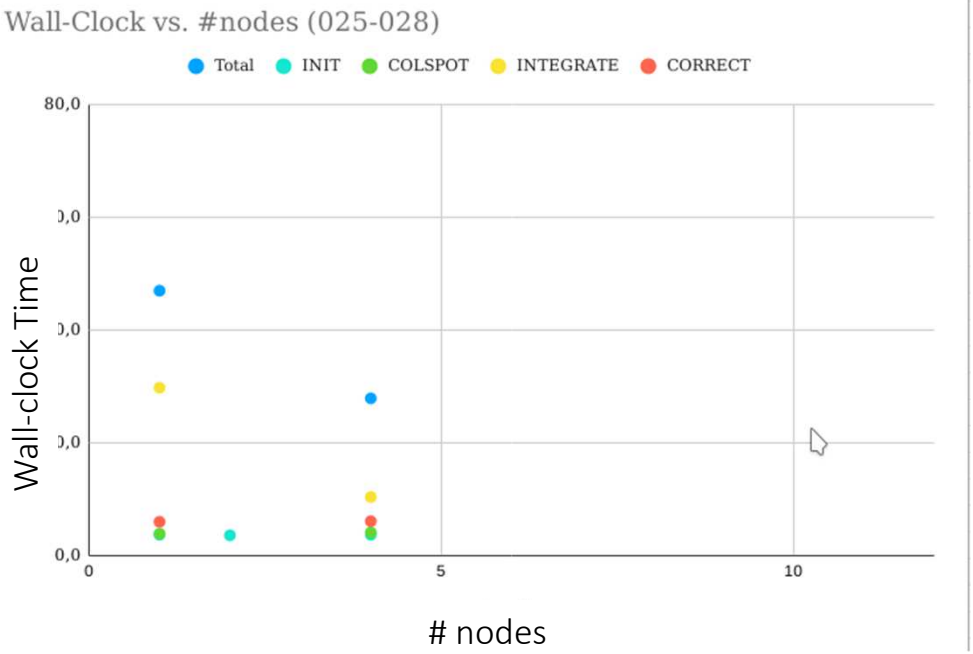
VDI Server connected directly to the Storage Network (burst buffer), which may be locale or at CPD.

CPU specification tests

Hardware specifications are under evaluation.

Tests of XDS jobs are performed with groups of 4 nodes (preliminary)





24 cores
256GB
CPU Xeon Gold 6136 CPU @ 3. GHz

40 cores
256GB
CPU Xeon Gold 6248 @ 2.50GHz

Acknowledgements
XAIRA is the people working in XAIRA

Beamline Engineering
- Nahikari González

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Thanks

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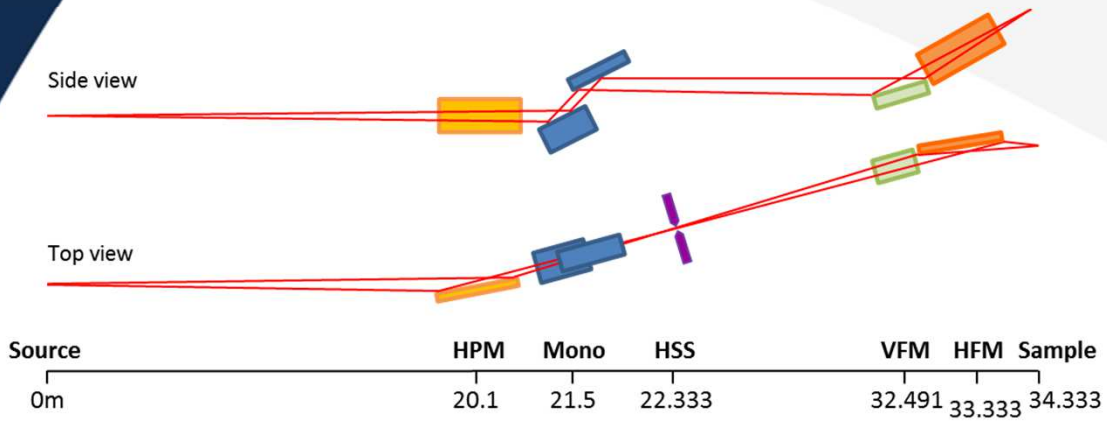
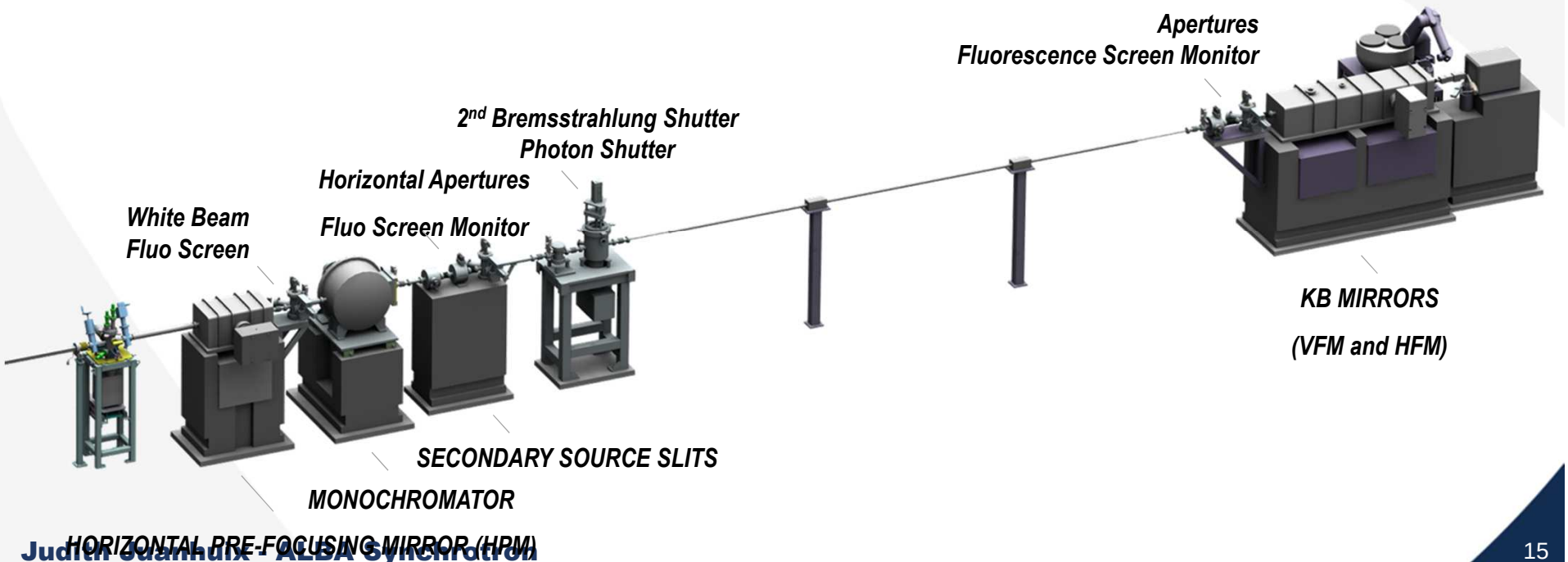
Thanks

Beam optics



- Mono: pseudo channel cut Si(111) and ML for high stability and flux.
- "Simplest" focusing Optics
- But: beam changes height with E



Mar21 Fall21 Installation Dates installed Feb21 May21 Mar21 installed