General Beamline Description

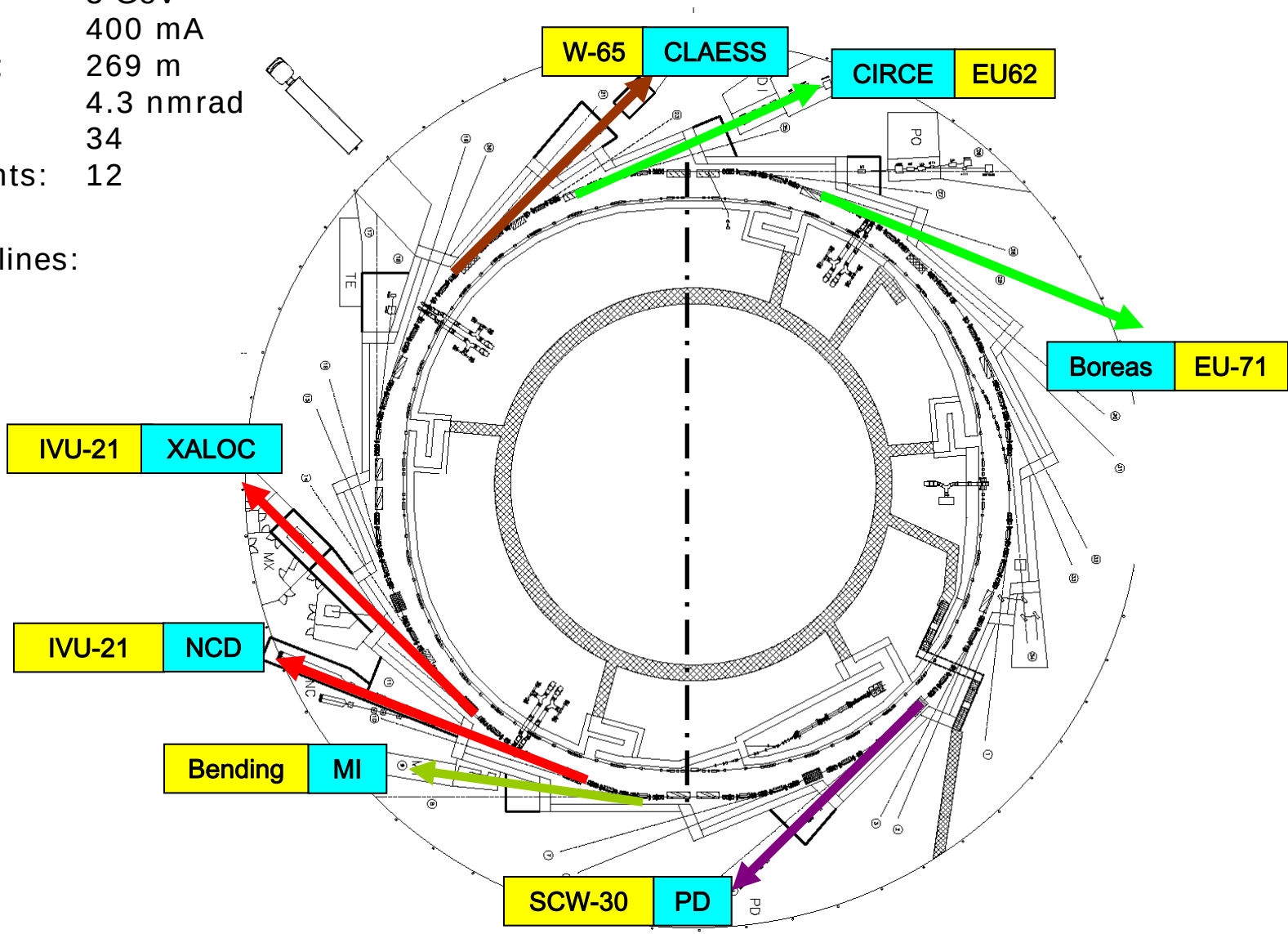
powderXRD2013

http://powderxrd2013.cells.es/

Alba synchrotron source: phase I beamlines

Energy:	3 GeV
Imax:	400 mA
Circumference:	269 m
Emittance:	4.3 nmrad
Total Ports:	34
Medium straights:	12

Phase I beamlines:
6 ID
1 BM



MSPD Materials Science and Powder Diffraction beamline

Applications:

High Resolution PD (Structure solution/refinement, Profile analysis)

Strain/Stress measurement

In-situ measurements, e.g. heterogeneous catalysis

Time resolved measurements down to milliseconds, pump and probe, cyclic measurements

Total scattering, Pair Distribution Function PDF at RT and non-ambient Temperature

High Pressure Diffraction with Diamond Anvil Cells (DAC) at RT

BL Team:

F. Fauth, Catalin Popescu and Inma Peral

C. Colldelram

F. Farre

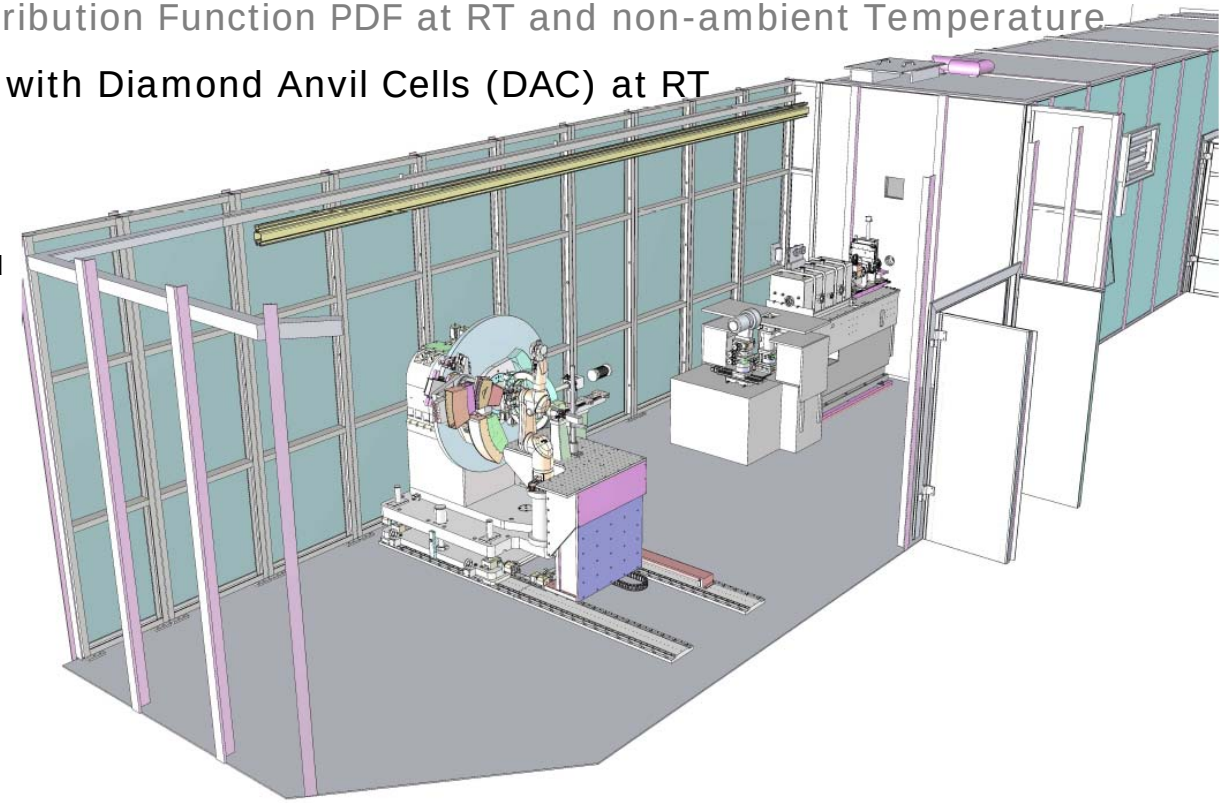
Z. Reszela

And:

L. Ribo/E. Fraga

J. Lidon/X. Serra

L. Gines



MSPD Materials Science and Powder Diffraction beamline

General characteristics:

Station 1: High Pressure Diffraction on powders with DAC and CCD detector

Station 2: High Resolution Powder Diffraction with Multicrystal- and Silicon-Strip detector

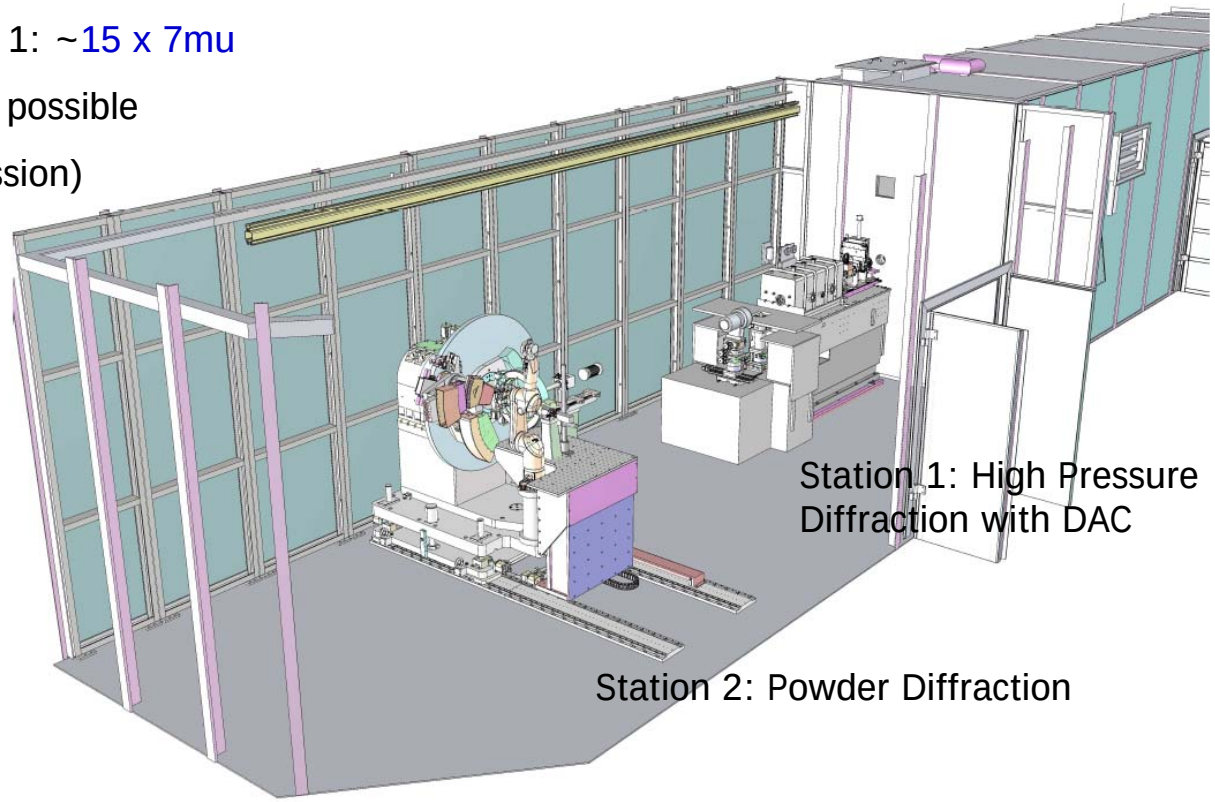
Energy Range: 8-50keV

Typical beam size: 4x1mm

Focused beam size at Station 1: ~15 x 7mu

All typical sample geometries possible

(reflection, capillary, transmission)



Beamline realization milestones

2007 March - Beamline Review meeting (optics)

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2012 June - High Pressure endstation starts operation

2012 September - Powder Diffraction endstation starts operation

The MSPD Beamline Review Meeting

March 2nd 2007 in Castelldefels/Barcelona

Participants

Other Synchrotrons:

Andy Fitch (ESRF)
Mohamed Mezouar (ESRF)
Jean Paul Itié (SOLEIL)
Erik Elkaim (SOLEIL)

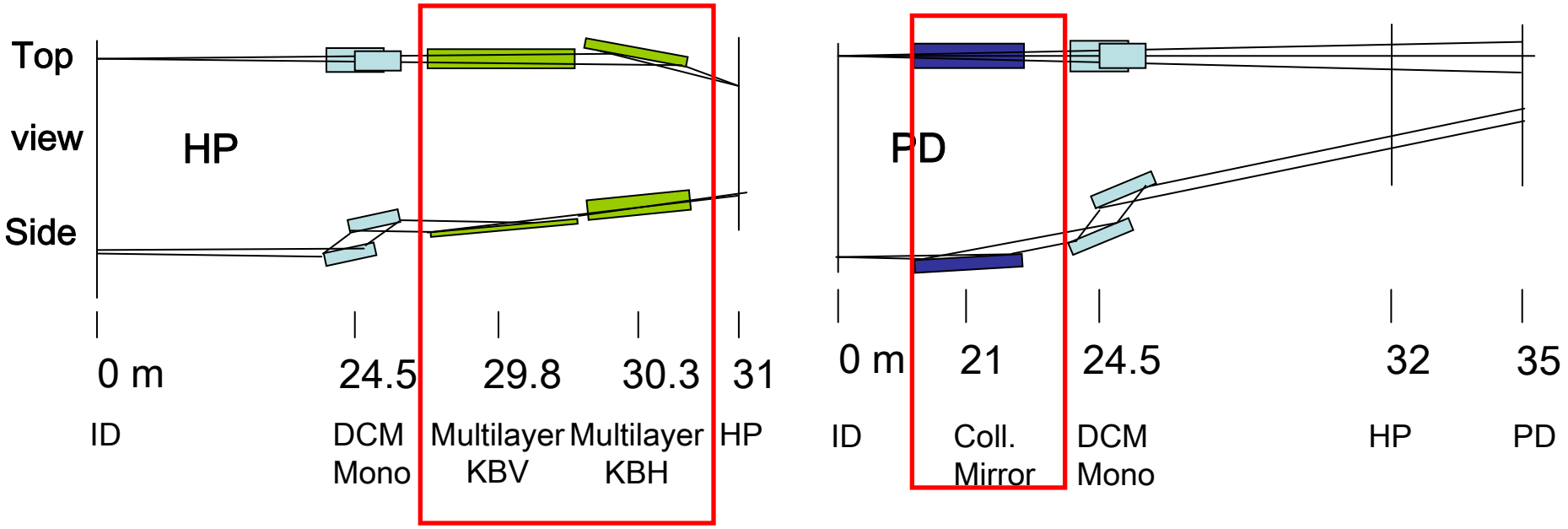
User community:

Jordi Rius (ICMAB)
Daniel Errandonea (UPV)
Andrzej Grzechnik (UPV-EHU)

Participants from ALBA:

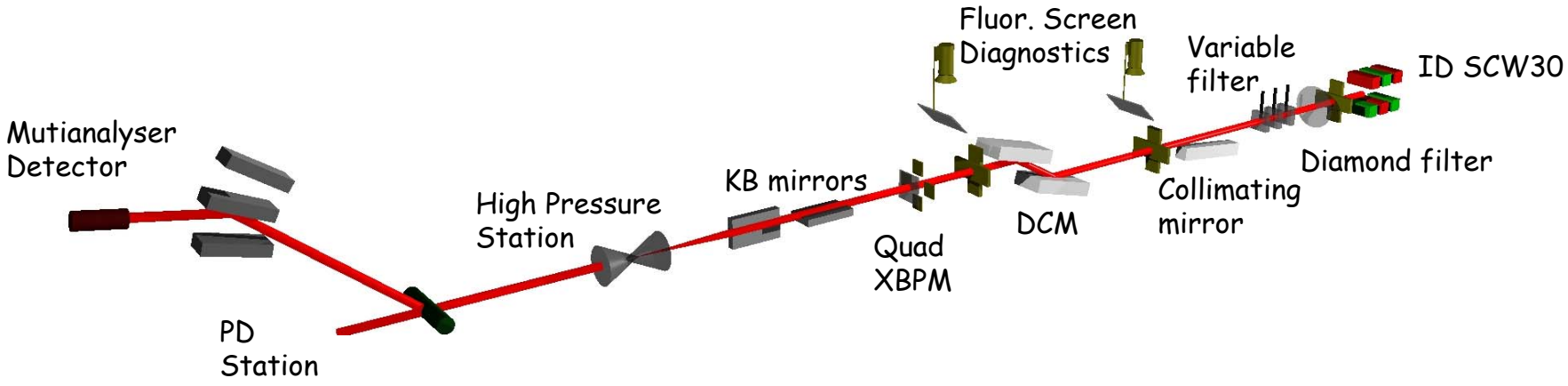
Joan Bordas
Malcolm Howells
Josep Campmany
Eva Boter
Marcos Quispe
Jordi Juanhuix
Salvador Ferrer
Wilfried Schildkamp
Konstantin Klementiev
Inma Peral
Claude Ruget
Michael Knapp

Optical layout



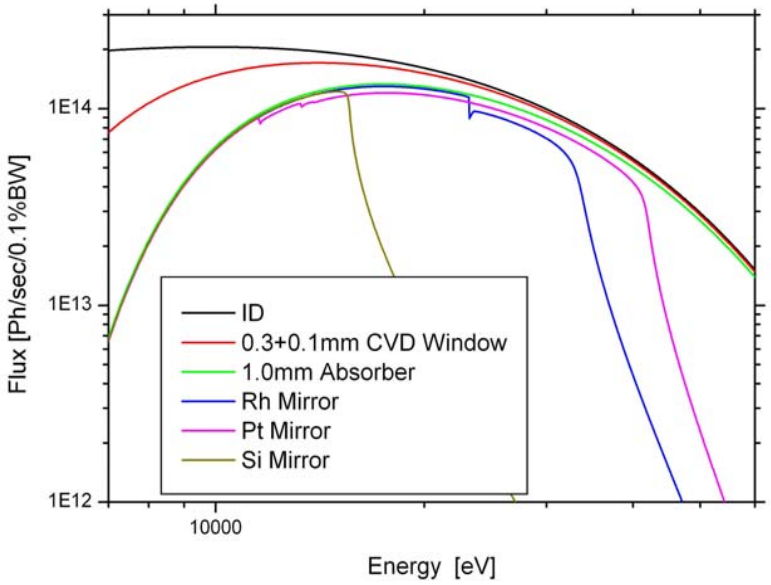
Un-mirrored mode with optional KB mirror
- CVD-diamond heat absorber
- Double Crystal Monochromator DCM (cryo-cooled)
- Multilayer KB mirror (optional)
- 20 - 50 keV

Mirrored mode:
- Collimating Mirror with Pt, Rh, Si coating
- DCM cryo-cooled, Si111
- 8 – 40 keV



The insertion device: Superconducting Wiggler SCW30

Flux through HxV 200x125 μrad
@ Max K=6.08, 400 mA



- Maximum power: 19 kW (at 2.15 T and 400 mA, worst case)
- Period length: 30.16 mm
- Number of periods: 58.5
- Effective length: 1764 mm
- Maximum field: 2.15 T

Heat load on optics components

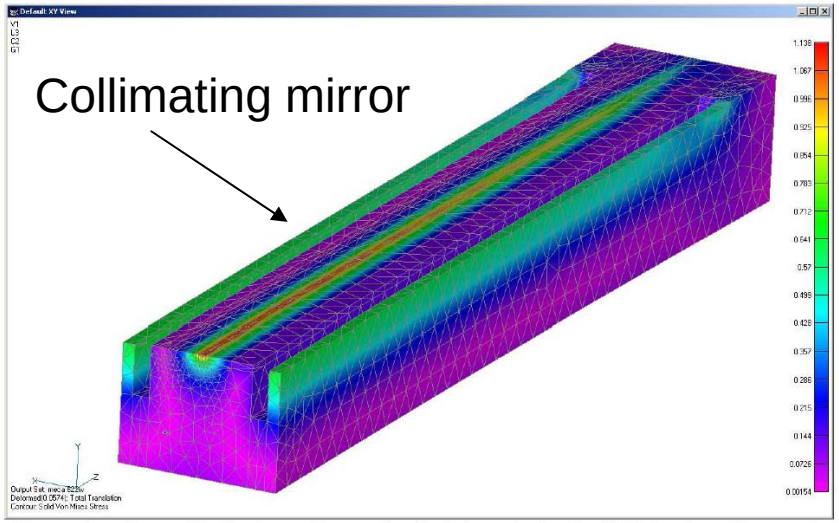
Total and absorbed Power in worst case:

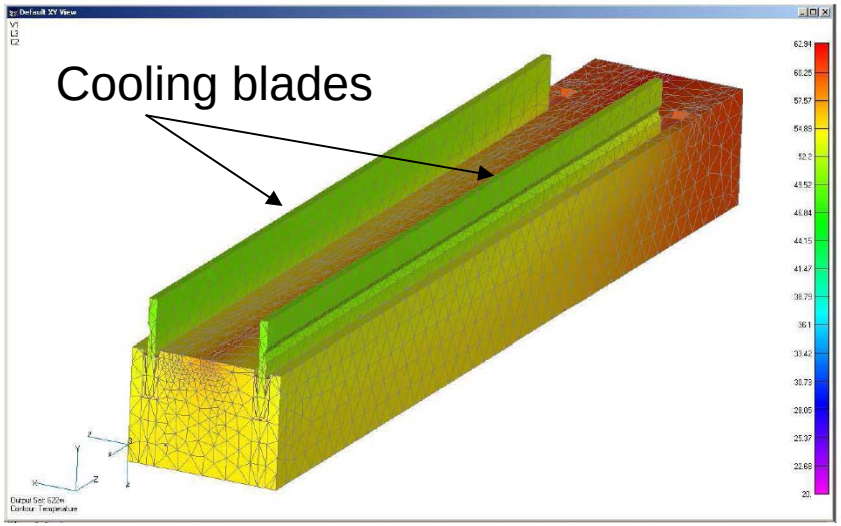
ID		19 kW
Max. in OH (HxV 400 x 125µrad)		2.1 kW
0.3mm CVD diamond pre-filter (absorbed)		435 W
0.1mm CVD diamond vacuum window (absorbed)		58 W
Mirror	**Save operation (absorbed)**	**1100 W**
	Si coating	622 W
Monochromator		**464 W**

- The high power load absorbed in the optical components always has to be considered.
- Safety of all components must be guaranteed under mis-operation
- Power load on components in normal operation can be adapted by K-value, movable mask (aperture) or additional absorber

Cooling of the collimating mirror

Collimating Silicon mirror Si stripe 622W absorbed (WinlightX)





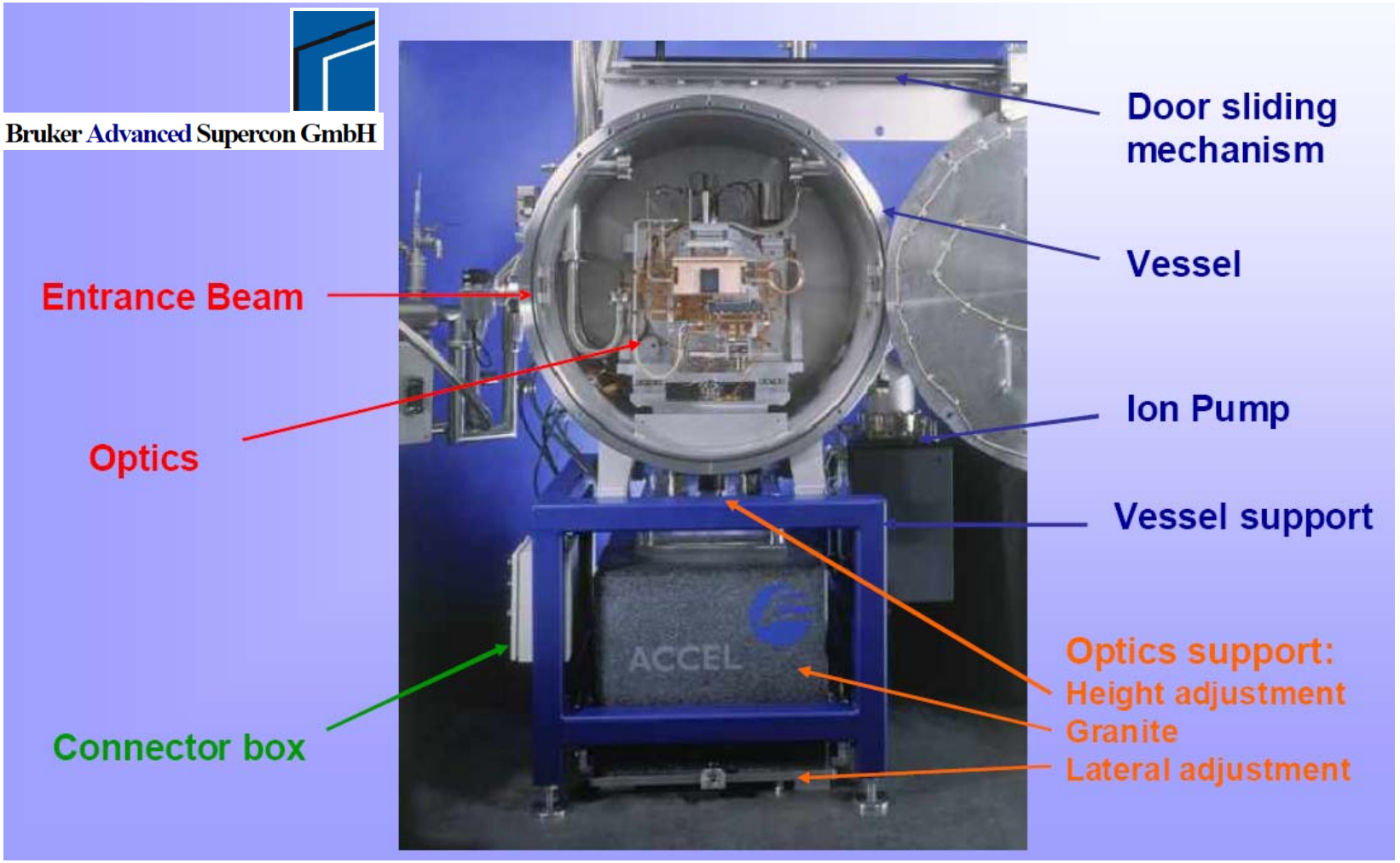
Stress and temperature distribution with an absorbed heat load of 622W on silicon stripe

Maximum generated stress in mirror body always stays <2MPa

Temperature distribution.
Max Temp: 62.9°C

- 2 Cooling blades nickel plated copper
- Ga-In Eutectic interface
- Heat Transfer Coefficient 1000 W/m^{2}K

Double Crystal monochromator



Bruker/Accel DCM:

- Optics moves inside vessel, cryo-cooling and water cooling enters from top side
- Vessel and optics mechanically decoupled
- Mechanics is temperature stabilized by water circuit

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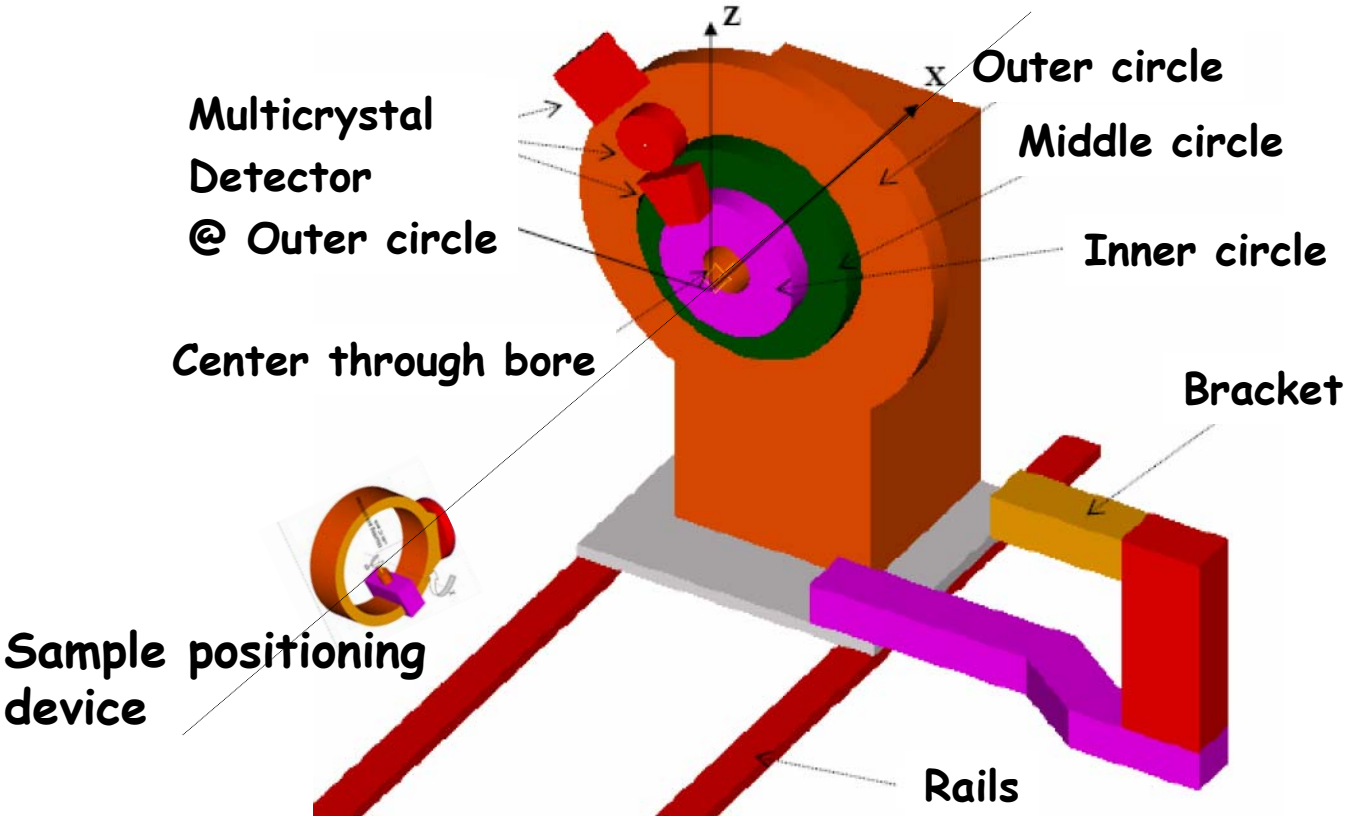
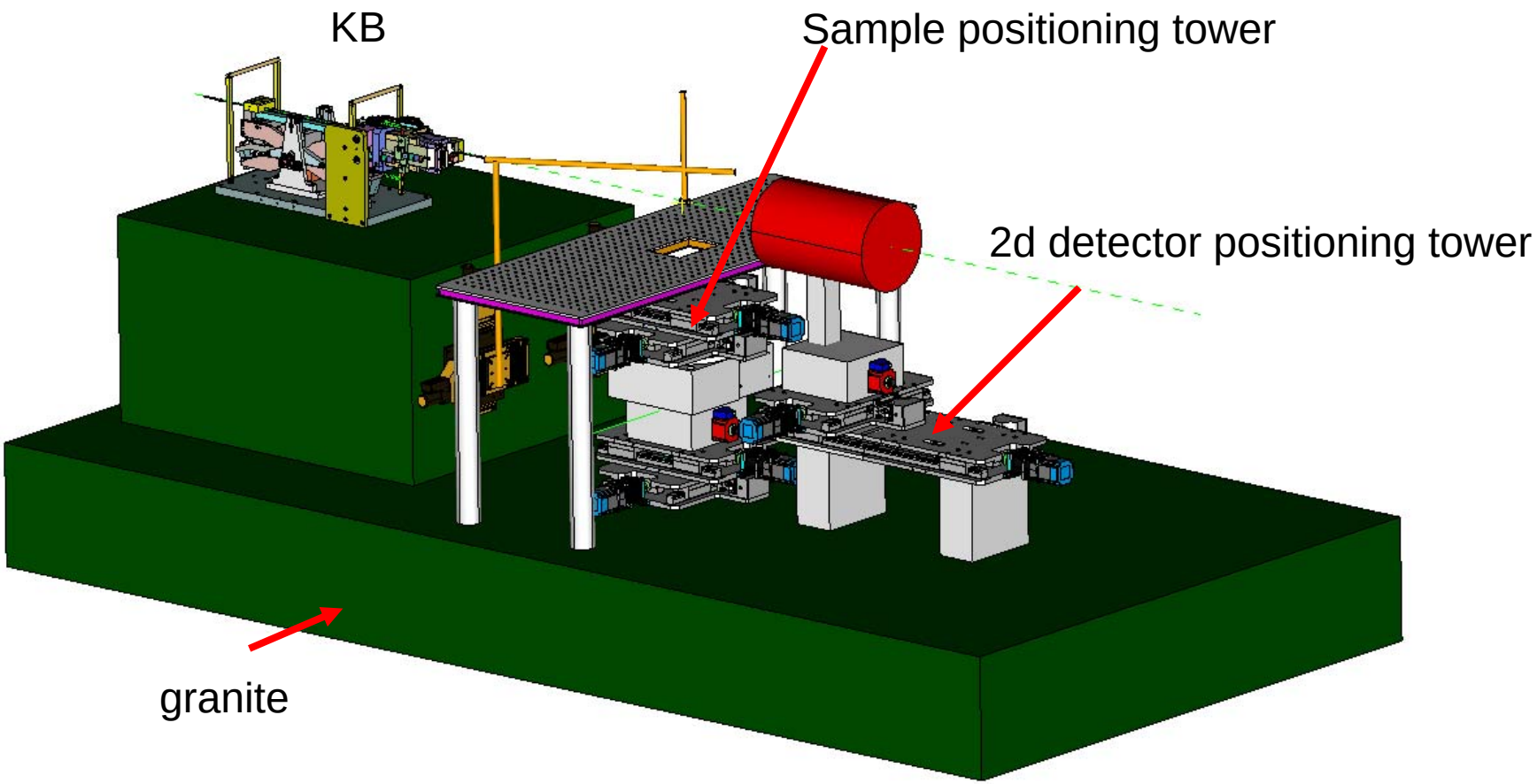
Schematic drawing of the diffractometer (for the call for tender)



* High angular resolution 0.0002°
* Flexibility for different sample environments
    - Horizontal and vertical translation of the whole diffractometer
* Stability and high load capacity

High Pressure endstation

- Preliminary layout after the Conceptual Design Report was reviewed by the user community



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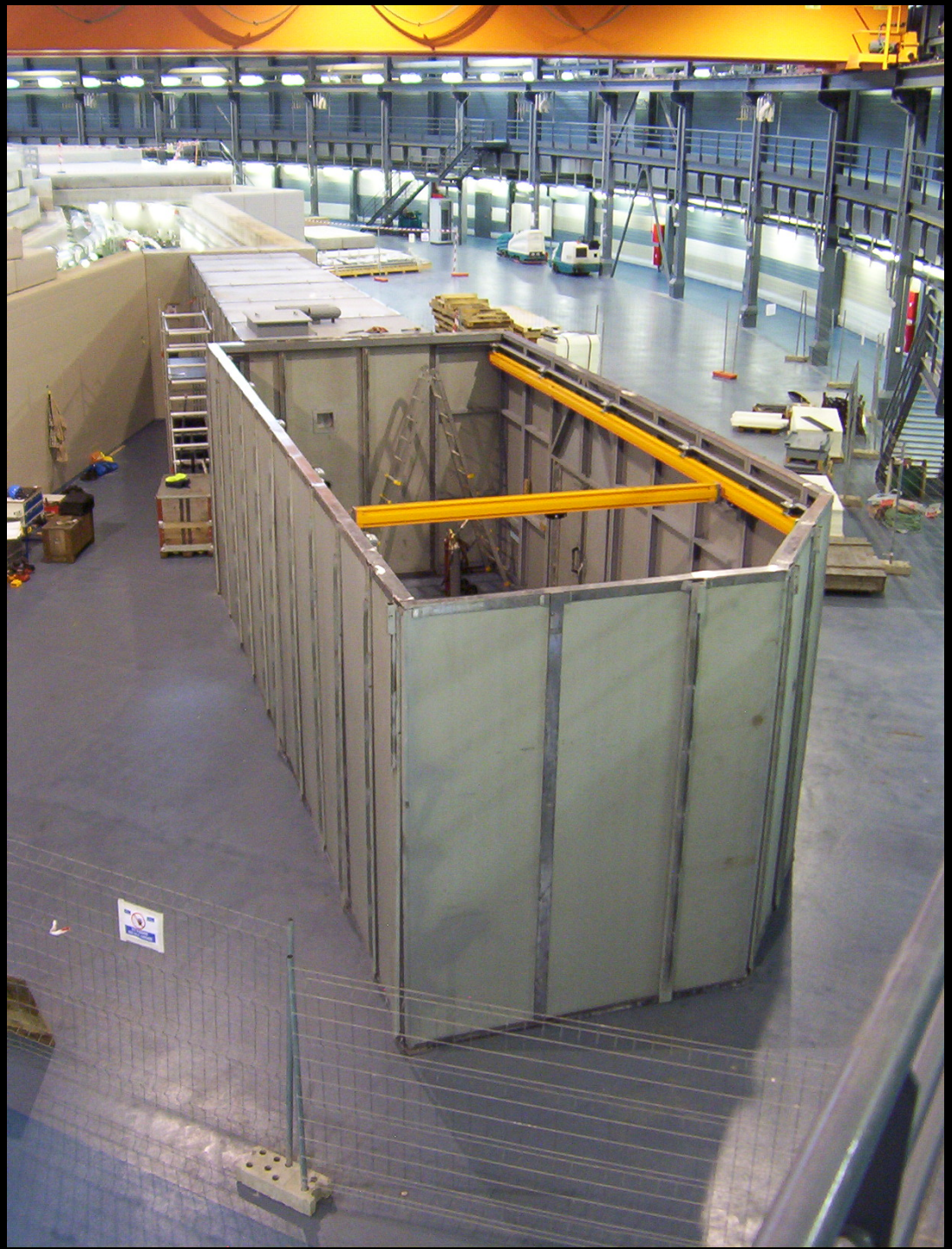
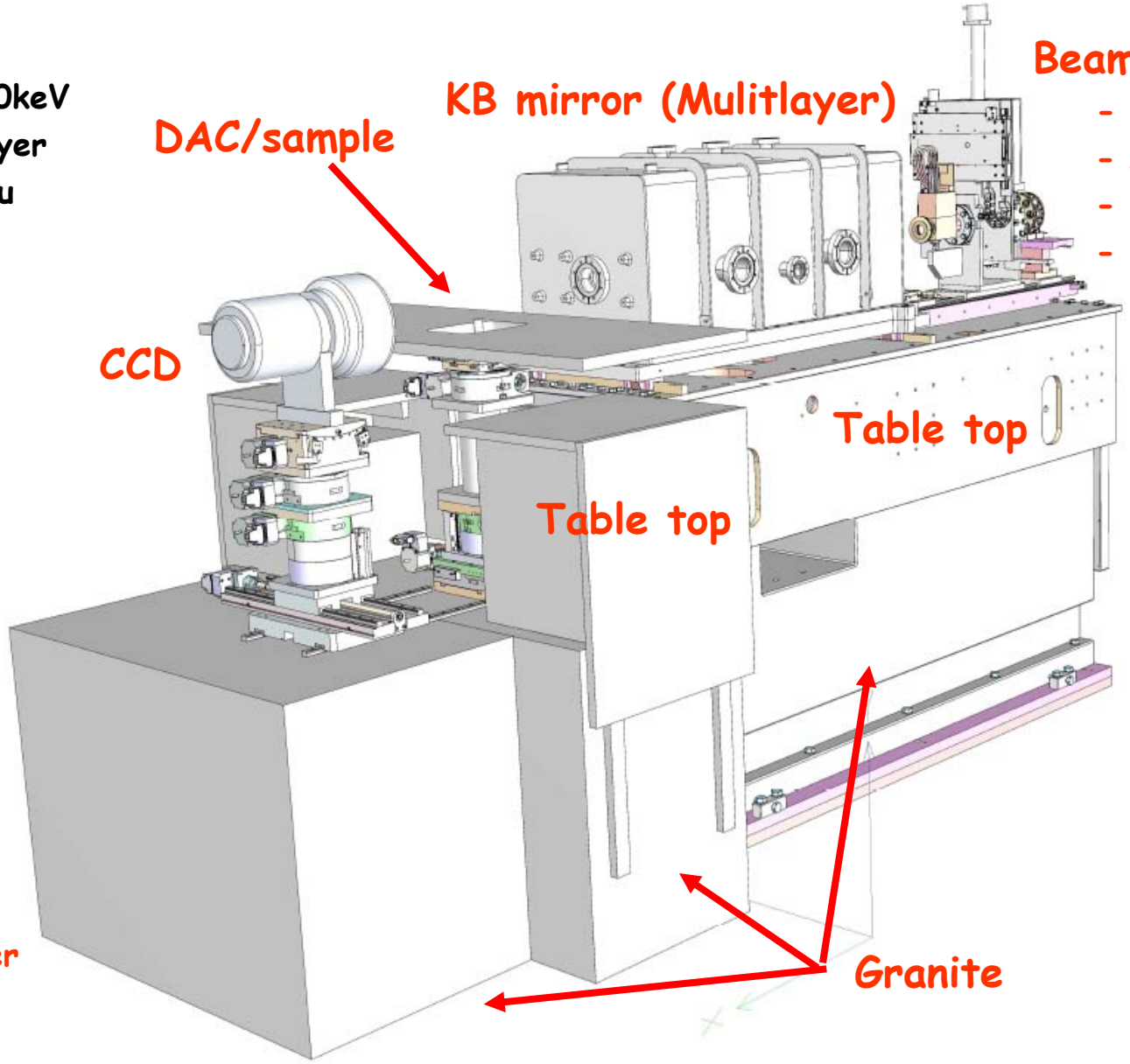


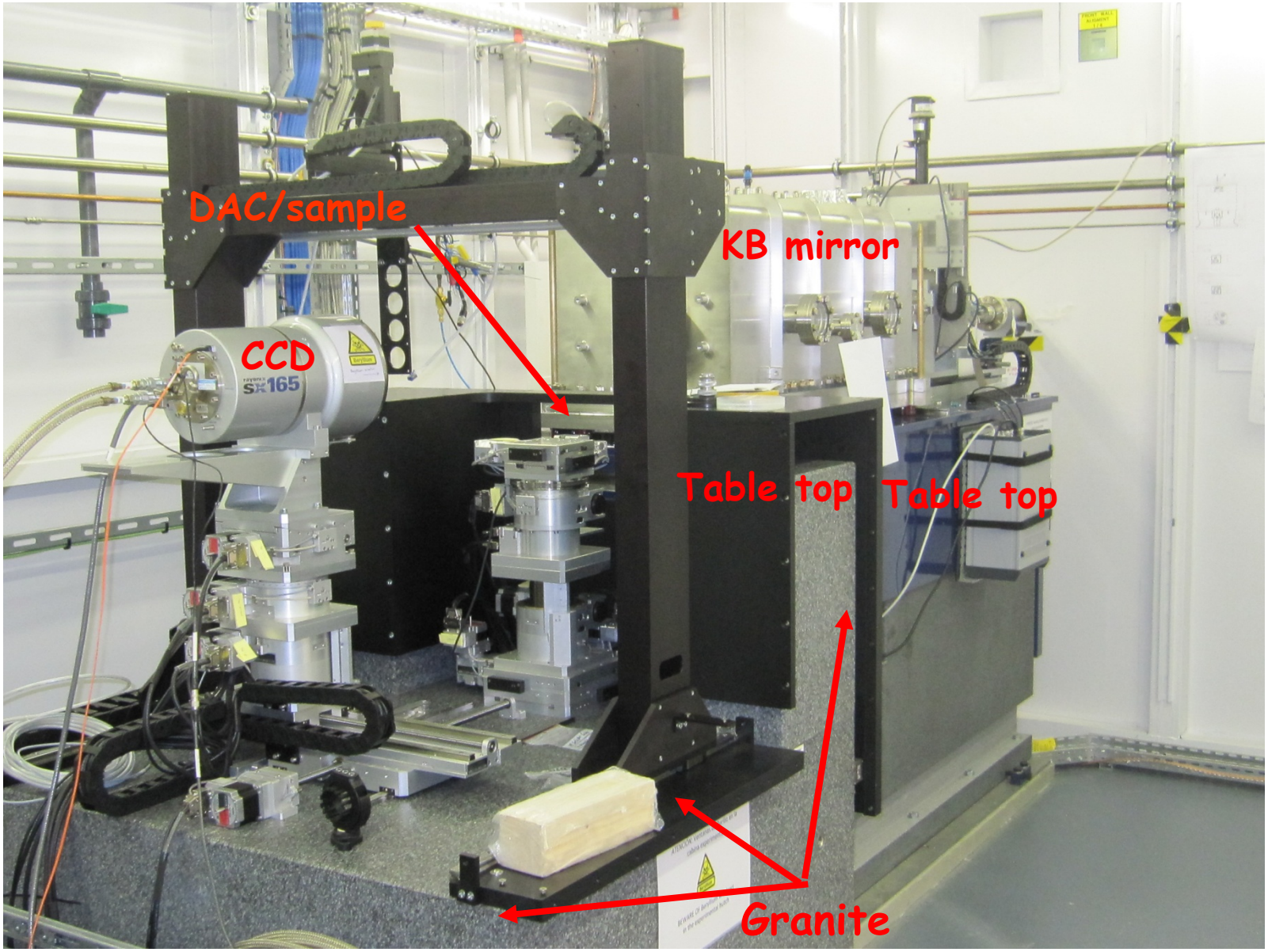

ABUS 500 kg

MSPD, High Pressure station

Energy 20-50keV
W/Si Multilayer
Spot 5x15 mu

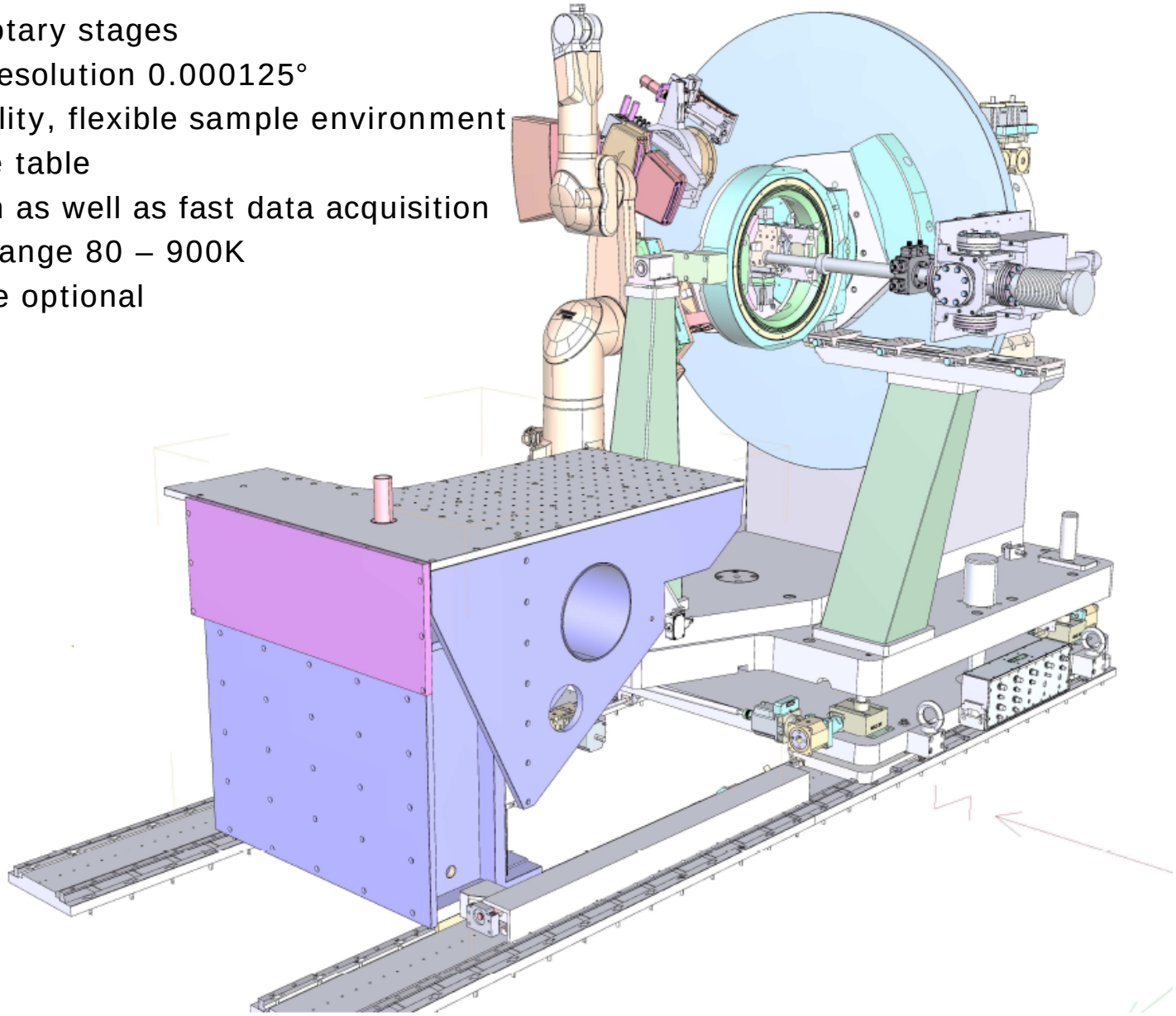


Not shown:
Beam cleaner
Beam stop


DAC/sample
KB mirror
CCD
Table top
Table top
Granite

MSPD, Powder Diffraction station

- 3 concentric rotary stages
- High angular resolution 0.000125°
- good accessibility, flexible sample environment
- second sample table
- high resolution as well as fast data acquisition
- Temperature range 80 – 900K
- Eulerian Cradle optional



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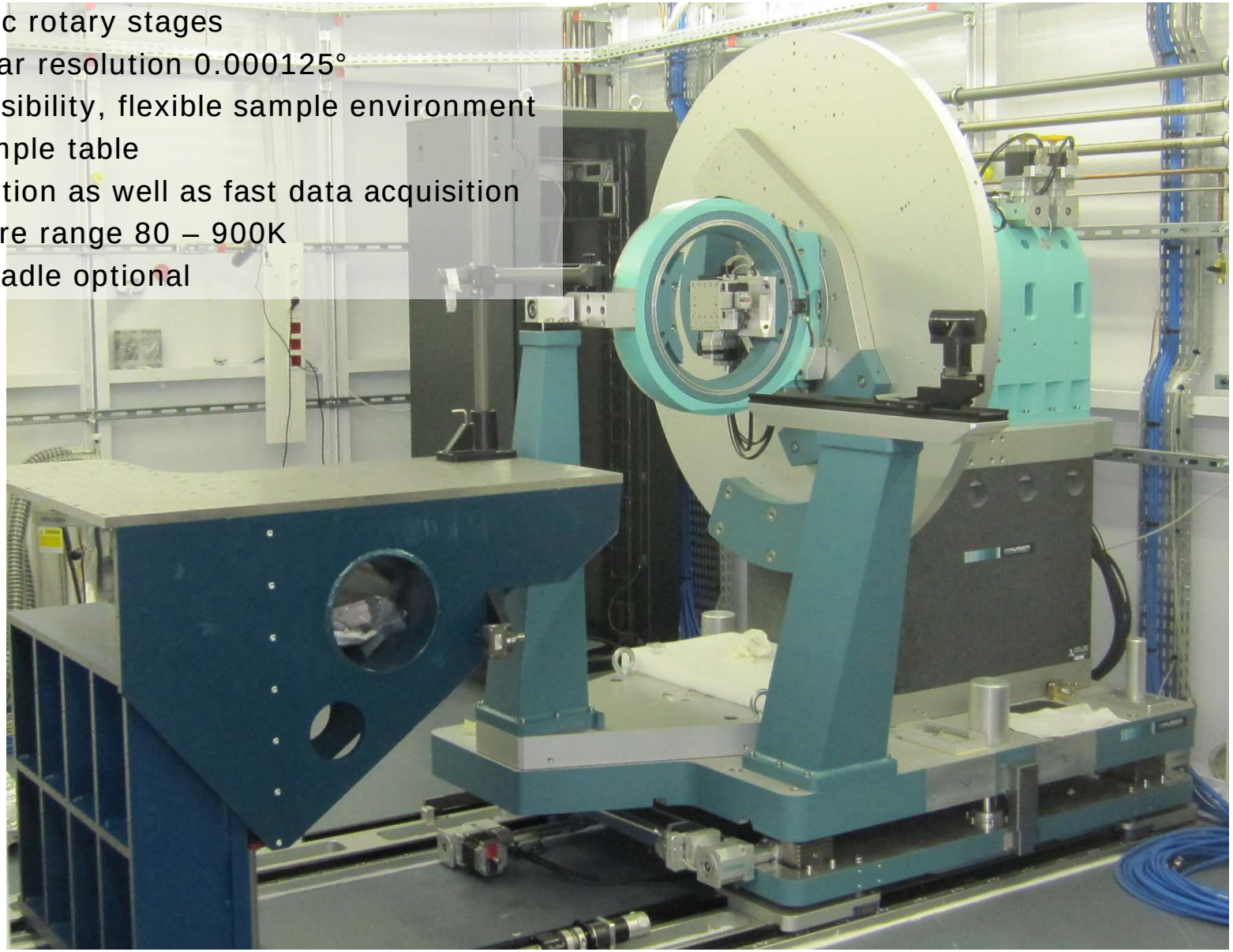

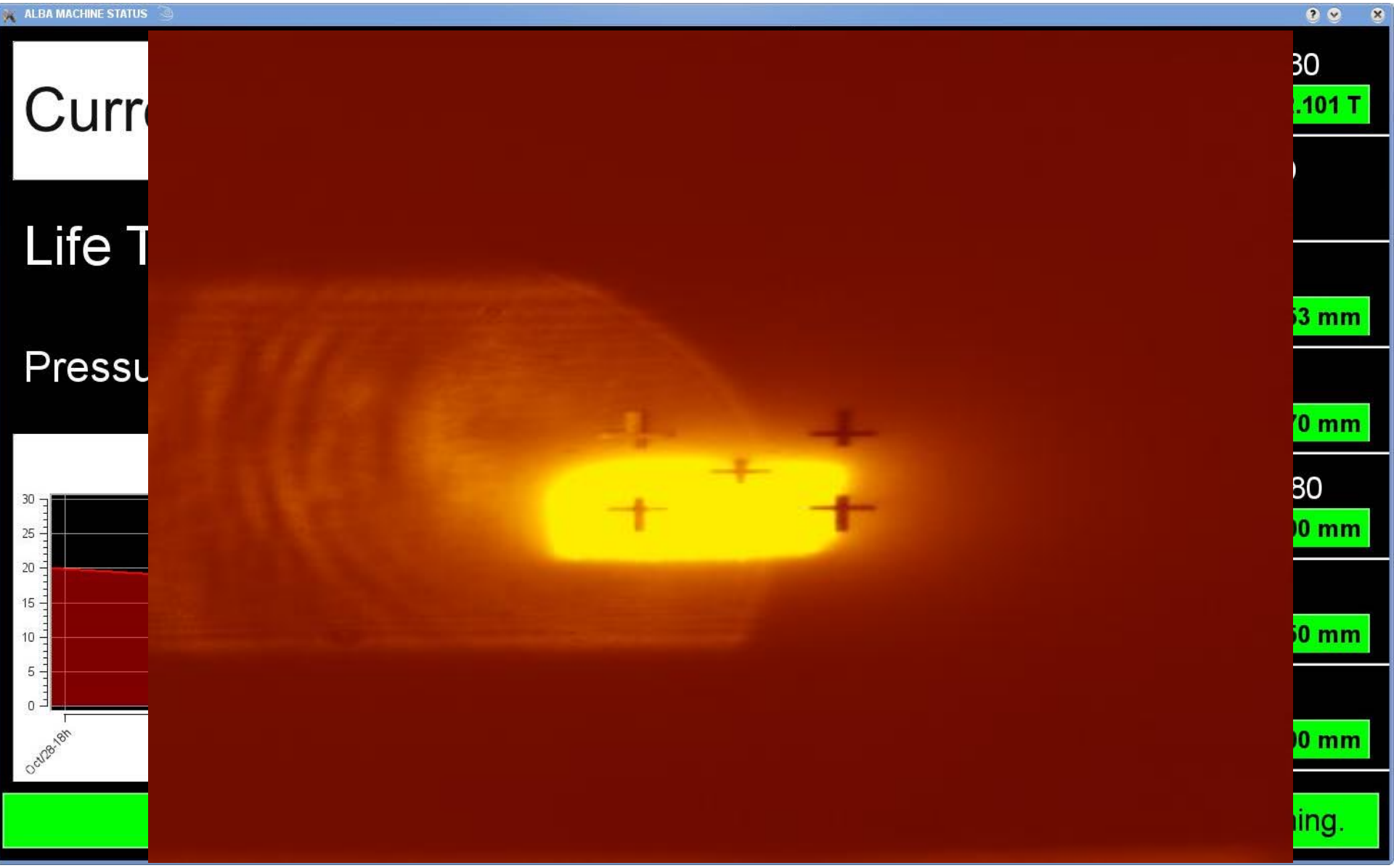
ALBA MACHINE STATUS
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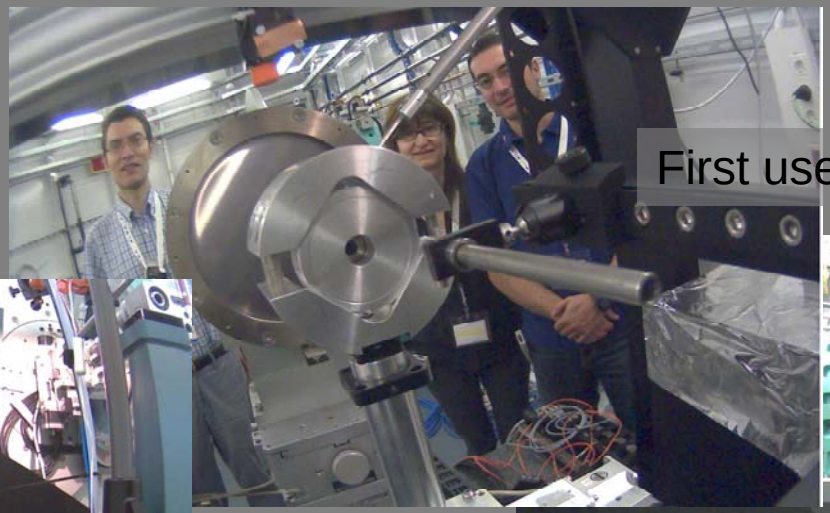
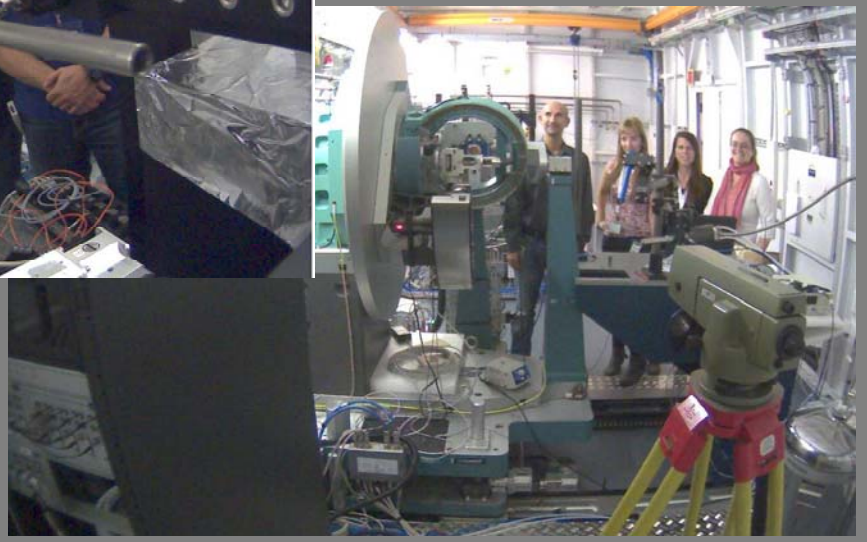
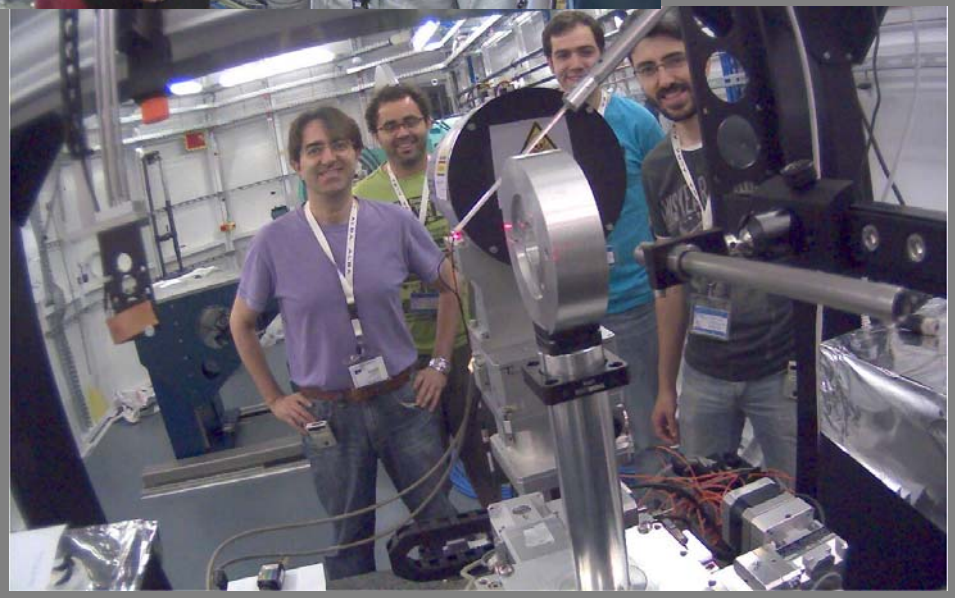
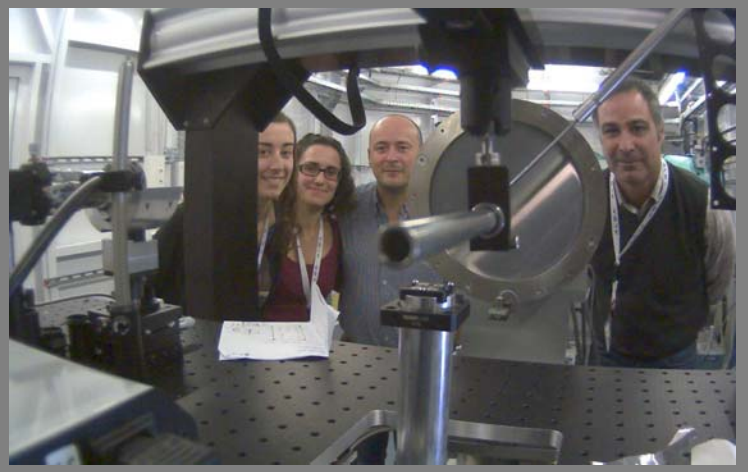
First users at PD endstation









First users at HP endstation

Acknowledgments

Andy Fitch (ESRF) and ID31 staff
Mohamed Mezouar (ESRF) and ID27 staff
Jean Paul Itié (SOLEIL)
Erik Elkaim (SOLEIL)
Chi Tang (Diamond)
Brian Toby (APS)

Former Alba staff
Julio Lidon
Jonathan McKinlay
Marion Kuhlmann

… and many others!

Thanks for your attention!