Alejandro Crisol

New BL20 Monochromator Design

Generalitat de Catalunya
Departament d'Empresa i Coneixement

This project is co-funded by the European Regional Development Fund (ERDF) within the Framework of the ERDF Operative Programme of Catalonia 2014-2020

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   - Mechanical design, Cooling & Results
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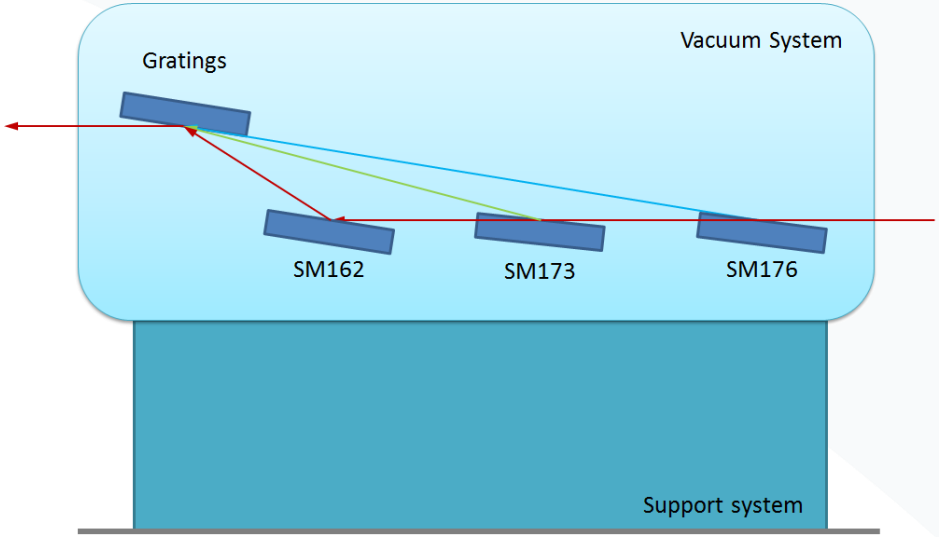
Specifications

- Monochromator for Soft X-Ray
- Cooling decoupled from mechanics, no double piping.
- Fully removable holders with optics to be adjusted and verified at lab.
- High stability and resolution.
- Vacuum level range 10^{-10}mbar

Up to 5 gratings



Geometry: Hettrick-Underwood

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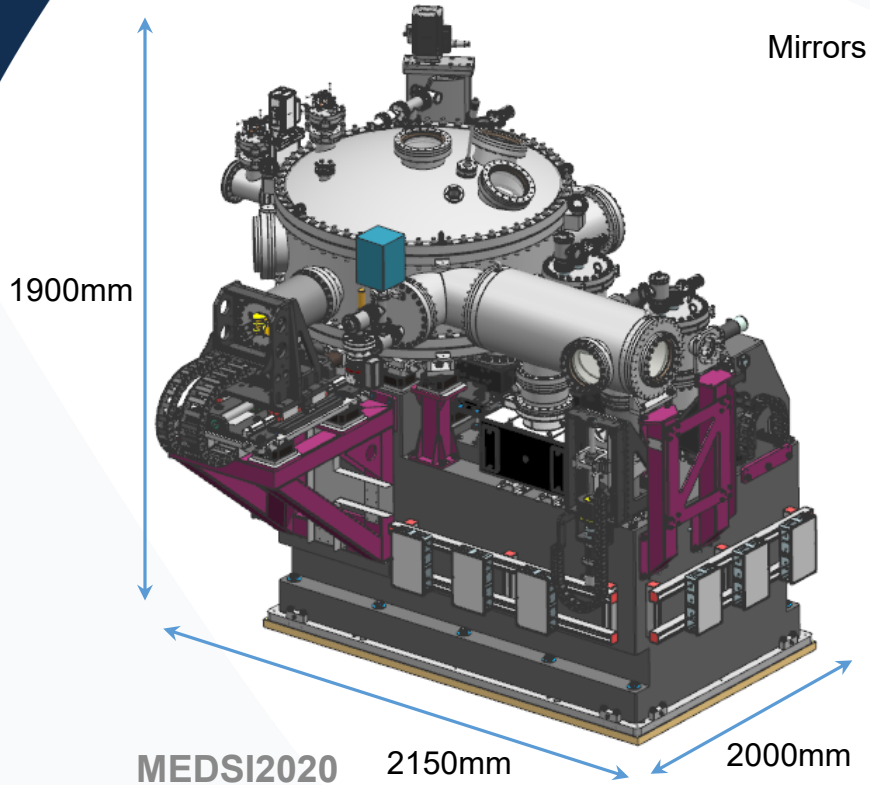
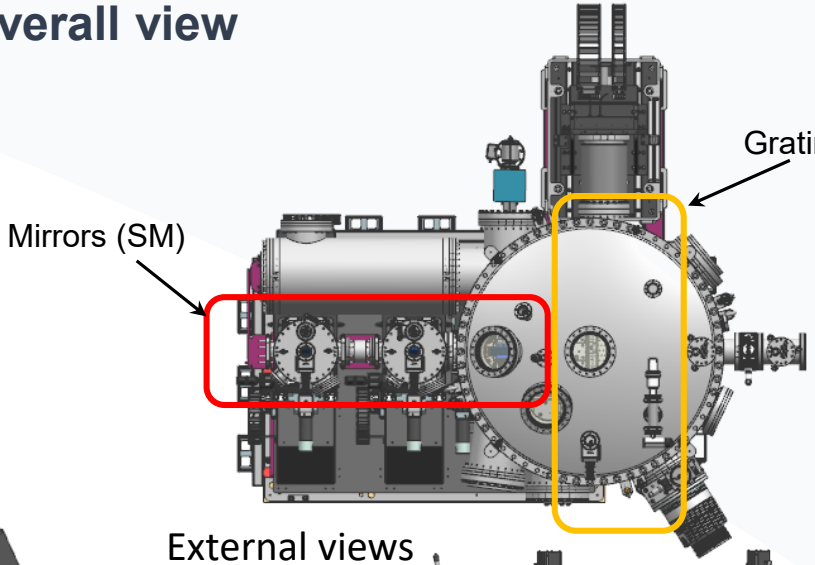
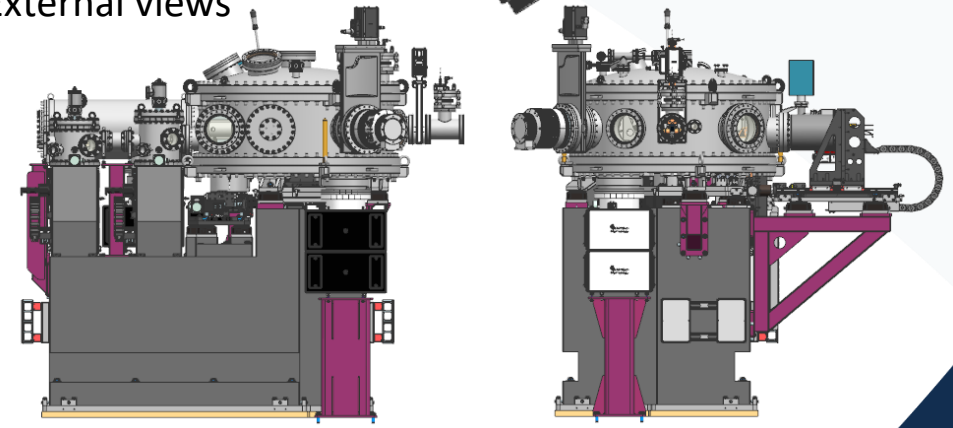
Overall view

Main dimensions





External views



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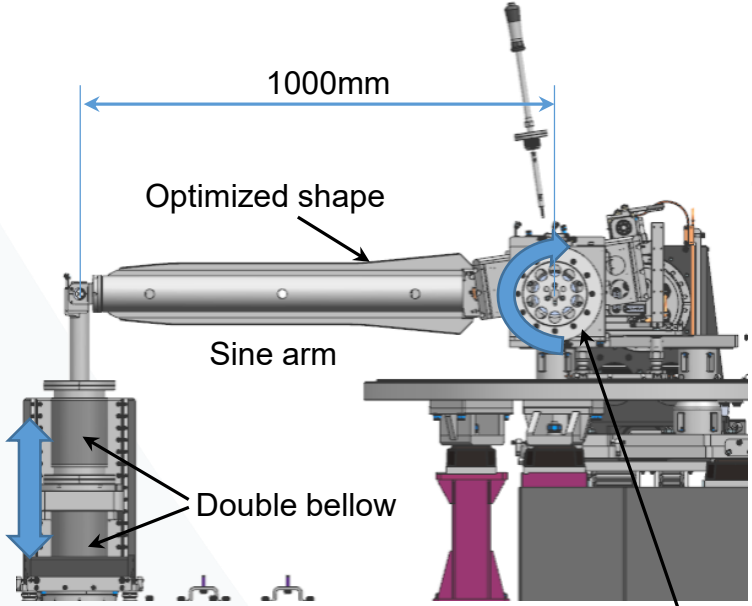
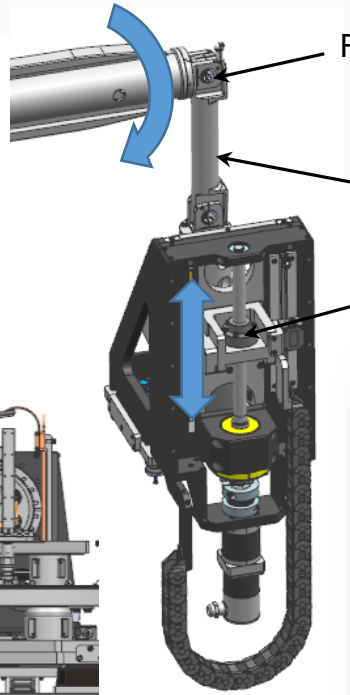
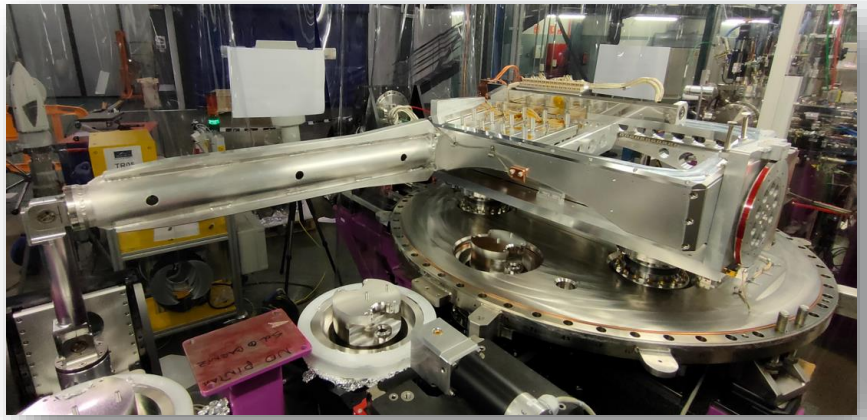
Gratings system

Pitch motion





Pitch actuator



2x Encoders + disc

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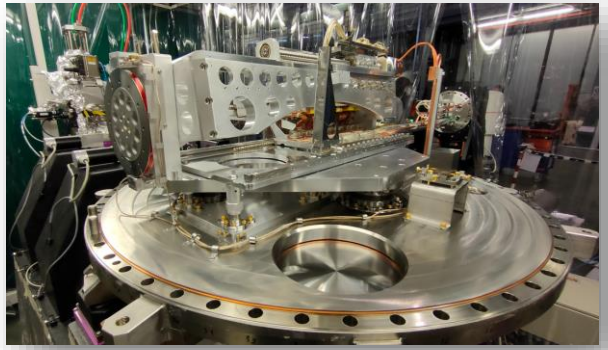
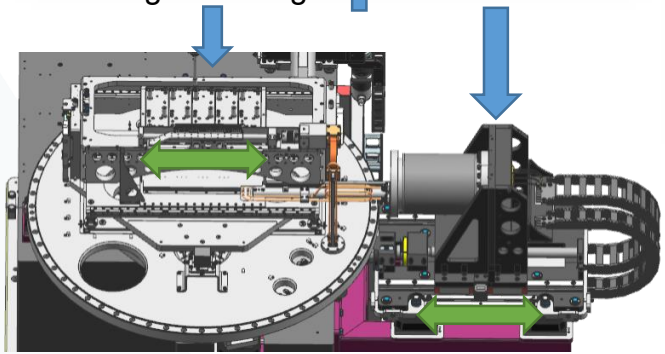
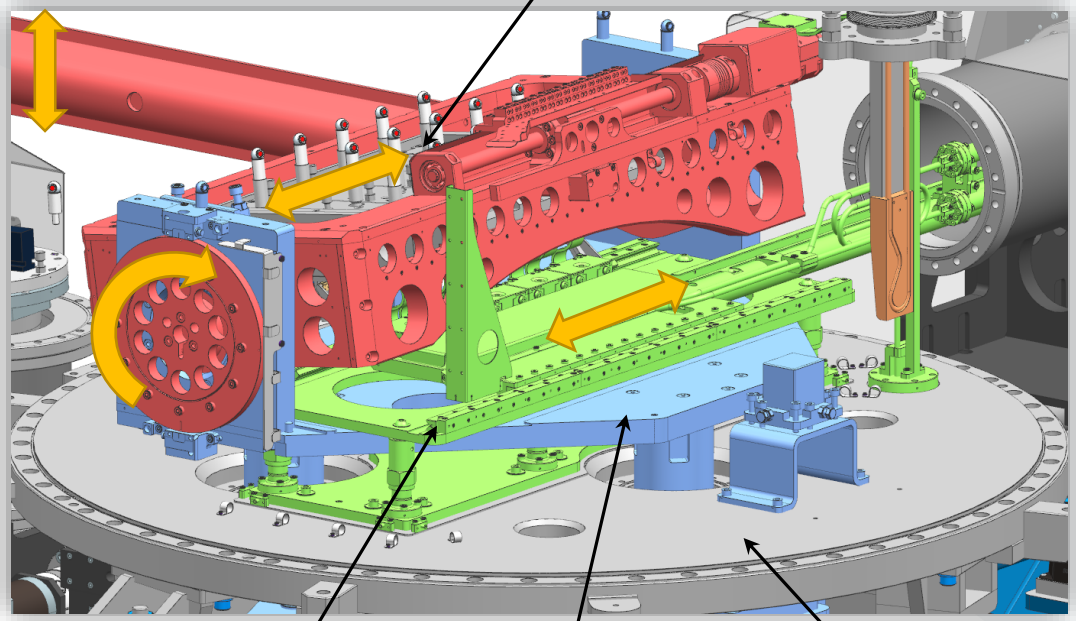
Gratings system

Exchange motions



Gratings exchange + Services motion





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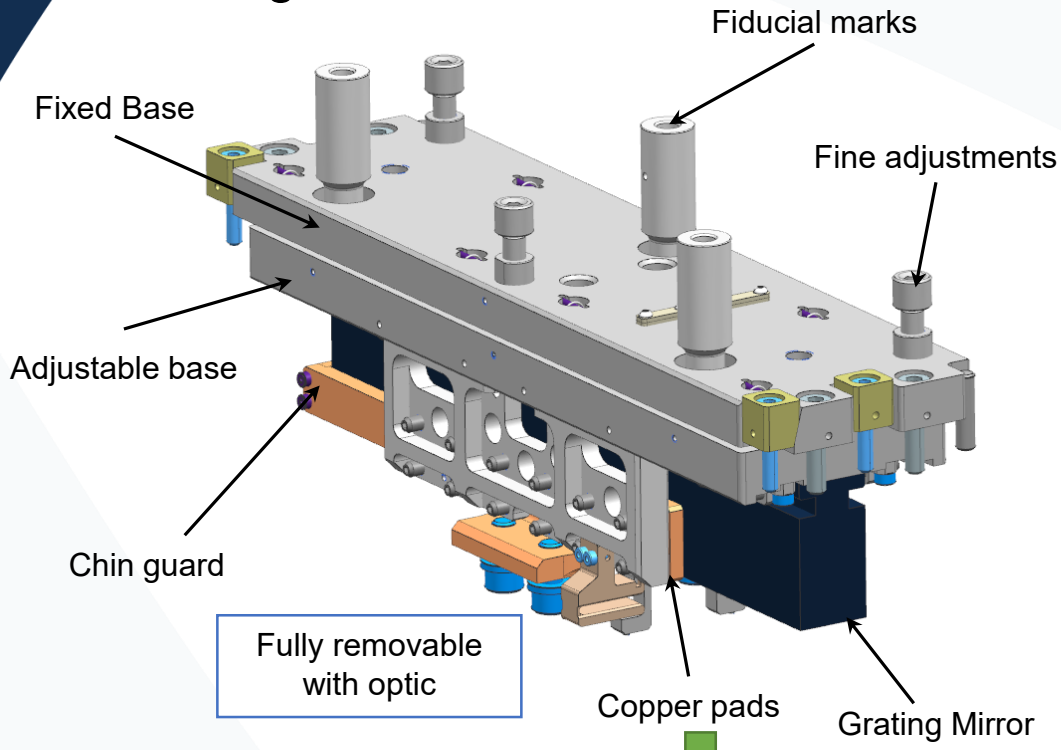
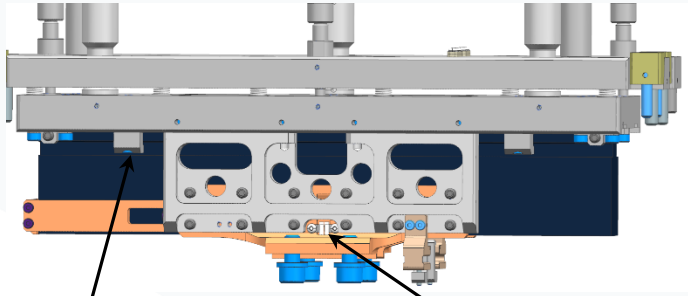
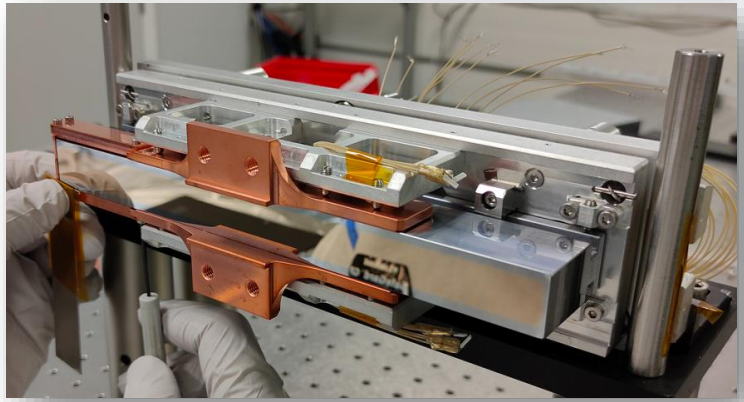
Gratings system

Gratings Holder



No water flow directly on the optics





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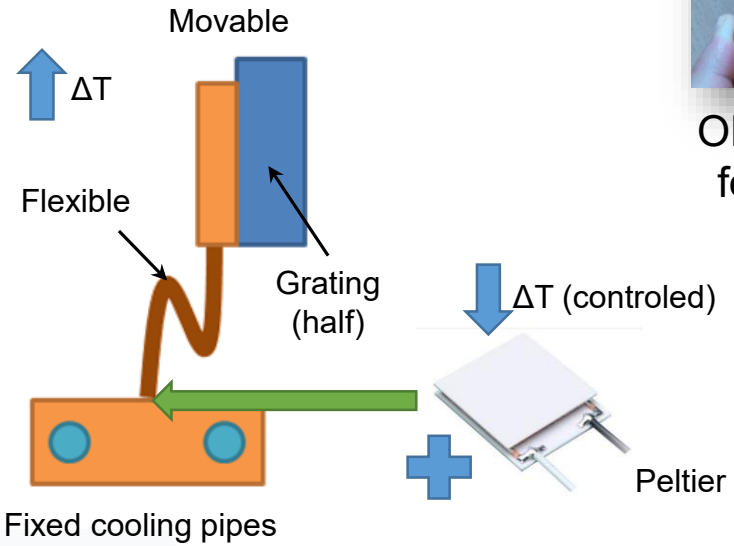
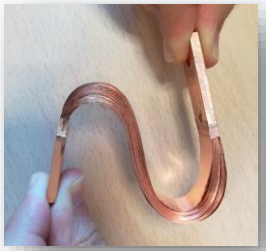
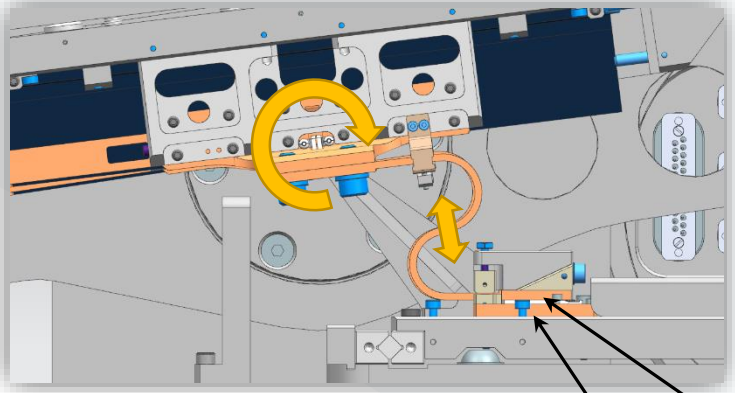
Gratings system

Gratings cooling

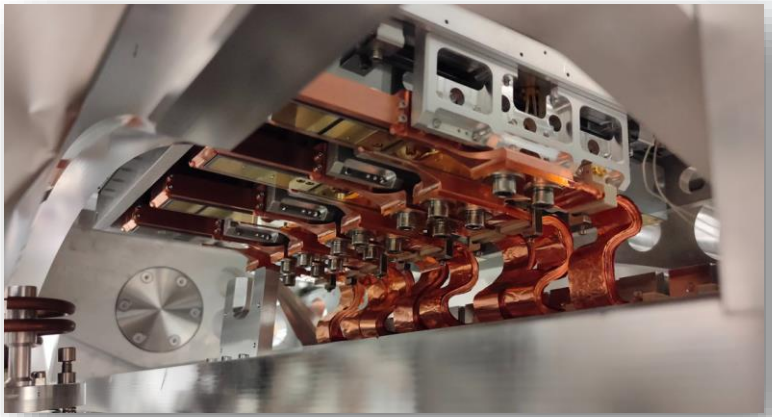




OHFC multi foils strap



Final assembly



Utility Model: U202131465

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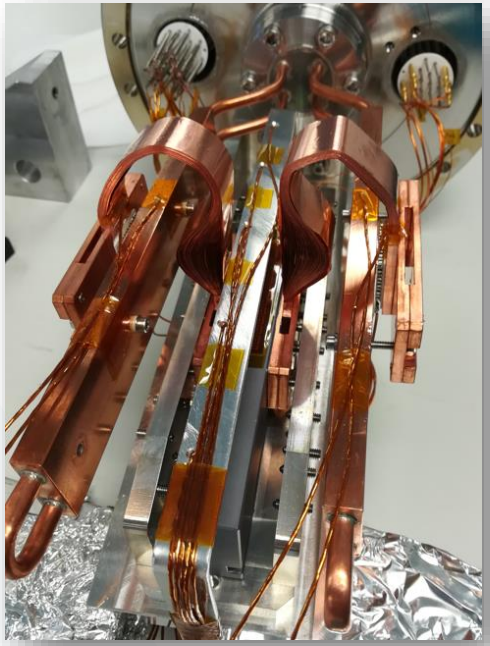
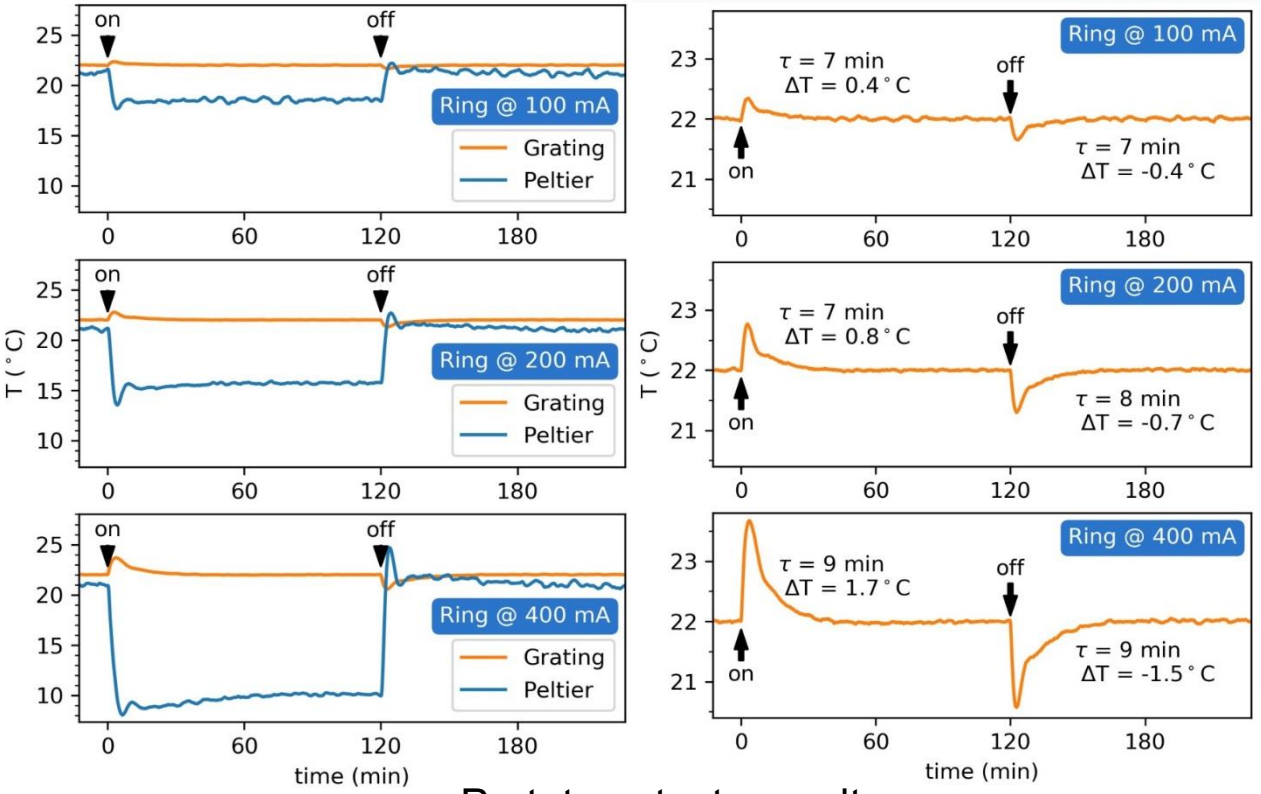
Gratings system

Gratings cooling



Grating cooling prototye



Prototype tests results

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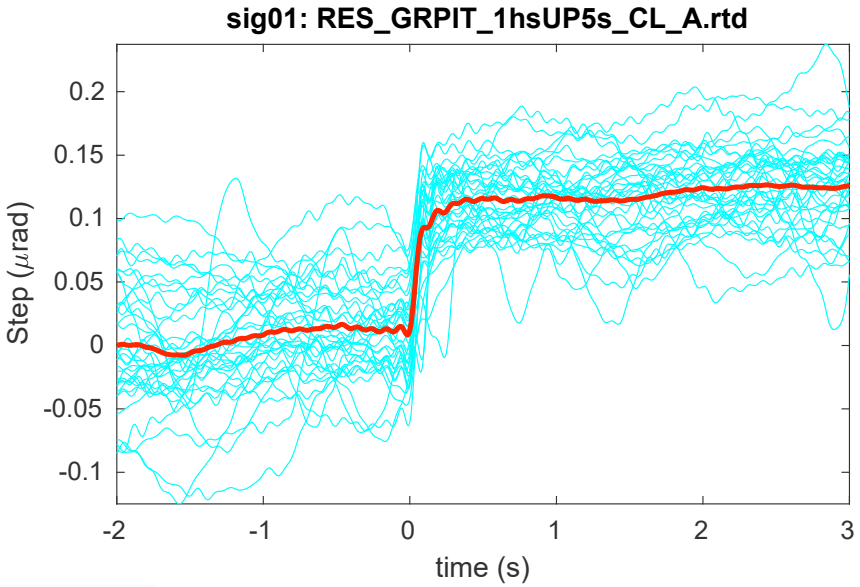
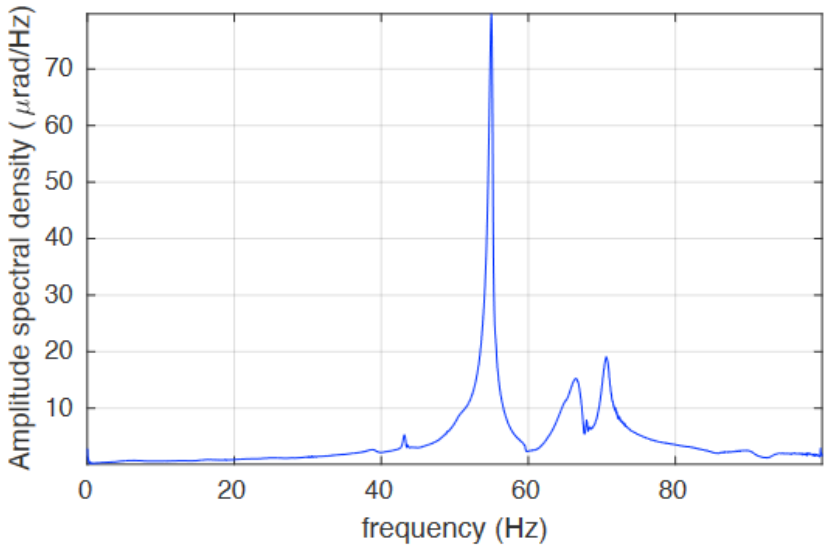
Gratings system

Motions, grating pitch



Resolution <100nrad
Errors below ±0.8μRad

Grating pitch stability



Gratings pitch resonance modes

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Performances. Theoretical & measured

Theoretical

Parameter	Pitch	Exchange
Total range	±5.5deg	±150mm
Resolution	0.105 µrad/halfstep	0.155 µm/halfstep
1st resonance mode	67.6Hz	

Measured

Parameter	Pitch	Exchange
Resolution	0.085 µrad/2 halfstep	Not measured
Repeatability	0.77 µrad	23.6µrad
1st resonance mode	56Hz	

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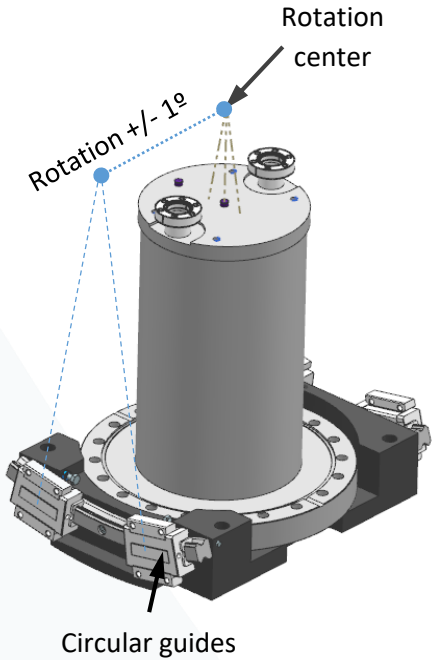
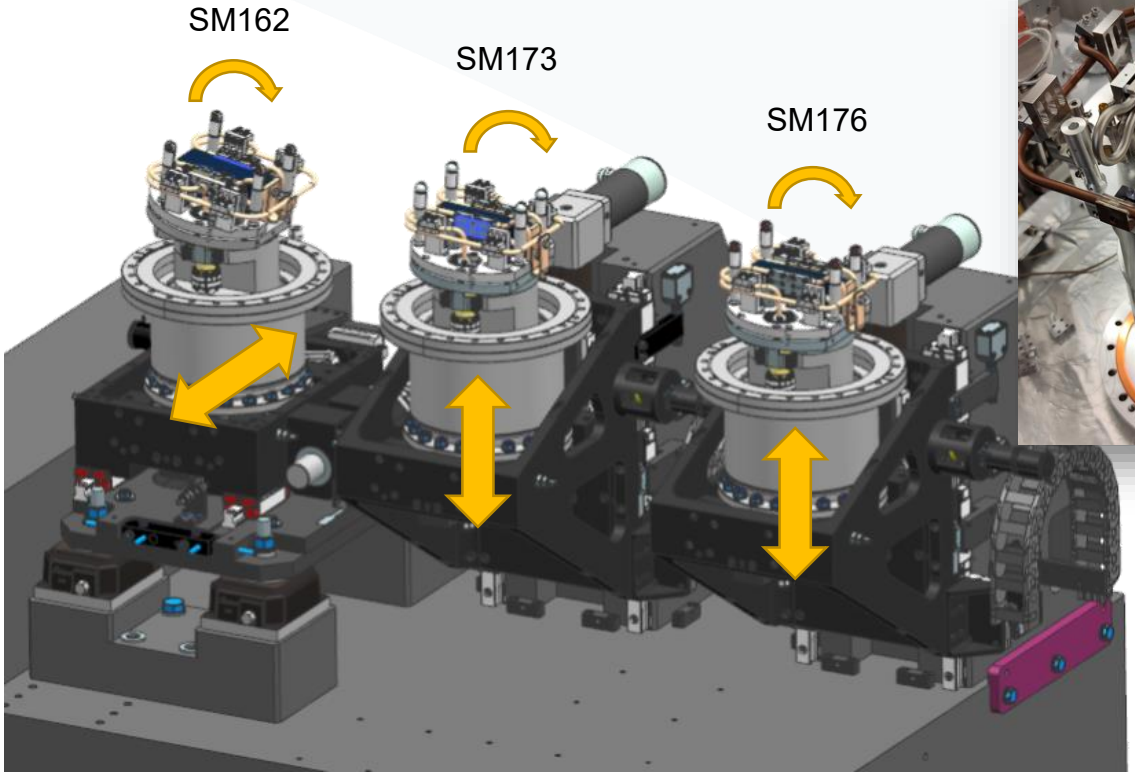
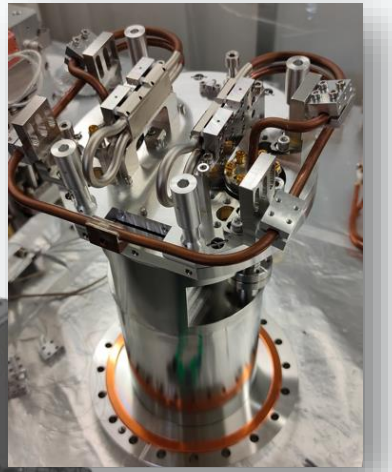
Mirrors system

Mirrors motions







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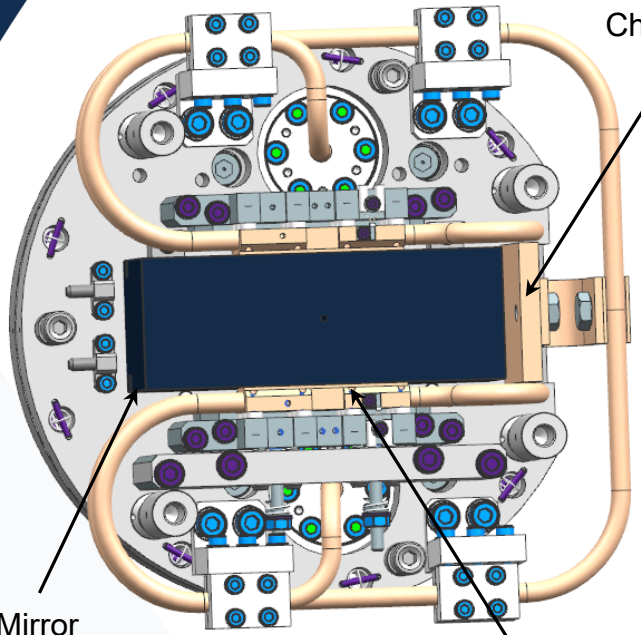
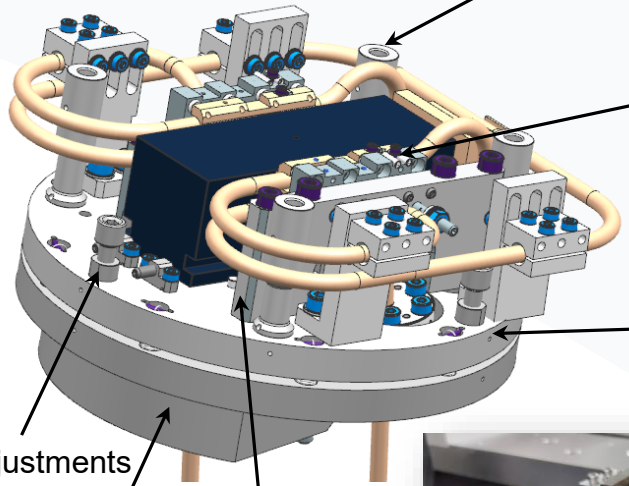
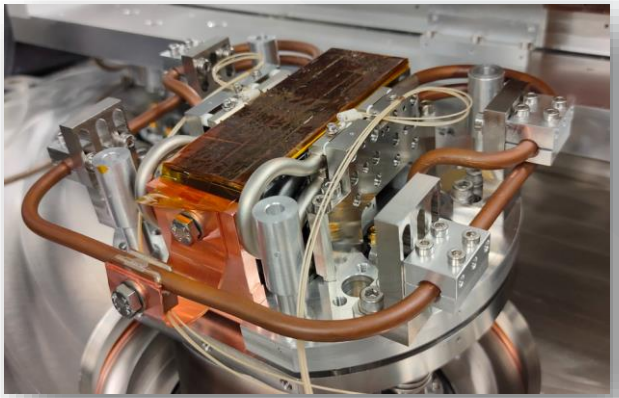
Mirrors system

Mirrors Holder







Not rigidly connected with optics

Fully removable with optic

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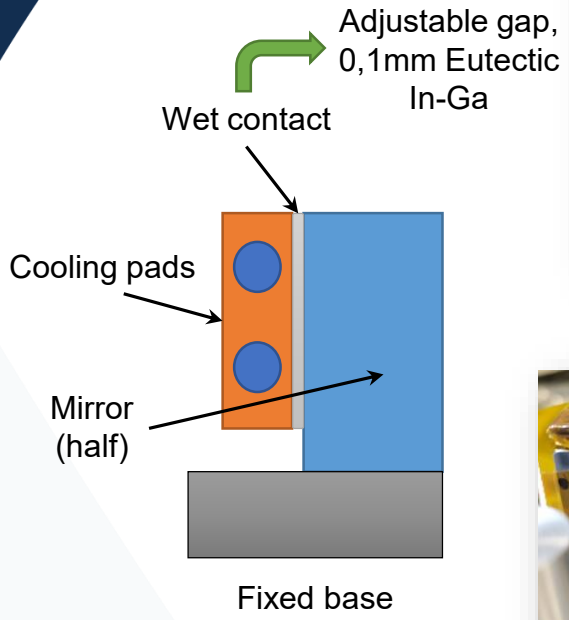
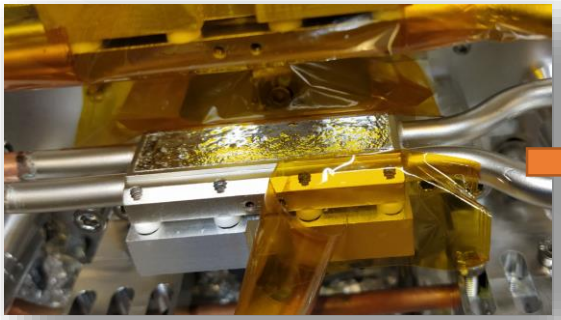
Mirrors system

Mirrors cooling



Mirror isolated from external perturbations



Pads preparation (Ni plated)

Mirror preparation

Final assembly adjusted

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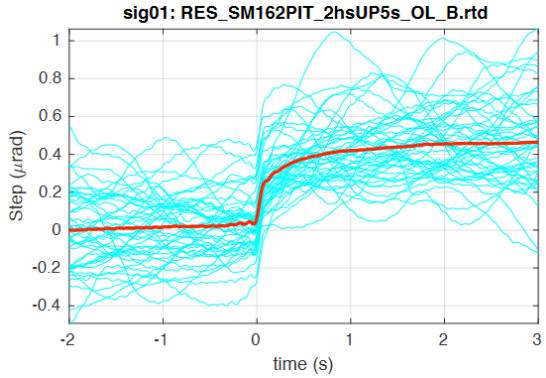
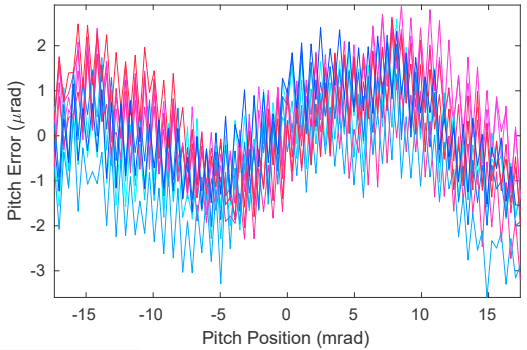
Mirrors system

Mirrors pitch (SM162)

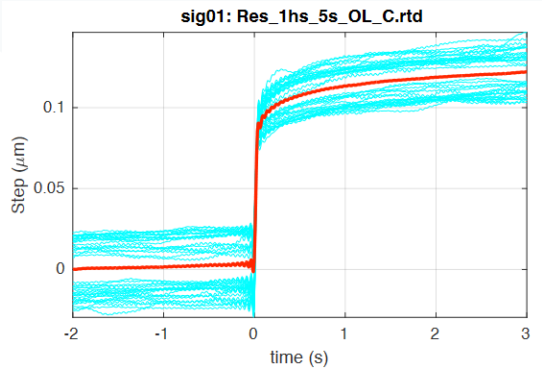


Resolution
0,23μrad

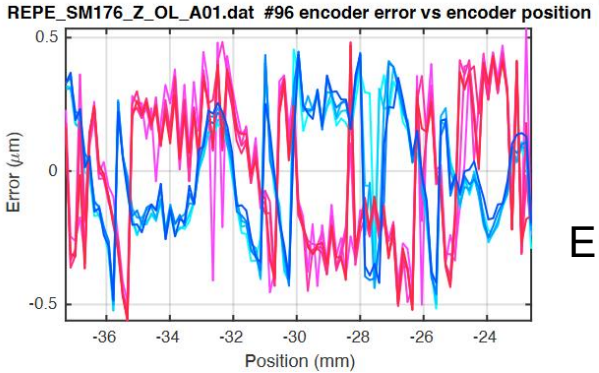


Errors below
±2μrad

Mirrors retraction (SM176)



Resolution
0,1μrad



Errors below
±2μm

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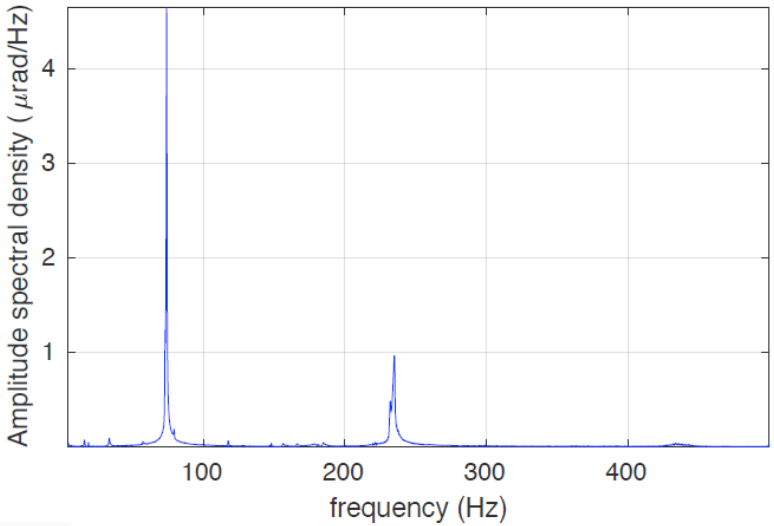
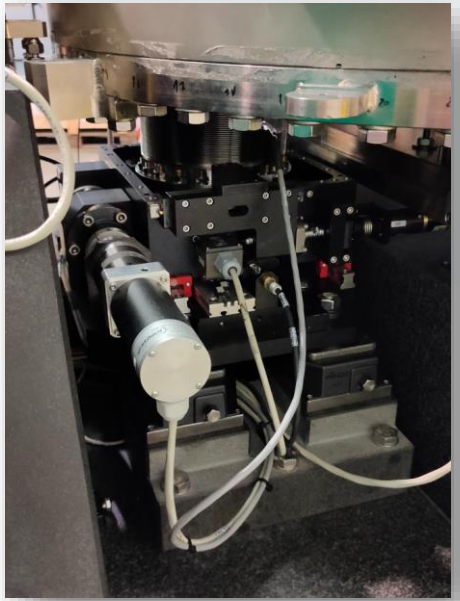
Mirrors system

Stability (SM162)



Mirrors resonance modes



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Mirrors system

Performances, theoretical & measured

Theoretical

Parameter	Pitch (x3)	Z (x2), X
Total range	±1deg	+40mm/±10mm
Resolution	0.2µrad/halfstep	0.125 µm/halfstep
1st resonance mode	135Hz	

Measured

Parameter	Pitch SM162	Z SM176
Resolution	0.232 µrad/2 halfstep	0.998 µm/halfstep
Repeatability	1.39 µrad	0.18 µm
1st resonance mode	74Hz	

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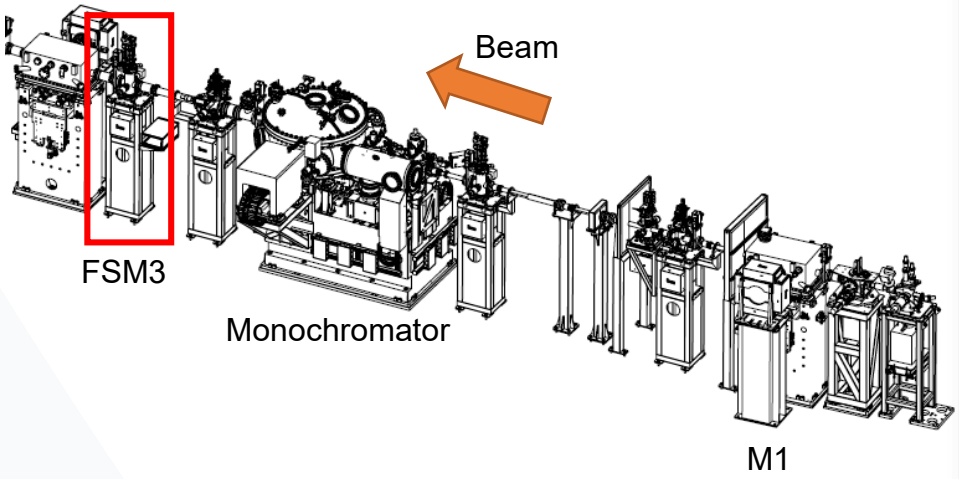
First beam



First 0-order of LEG Grating at LOREA FSM3

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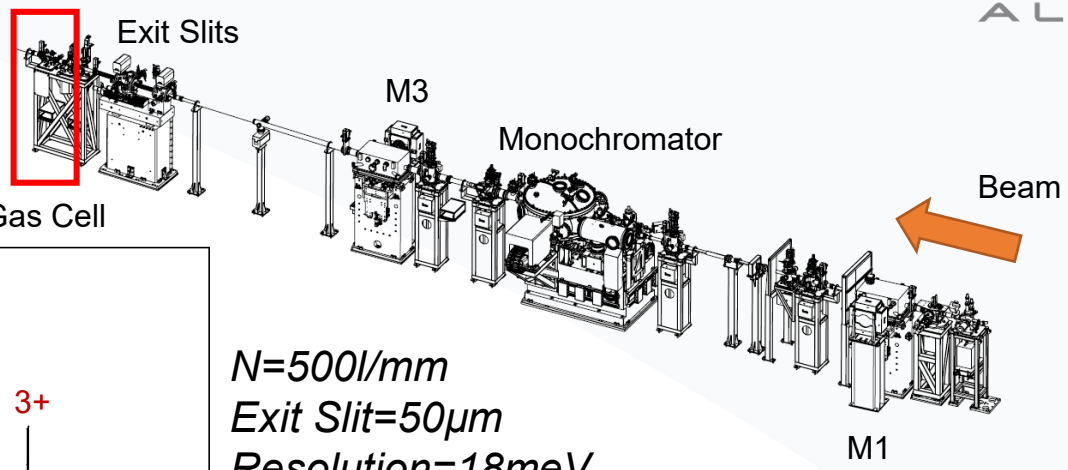
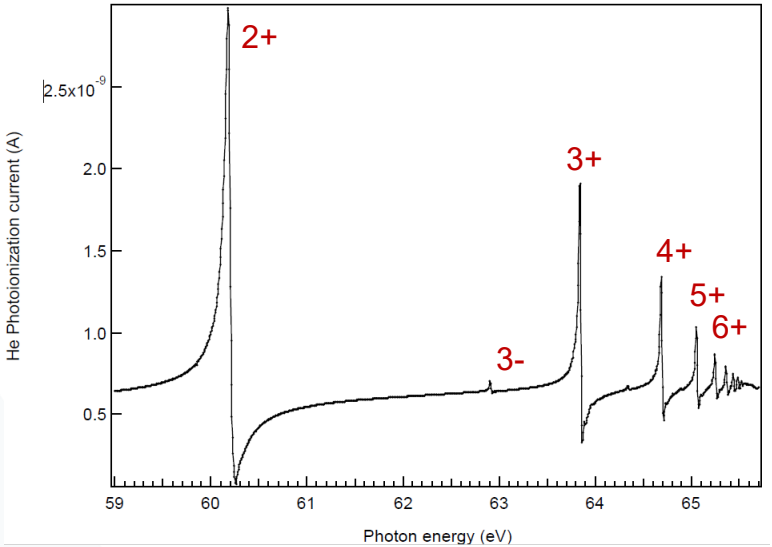
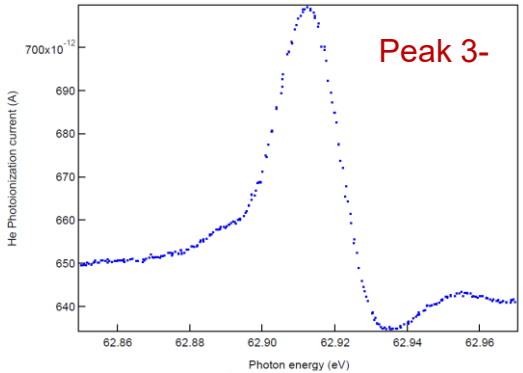
Results & Measurements

First spectra





N=500l/mm
Exit Slit=50μm
Resolution=18meV



Helium photoionisation spectra at LOREA Gas Cell

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Conclusions

A high performance soft x-ray monochromator has been designed and built at ALBA

1) Grating cooling without any water circulating at the grating moving parts, to minimize vibrations and potential vacuum problems.
- Water circuit (continuous copper tube) is mechanically decoupled from grating pitch mechanism.
- Peltier cooling allows for high cooling efficiency and active stabilization of gratings temperature.

2) High stability mirror system
- Cooling geometry is fixed and independent of the motions of the mirror.
- Thermal contact between cooling and mirror is done via a wet interface. It is more efficient than dry interface, and avoids mechanical deformations of the mirror.

3) excellent results confirmed by metrology and first commissioning results

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Llibert Ribó

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Josep Nicolas

BL Scientists

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Federico Bisti

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Thank you

Questions?

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