

# ALBA BOREAS Beamline 29 MARES End Station detectors design, ALBA-CELLS synchrotron light source

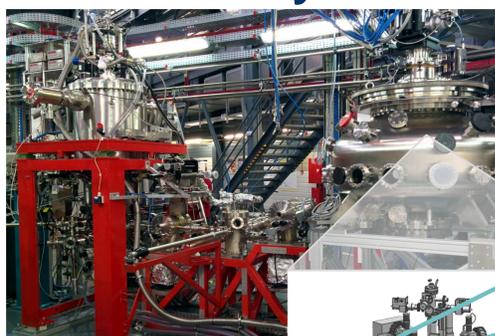
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## Abstract

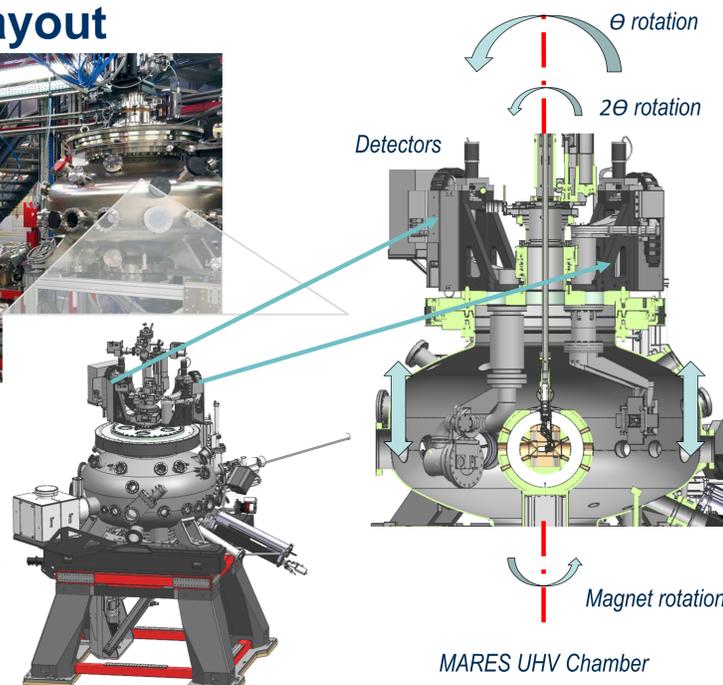
BOREAS beamline at ALBA synchrotron facility is soft X-ray beamline dedicated to polarization-dependent spectroscopic investigations of advanced materials. The second End Station, MARES (magnetic resonance scattering) is a reflectometer for a scattering in a UHV environment. For this purpose, the system has a  $\Theta$ ,  $2\Theta$  rotary feedthrough that allows the positioning of detectors and samples in the appropriate configuration to perform the experiment. ALBA engineering division has developed two mechanical arms to place different detectors, one in-vacuum CCD camera and one channeltron device (with additional diodes). The main goals of designs were to achieve high resolution, accuracy and stability. The concept of the two detectors is a classic mechanical system that moves the detector inside vacuum chamber in Z direction. The whole mechanism is separated in two assemblies; the external one mounted at air side, basically the mechanics, and the internal one, the detectors with an in-vacuum arm support. With this solution, main design goals have been achieved, these are the some important results: first resonance modes of systems are being moved over 35Hz to avoid floor resonance amplifications. Regarding positioning performances, CCD camera system has a 155mm range inside vacuum with  $1\mu\text{m}$  resolution. Channeltron system has a 100mm range inside vacuum with  $1\mu\text{m}$  resolution too. All material used are UHV compatible, bakeable and especially non-magnetic in order to not disturb the magnetic field of station cryomagnet. In addition, some in-vacuum piezoelectric precision movement systems have been introduced to move detectors shutters or slits. These components simplify the design, keeping the capabilities of detectors. Finally, to reach a proper design several solutions have been analyzed, with FEA tools, to validate a compromise solution which has been produced and tested.

## Beamline Layout



BL29 End Stations System

MARES End Station



## Specifications

### Basic design

The systems are composed by two main systems:

- Out vacuum mechanics:
  - Main body support
  - Z-motion
  - Stable support
- In vacuum sensors systems:
  - Sensor holders
  - Shutter, slits subsystems
  - Air side, vacuum separation
  - Vacuum compatible, bakeable materials

### Specifications CCD detector

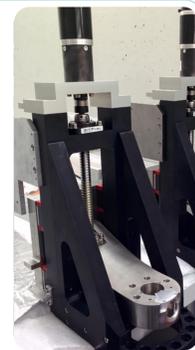
Characteristic	Performance
Materials	No magnetic
Z-movement	Motorized
Mechanical stability	Minimum deformation
Mounting interphase	DN100CF Flange
Travel	As long as possible
Movement resolution	1-5 $\mu\text{m}$
Detector protection	Shutter, screen

### Specifications Channeltron detector

Characteristic	Performance
Materials	No magnetic
Z-movement	Motorized
Mechanical stability	Minimum deformation
Mounting interphase	DN100CF Flange
Travel	+/- 50mm
Movement resolution	1-5 $\mu\text{m}$
Detector protection	Slits

### Linear movement

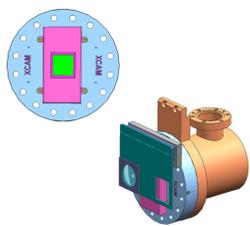
- Stepper motor:
  - Low backlash, 50'
  - Reduction 1:100
- Linear precision guides:
  - Preloaded carriages
  - $<50\mu\text{m}$ ,  $<0,05\text{mRad}$
- Ball spindle:
  - Preloaded
  - $\varnothing 20\text{mm}$ ,  $p=5\text{mm}$
- Expected resolution
- Resolution of 0,5 $\mu\text{m}$



## Design CCD Detector

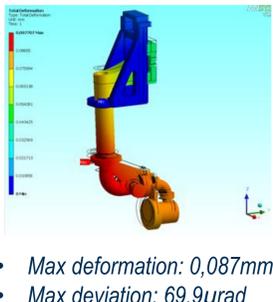
### Detector

- CCD Camera



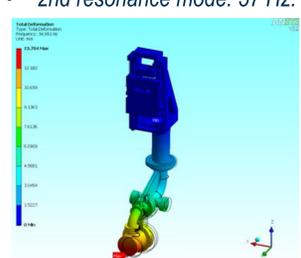
- In vacuum

### Deformation



### Stability

- 1st resonance mode: 35 Hz
- 2nd resonance mode: 57 Hz.



### Detector protection system, shutter & screen

- Piezoelectric actuator, guided (Smaract®)

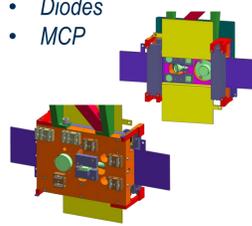
CCD three working position available



## Design Channeltron Detector

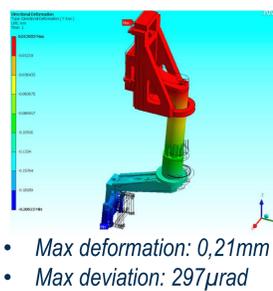
### Detector

- Channeltron
- Diodes
- MCP



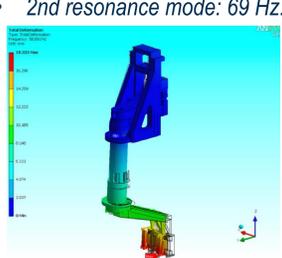
- Peek box

### Deformation



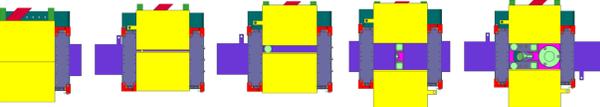
### Stability

- 1st resonance mode: 59 Hz
- 2nd resonance mode: 69 Hz.



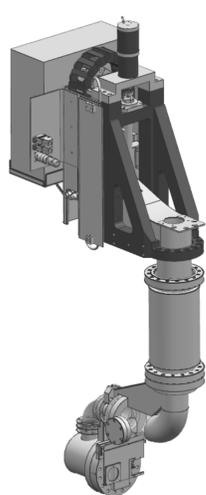
### Detectors slits

- 4 Piezoelectric actuator, guided (Smaract®)

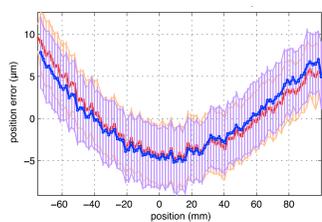


Beam footprint available at every sensor from 0 to 100%

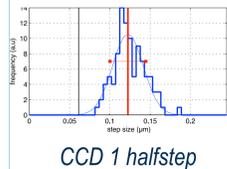
## Construction & tests



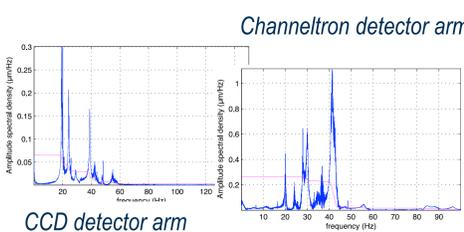
Mechanics Resolution. Results: Measured, both systems 0,125  $\mu\text{m}$



Channeltron2 halfstep



### Resonance Modes



Detector	1st mode
CCD arm	39Hz
Channeltron arm	42Hz

### Background

