SYNCHROTRON LIGHT SOURCE

First results with the NOM-LTP at the Alba optics laboratory

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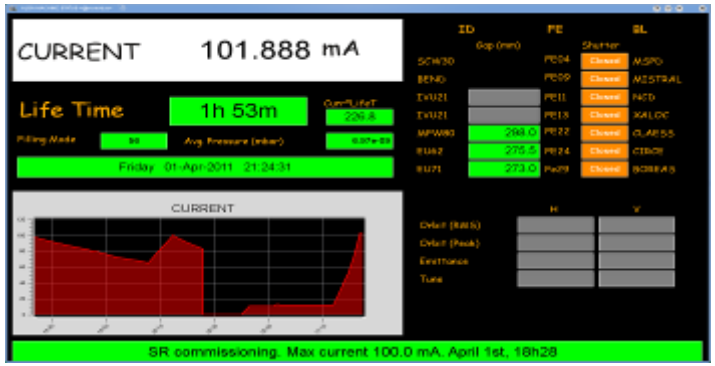
About ALBA

The machine

- *3 GeV machine 4.5 nmrad, prepared for Top Up*
- *Currently in commissiong of the SR*
  - *Mar 8th: Arrives the operation permit*
  - *Mar 9th: 1st turn completed*
  - *Mar 16th: 1st accumulated beam*
  - *Apr 1st: 100 mA*



Beamlines Phase 1: 7 beamline

- *3 grating monochromators 100 eV – 4keV*
- *4 crystal monochromators 6 keV – 60 keV*
  - *37 mirrors and gratings - 27 measured and installed*

The lab of optics has performed the acceptance and characterzation of optical elements.


NOM enclosure
NOM
FIZEAU
INTERFEROMETER

NOM @ Alba

Based on autocollimator and scanning pentaprism in stable environment

1500 mm scan length

300 mm sagittal translation

High accuracy,repeatability and stability

AC noise:

Typical 100 nrad @ 25 Hz

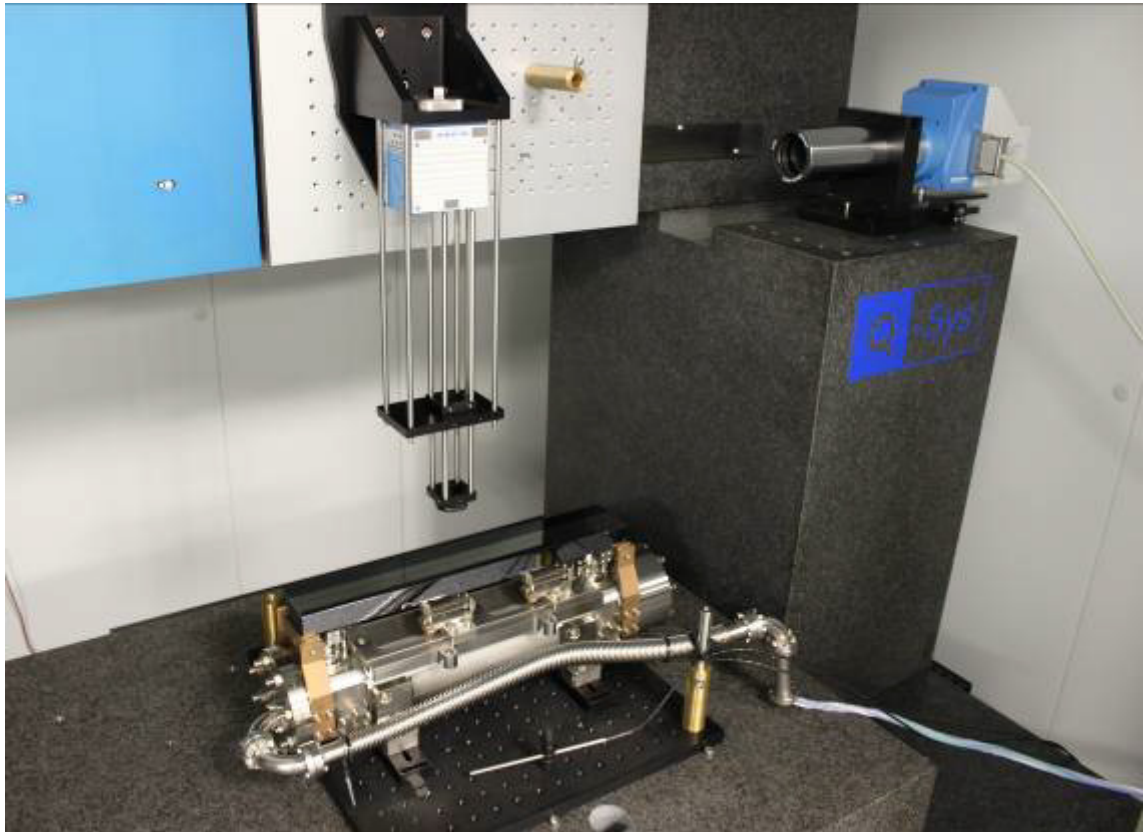
20 nrad @ 1 Hz

Temperature stability:

~ 20 mK/day

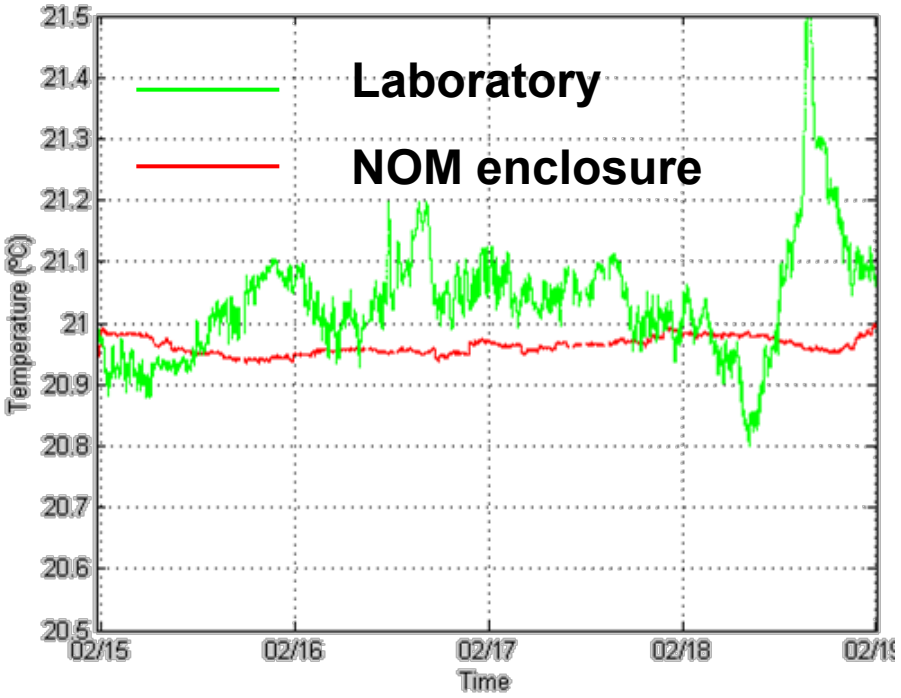
~10 mK during scans

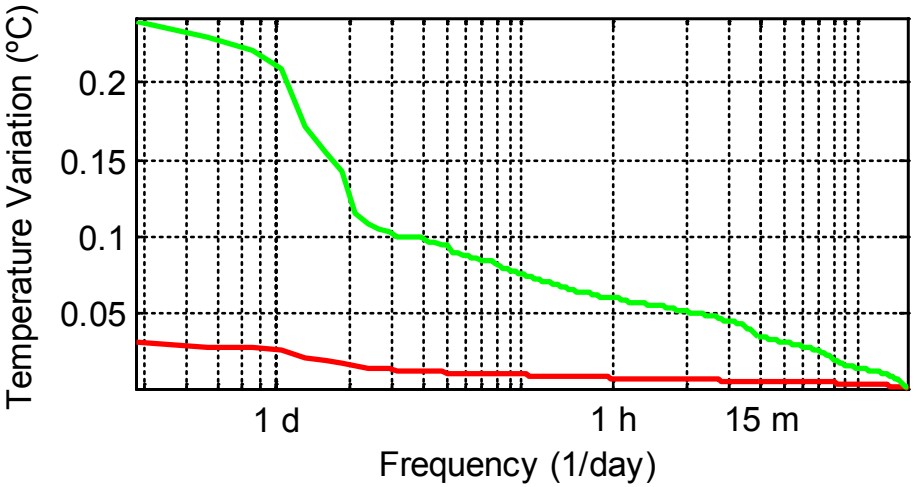
worse for longer periods



Temperature stability

The NOM is installed in a thermal isolation enclosure





Temperature of the room still to improve. HVAC still in commissioning.

However the NOM enclosure dumps very well temperature variations

Integrated to Tango control system

Motion and acquisition are driven by Tango device servers

Easy to integrate mirror control on the lab.

Matlab binding:

➔ *Program scans* ➔ *Automation*

➔ *GUI*

➔ *Data Analysis*

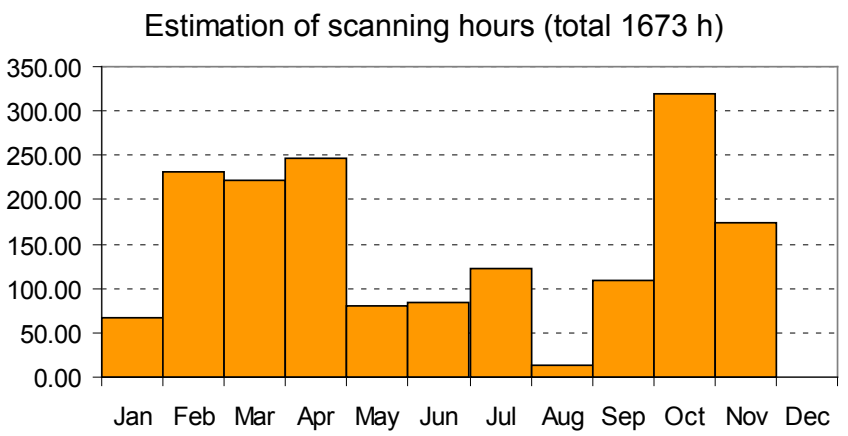
Almost 1700 h of scans in 2010

➔ *Acceptance of 27 mirrors + holders*

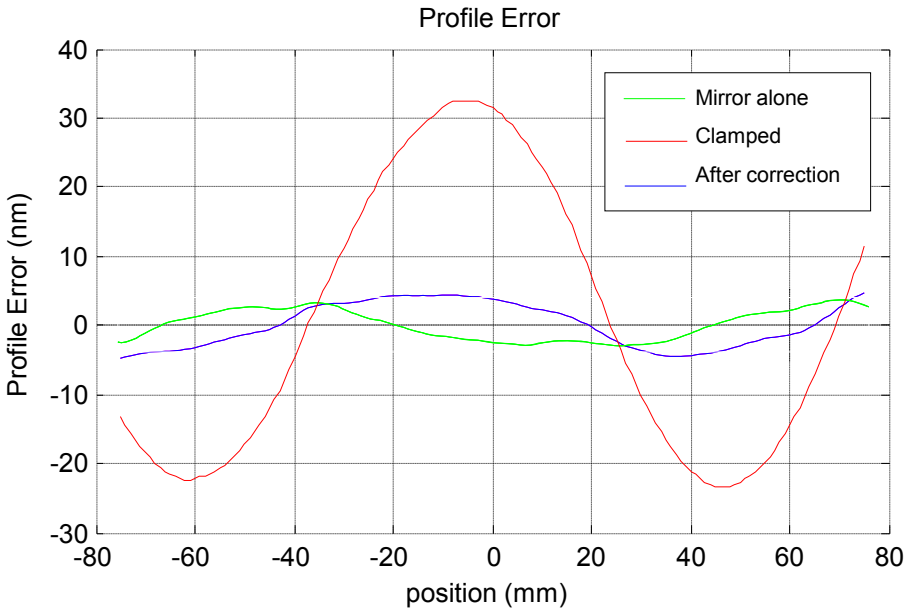
➔ *Calibration of benders*

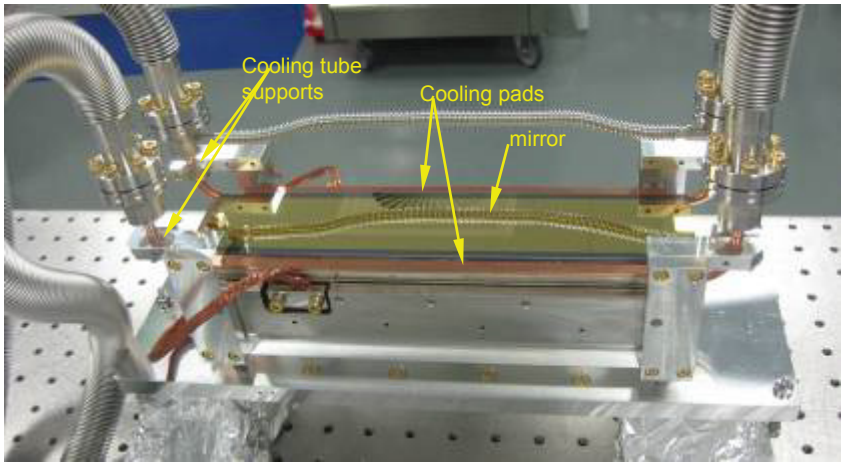
➔ *Optimization of mirror shapes*

➔ *Figure erros below 0.5µrad are frequent*



Deformation induced by a cooling tube





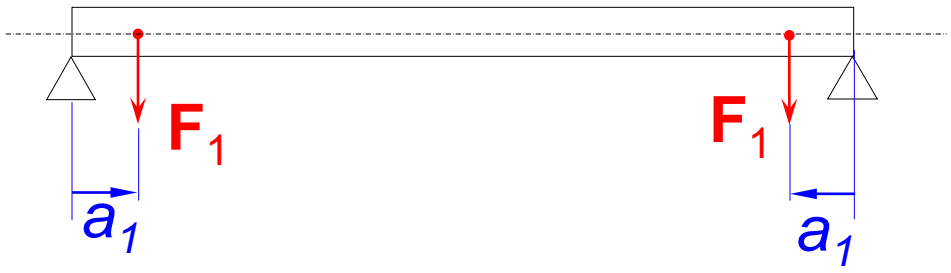
Grating by Carl Zeiss installed on a holder by Toyama:

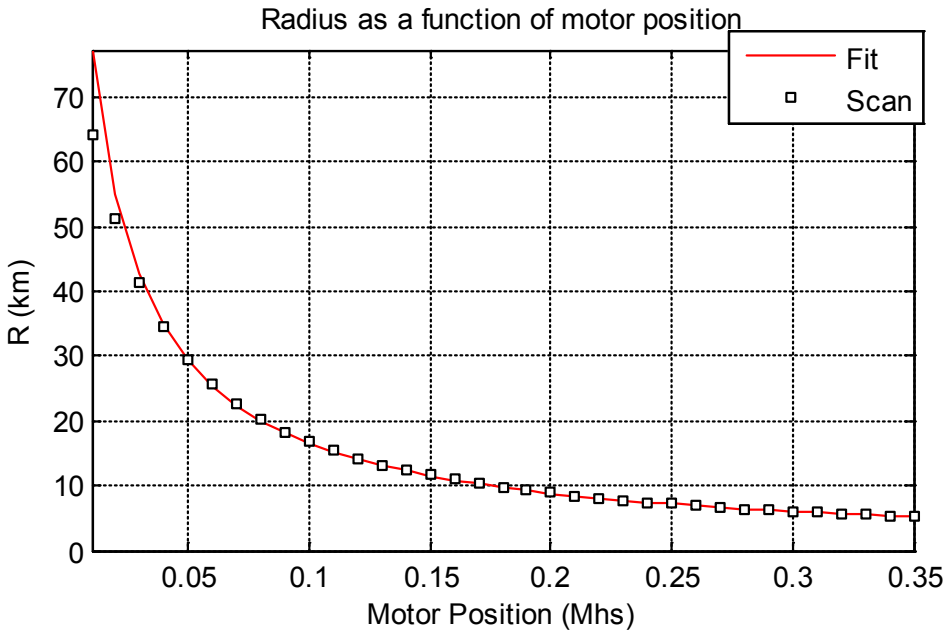
Specification: 0.3 µrad

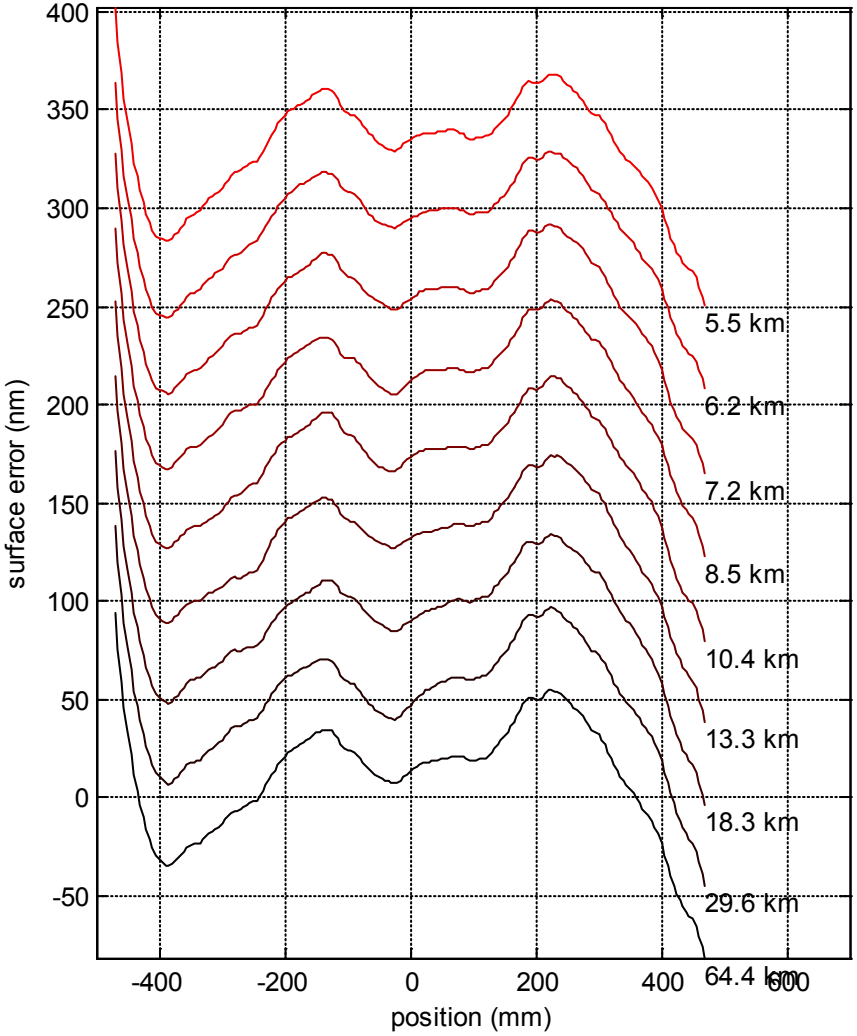
- ***Blank alone: 0.163 µrad***
- ***First mounting on holder 0.533 µrad***
- ***After correction of a support of one cooling tube: 0.190 µrad***

Calibration of mirror benders

One-motor benders can bend mirrors to a cylindrical shape. Calibration consists in providing the Radius as a function of the motor position.



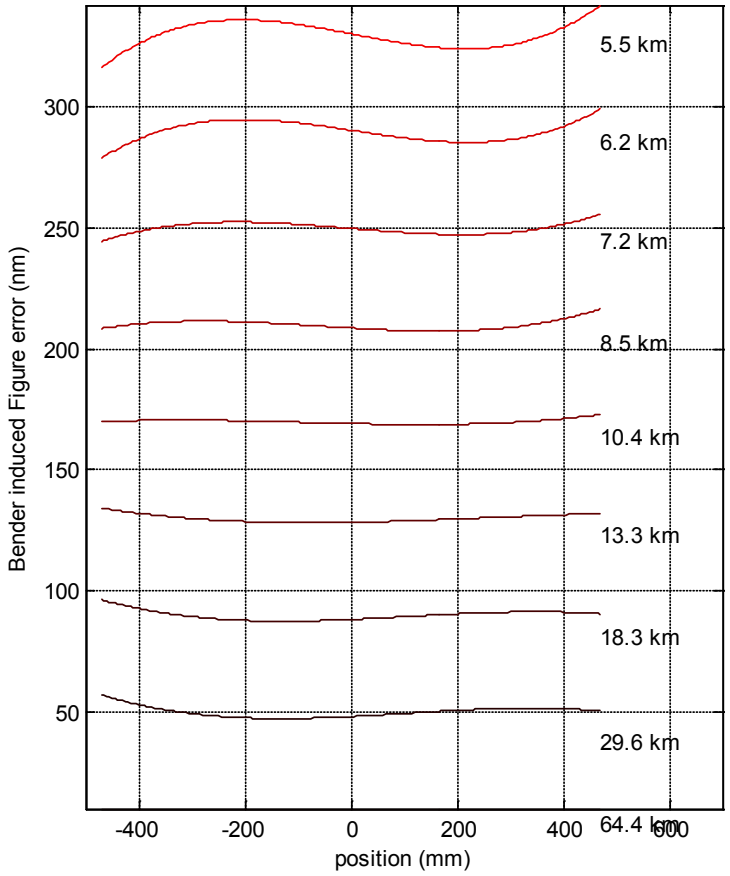




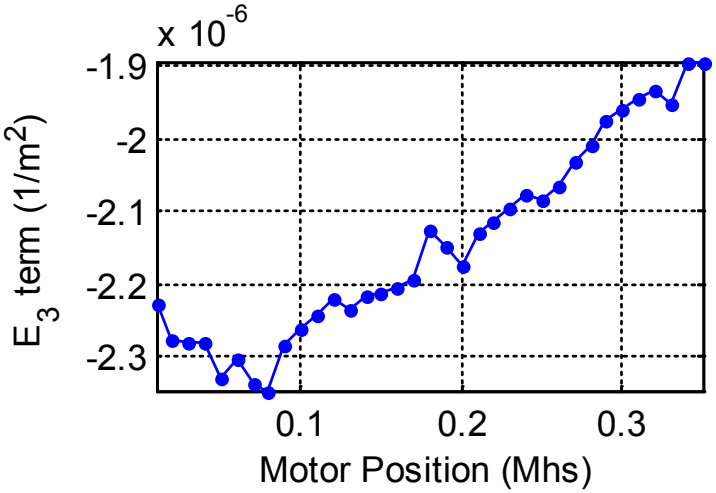
Slope error induced by bender

…when the bending moment is not equal at both ends.

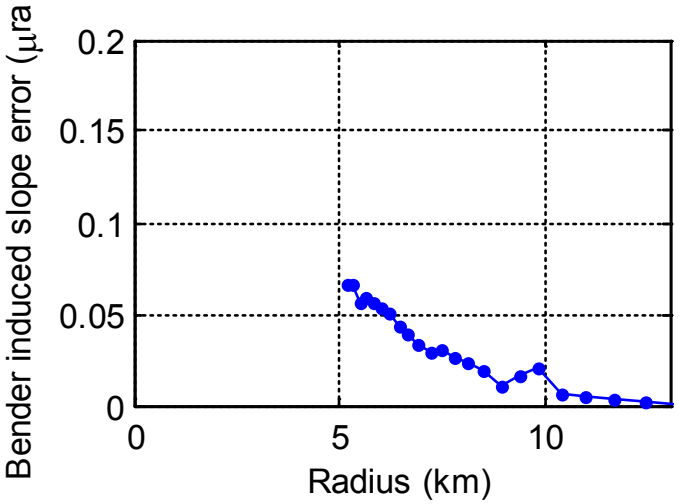
$$f(x) = \frac{a_2 F_2 - a_1 F_1}{6E \cdot I \cdot L} x^3$$



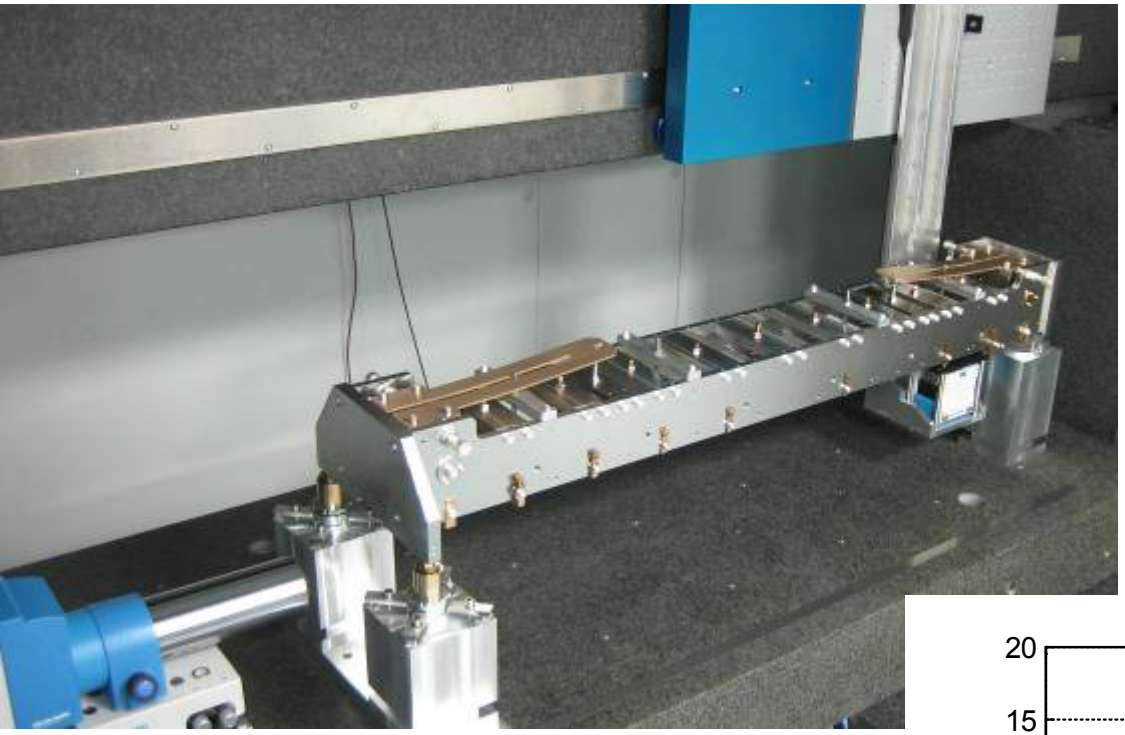
The cubic term should be constant



And contributes to the slope error



Spring actuators (by SESO)



Plano elliptic

Facing down

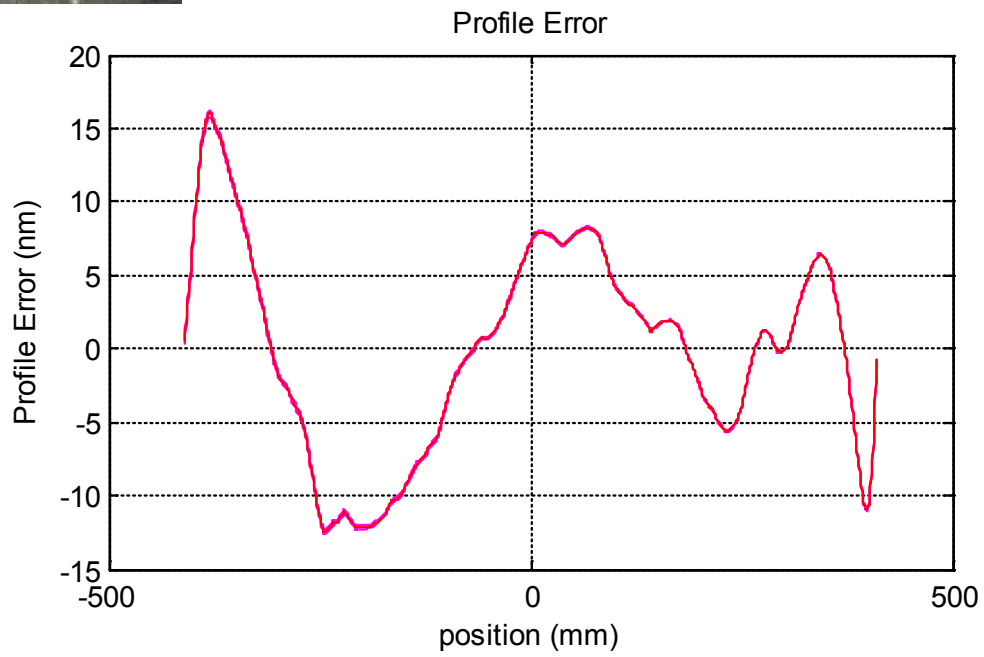
R_0 = 129 m

L = 800 mm (6 mrad)

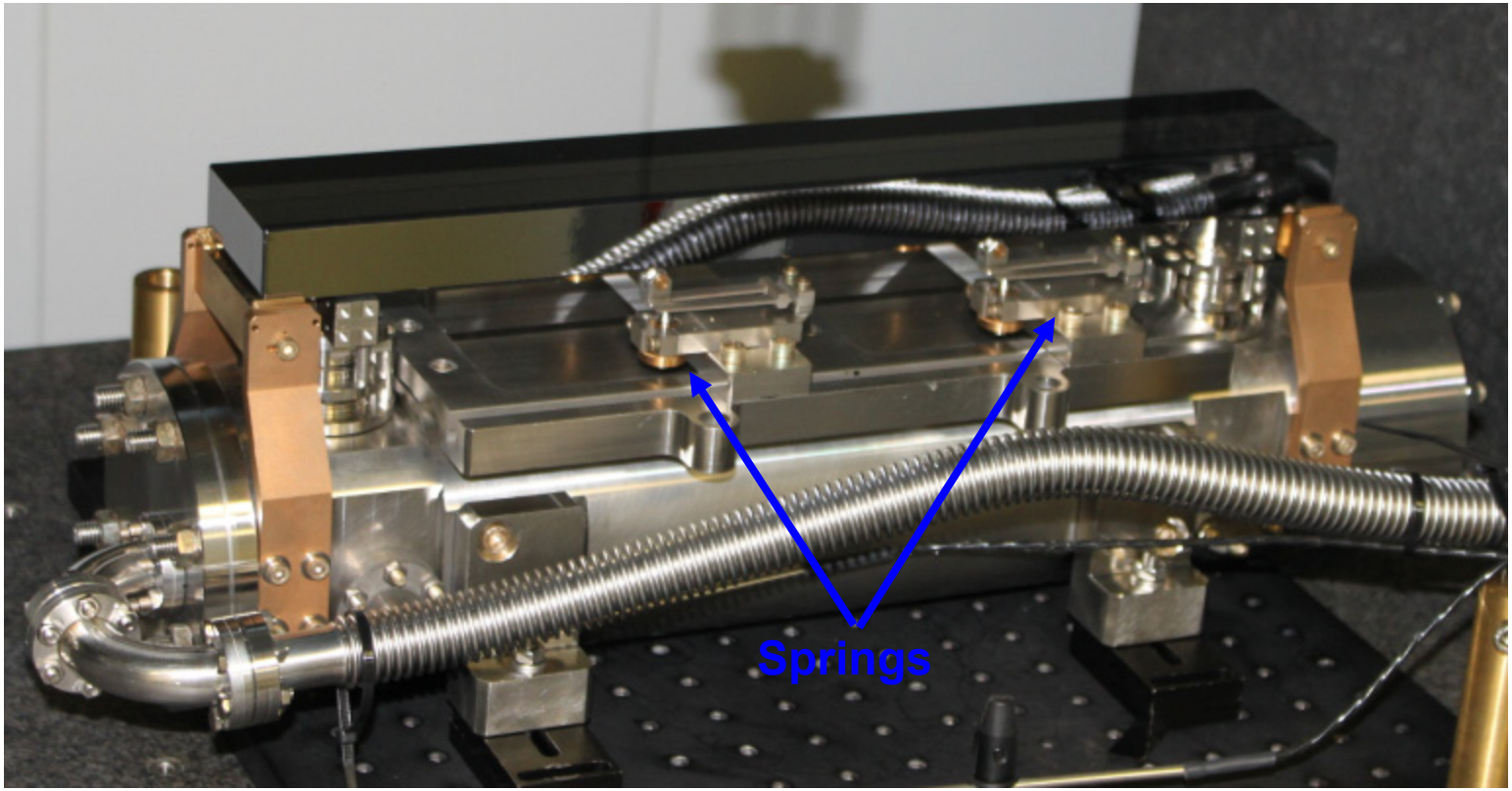
0.234 µrad RMS

The mirror figure was optimized by spring actuators.

***Accuracy** is required for convergence of the optimization process, on both the measurement and on the spring adjustment*



Spring actuators (by Alba)

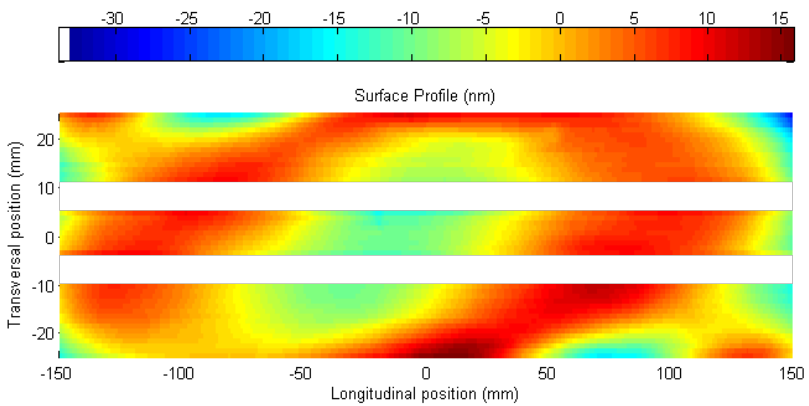


300 mm long mirror by InSync on an elliptical bender by Irelec.

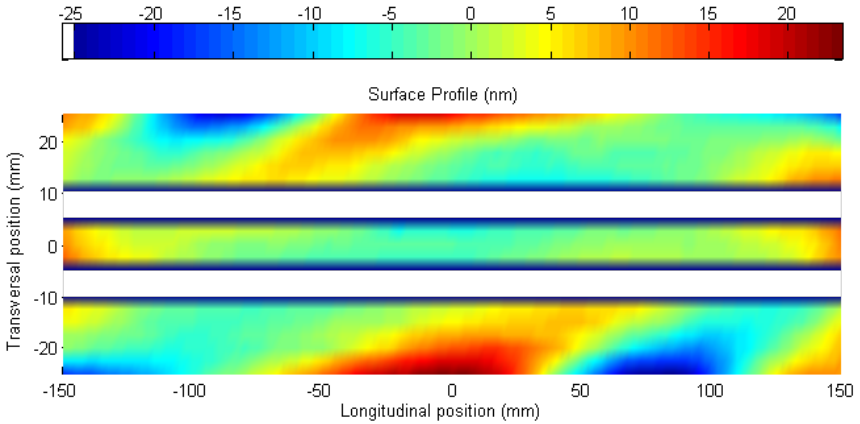
Only 2 spring actuators, initially intended for gravity sag compensation were used to optimize the figure.

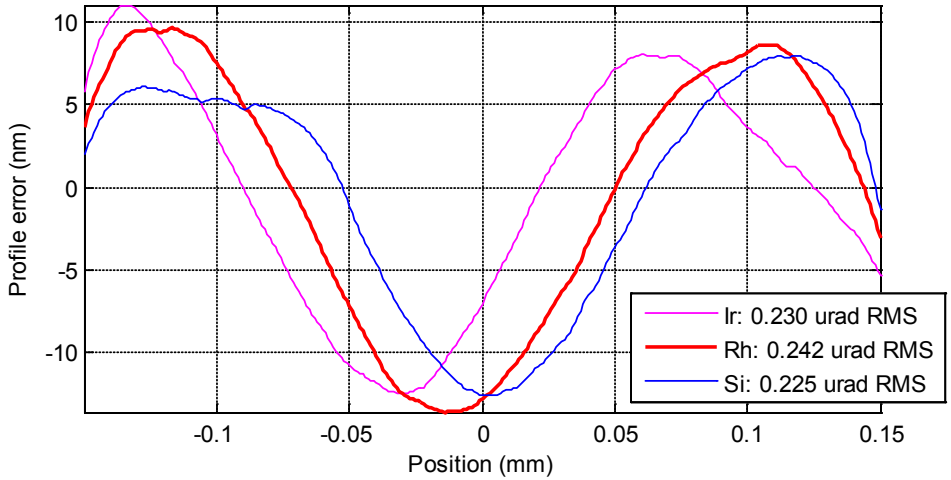
Spring actuators

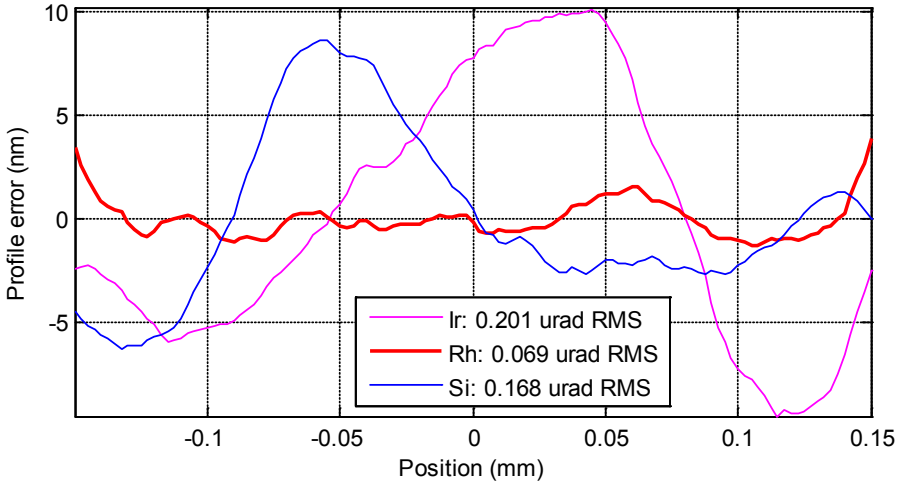
Before optimization



After optimization

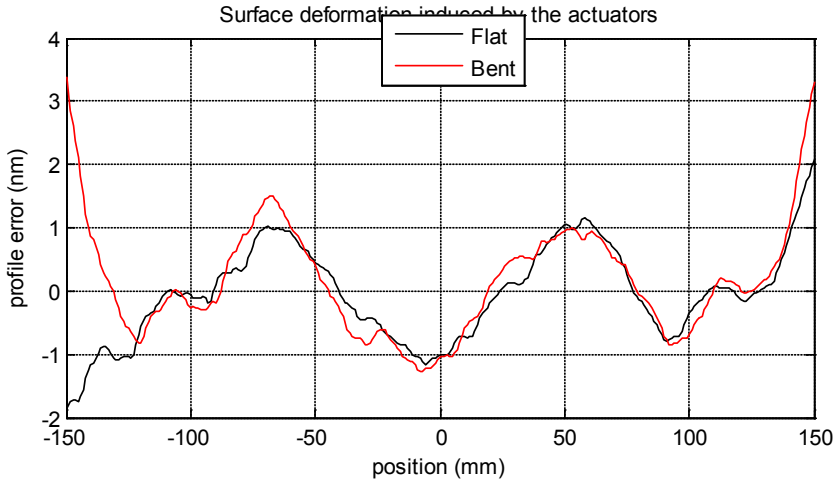






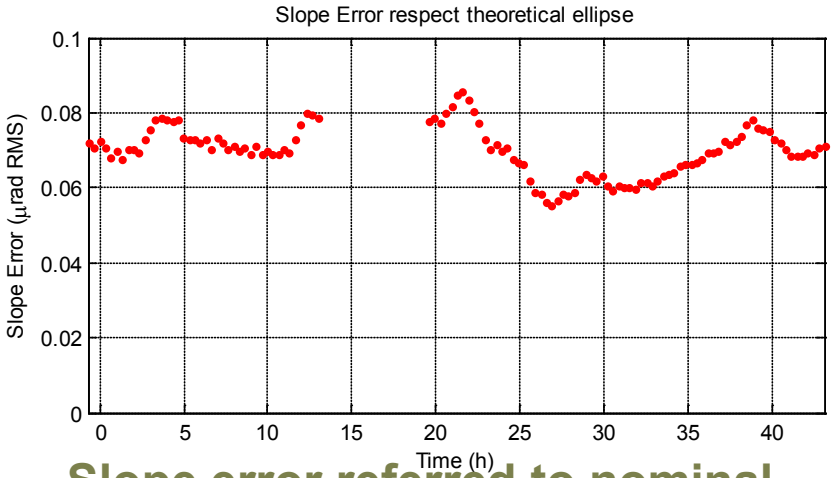
Center stripe improved from 0.242 µrad RMS to 0.055 µrad RMS with 2 actuators
Agreement between prediction and measurement is 0.18 nm RMS

Spring actuators



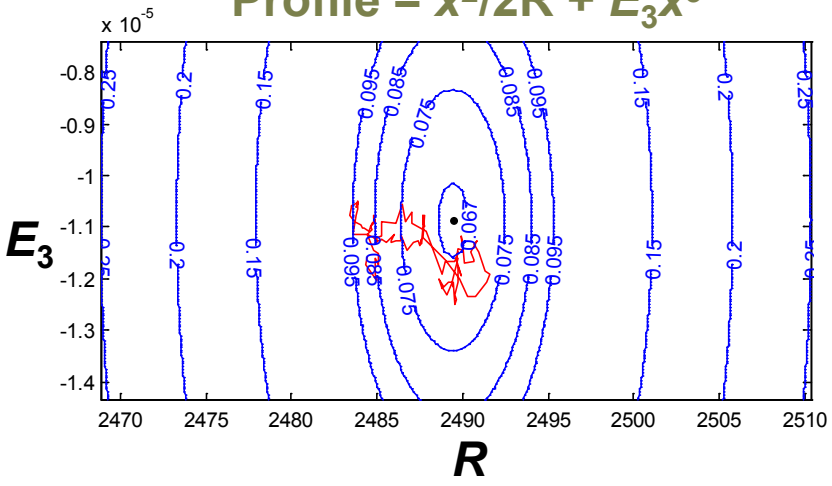
Excellent agreement between measurements done flat and bent. Except near the actuators

Drifts are correlated to thermal unstability, affecting mainly the measurment of curvature.

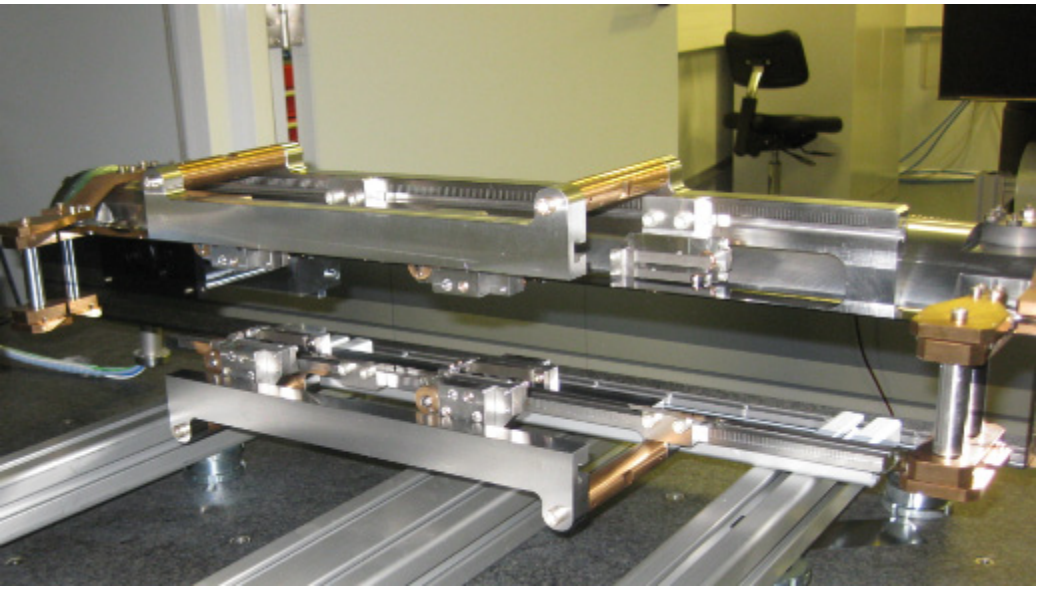


Slope error referred to nominal ellipse vs time

Profile = $x^2/2R + E_3x^3$

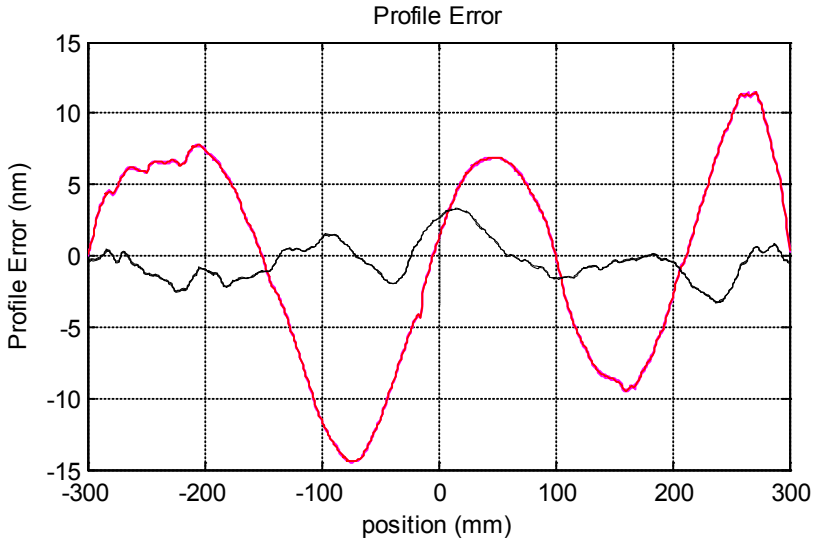


Spring actuators



A second mirror was optimized:

- 600 mm long mirror
- Horizontal deflection
- 4 spring actuators



- Initial error: **0.211 µrad RMS**
- Final error: **0.083 µrad RMS**
- Limited by the poor control of the applied force by the springs (designed for corrections in the order of 0.5 µrad)

Summary

- The ALBA NOM is operating since January 2010
- Alba BL mirrors characterized, slope errors below 0.5 µrad are frequent.
- Measurements of mirrors at working orientation is feasible.
- Among others, the Alba NOM has been used to improve the figure error of mirrors with a reduced number of spring actuators.
- The correction is good to the order of 50 nrad RMS

But we still need to…

- Improve the temperature control of the lab.
- Replace some parts: pentaprism+iris.
- Improve alignment and accuracy tests.

Acknowledgements

Alba's Optics group is small but we have strong support of many people

LTP motion control software	**Zbigniew Reszela**
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	Ricardo Valcárcel
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Clean room climatization	**Jordi Iglesias**
Technicians	**José Ferrer**
	David Calderón
	Pablo Rodríguez
Administration	**Alejandro Sánchez**
	Laura Campos