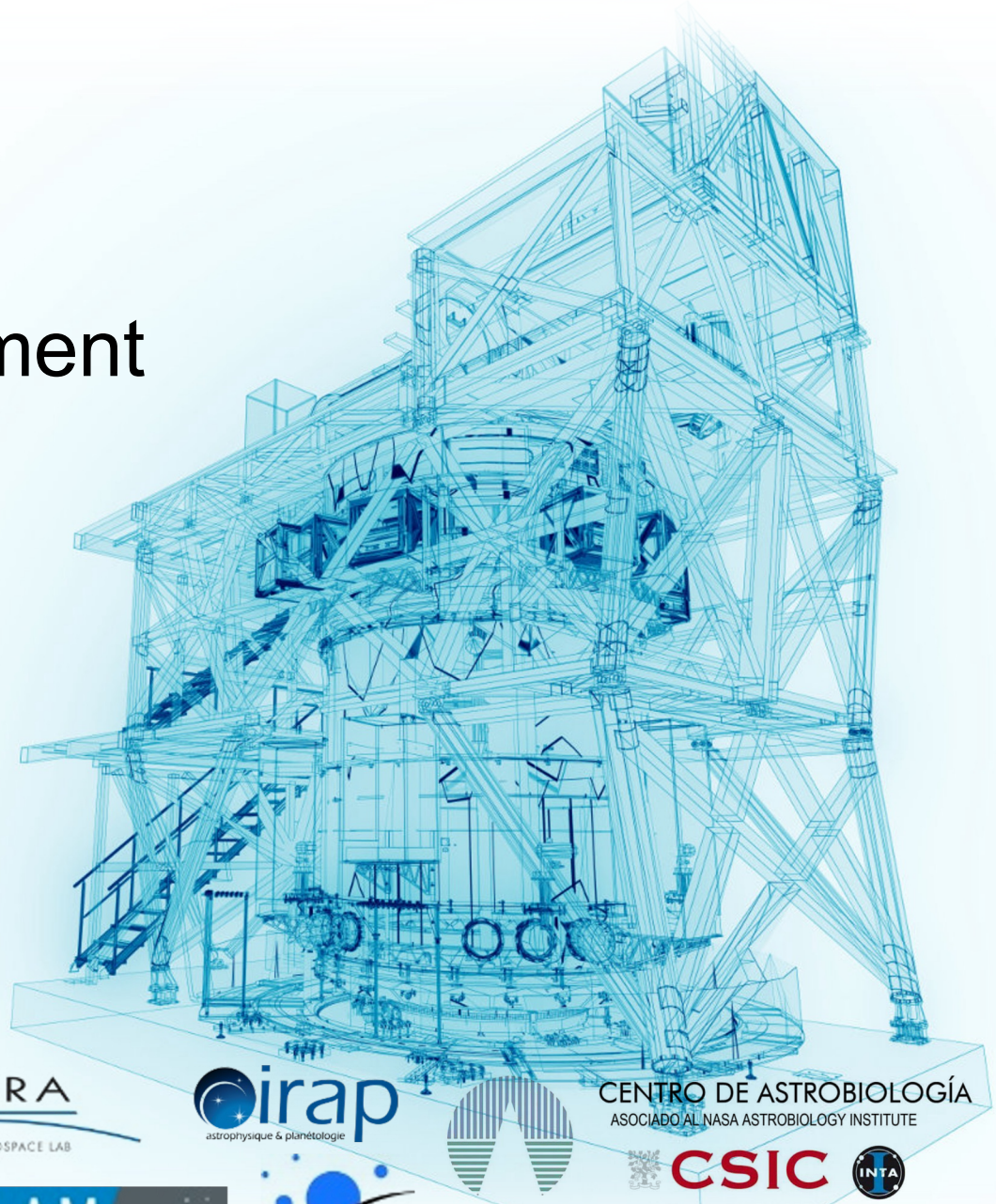
CAB Contribution to the Instrument ELT-HARMONI

The last steps of its design phase

Javier Piqueras López (CAB CSIC/INTA)

HARMONI Calibration Scientist and CAB Project Manager

piqueraslj@cab.inta-csic.es



Science & Technology Facilities Council
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CENTRE DE RECHERCHE ASTROPHYSIQUE DE LYON

THE FRENCH AEROSPACE LAB

astrophysique & planétologie

CENTRO DE ASTROBIOLOGÍA
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE

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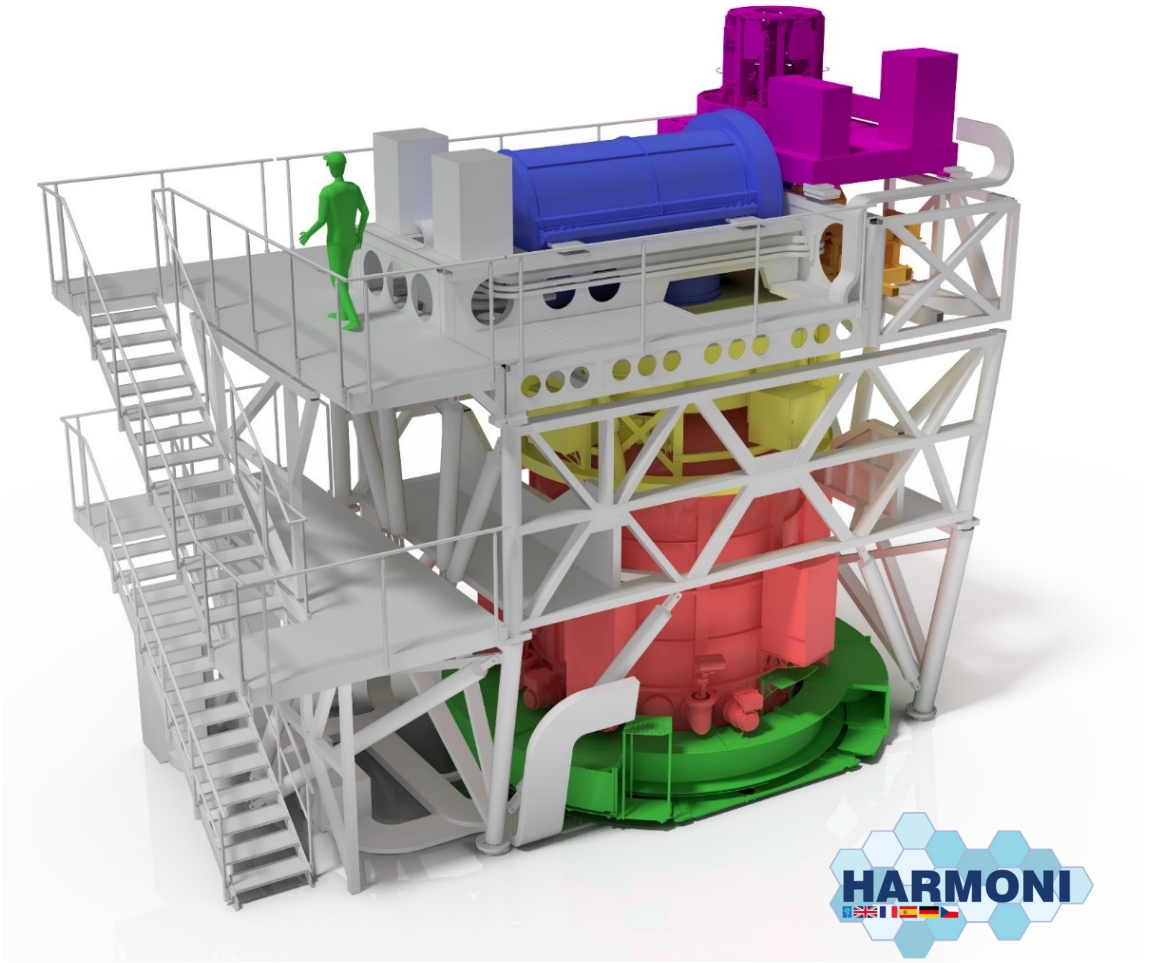
Plan de Recuperación, Transformación y Resiliencia

CAB Contribution to HARMONI

- IAC and CAB contributed to all the HARMONI phases since its original proposal in 2007
- Their contribution to the project (~ 20%, 12.9% IAC and 7.2% CAB) constitutes the Spanish contribution to ELT first-light instruments
- CAB contribution to HAMONI
  - Technical work-packages
  - Instrument Calibration Plan
  - HARMONI Science Simulator (HSIM)
  - HARMONI Science Team



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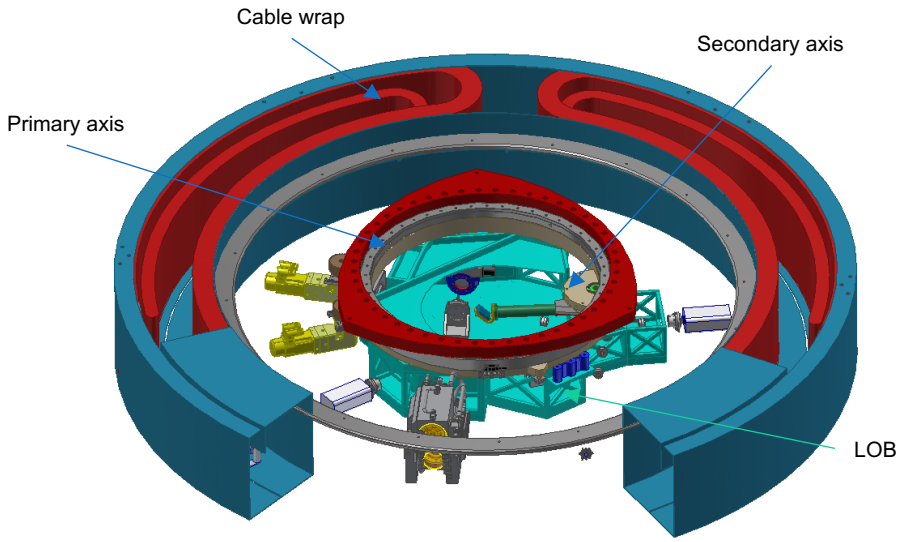
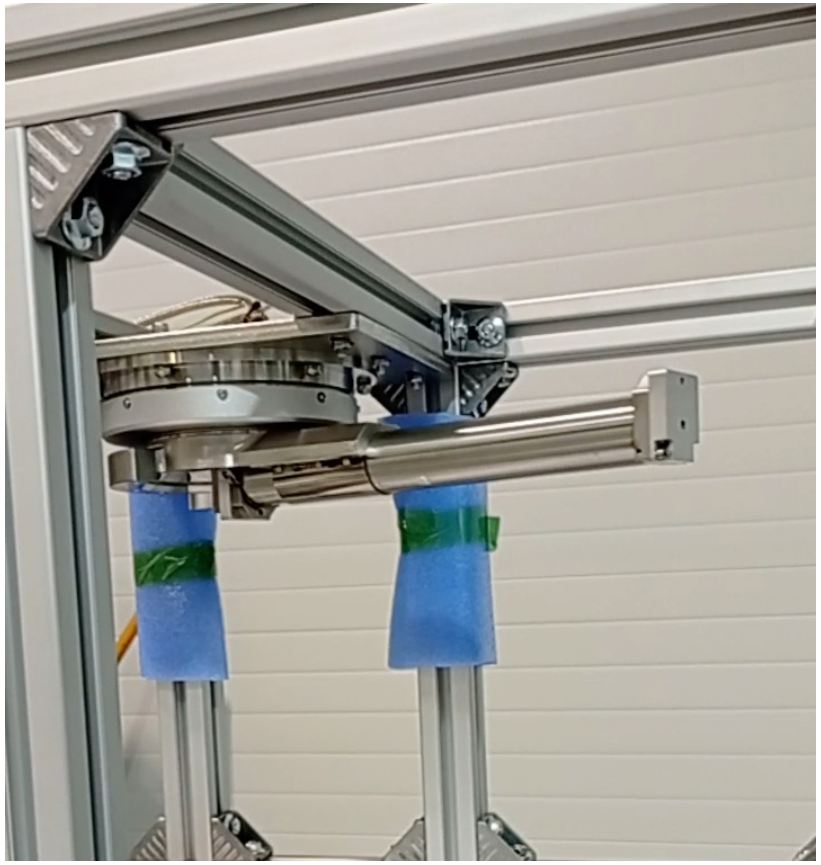
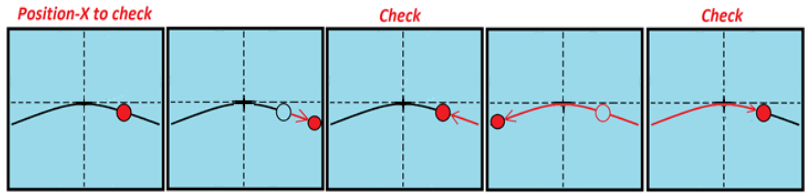
CAB Technical Work-packages

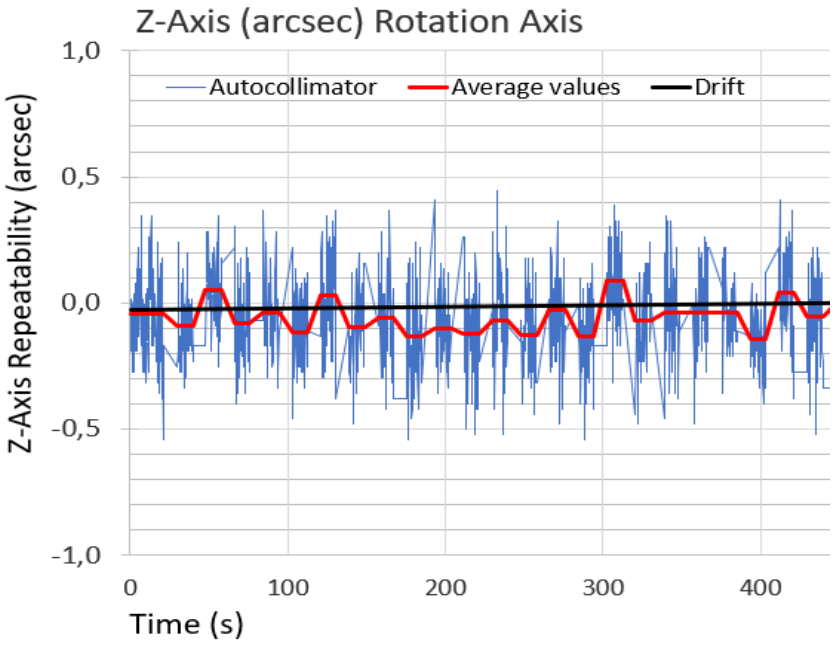
- LOWFS – Low-order Wavefront Sensing Sub-system
  - Pick-off arm (POA)
    - Pick-off mirror that can be positioned around the entire technical field and scientific field of view of the instrument
    - Host the wavefront sensing cameras on a mechanical stage (LOB)
    - Challenging positioning accuracy of ~10 µm over the whole 400mm diameter technical field
  - Low-order optical bench (LOB, developed by U. Durham)
  - The POA is critical to maintain the IQ closer to the ELT diffraction limit, and to transfer the absolute on-sky coordinates to the detector plane
  - Technology development: a prototype of the POA is under development and test at INTA



POA prototyping







	Acceptance Criteria	Results
Bidirectional repeatability	±0.5 as	±0.36 as
Wobble	±0.5 as	±0.45 as
Step resolution	±1.6 as	±1.45 as

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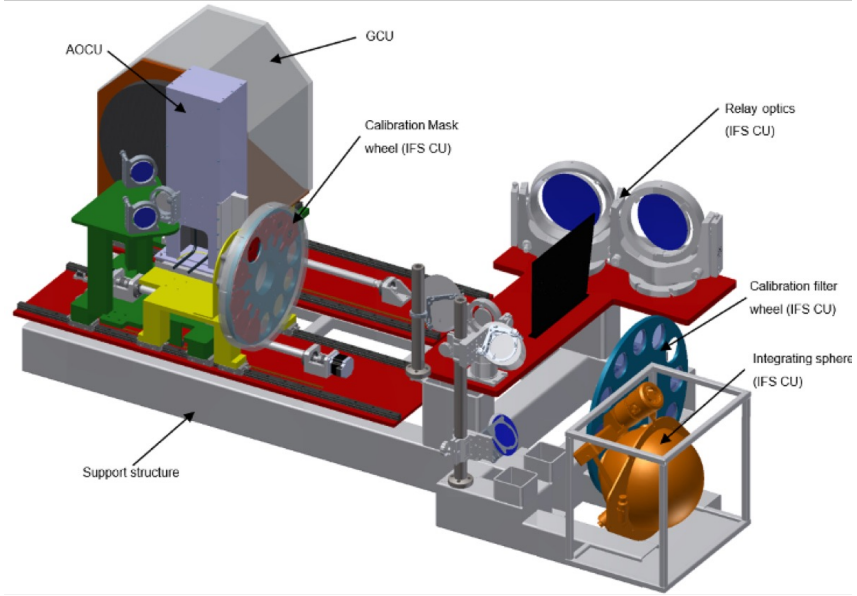
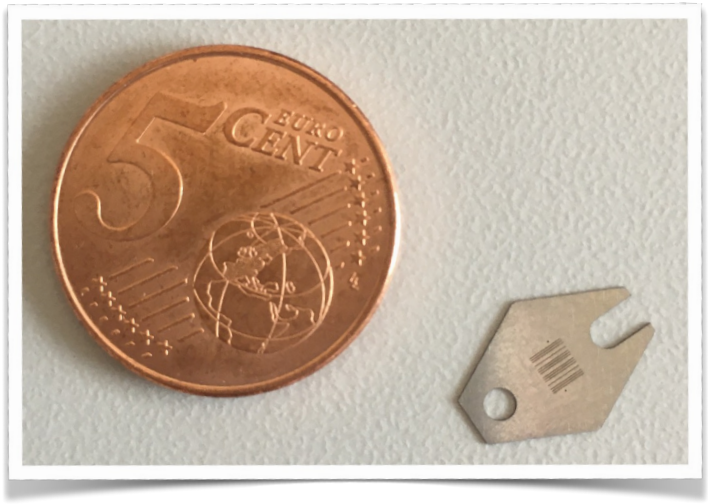
CAB Technical Work-packages

- CM – Calibration Module
  - The CM includes all functions necessary to remove the instrumental signature from the observed science data:
    - Provide uniform (continuum and arcs) illumination at the ELT focal plane
    - Provide well-known spatial and spectral patterns
    - Monitor the health and stability of the instrument
  - Three units to provide different sets of calibration data:
    - IFS unit: science calibrations
    - AO unit: SCAO and NGS calibrations
    - GCU: Geometrical Calibration Unit to calibrate the POA and SCAO
- IFS test equipment
  - Modified copy of the CM for IFS and pipeline testing during AIV





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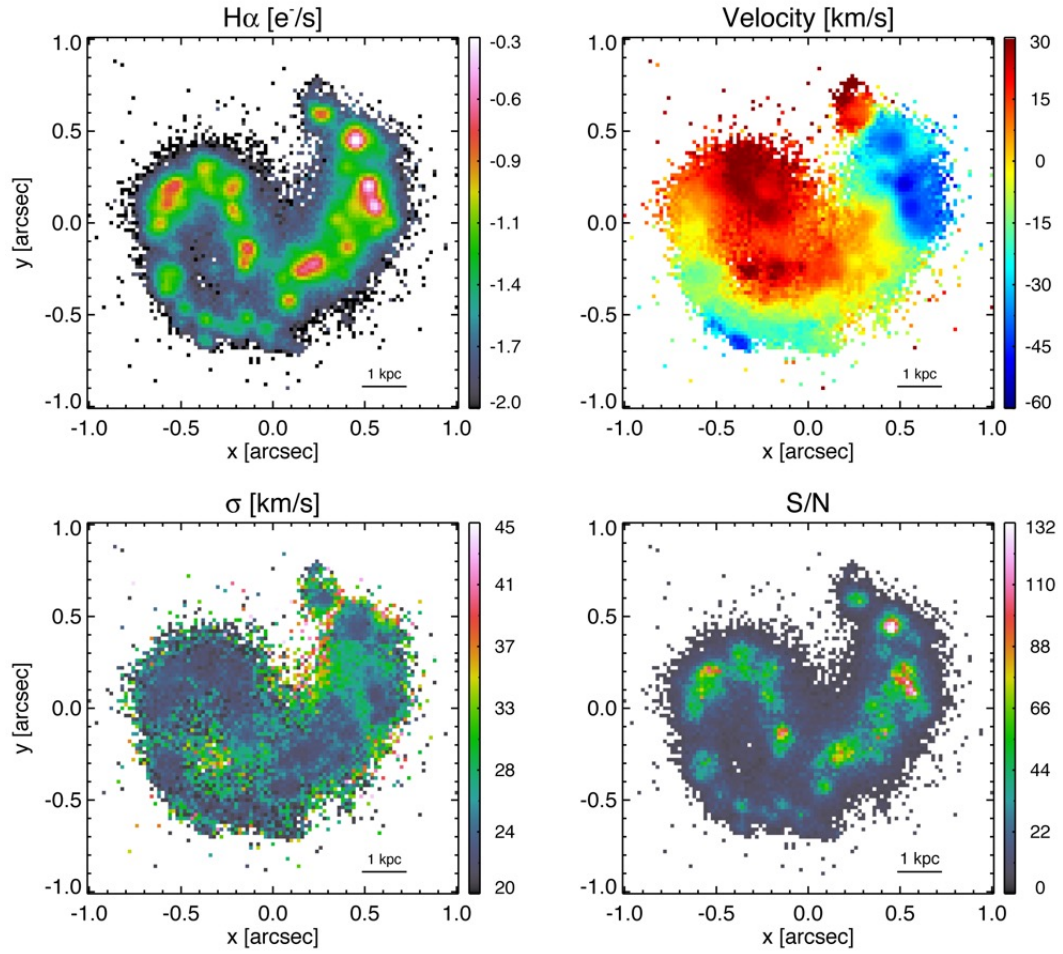
Calibrations and HSIM

- Instrument Calibration Plan
  - CAB hosts the Calibration Scientist of HARMONI, responsible of the development of the Calibration Plan of the instrument
  - The Instrument Calibration Plan describes all the tasks and procedures needed to perform the calibration of science data, and to perform the monitoring and AO calibrations
  - We also study, establish and refine the procedures and patterns to equip the CM with all the needed elements (lamps, masks, etc) to perform the instrument calibrations
- HSIM – HARMONI Science Simulator
  - CAB hosts the HARMONI Simulation Scientist, responsible of the development of the Science Simulator, and of the coordination of the science simulations across the Consortium.
  - HSIM is an open-source (https://github.com/HARMONI-ELT/HSIM) parallel processing code to simulate HARMONI observations based on the user inputs
  - It is an essential tool for the future HARMONI users to optimize the ELT observing time

HSIM Simulations of z~2 ULIRGs



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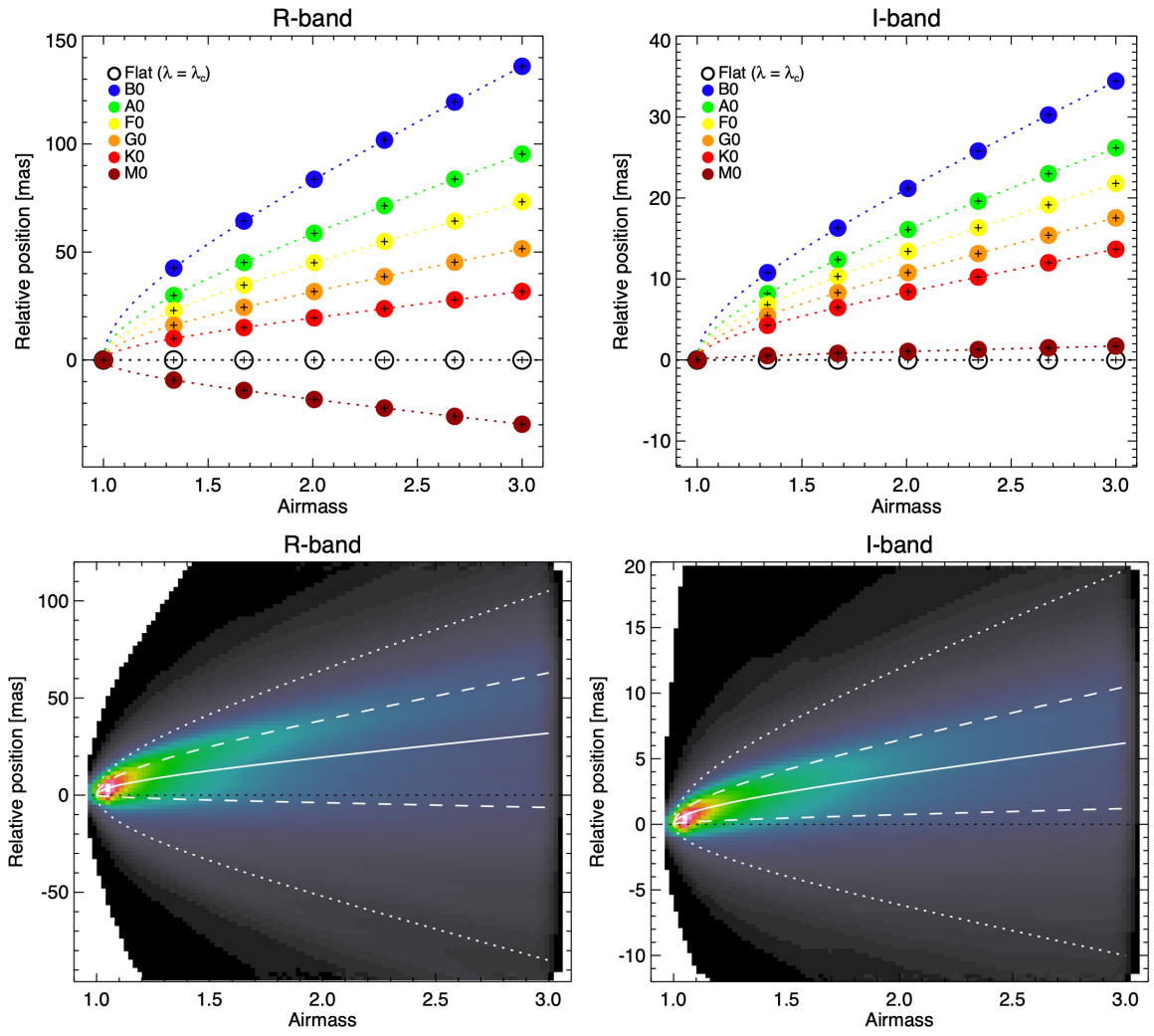
Science Support Activities

- HARMONI Science Team
  - CAB participates on the definition of the science cases for the HARMONI scientific exploitation
  - We are also responsible for the development of science simulations with HSIM
- Science Support Activities
  - Scientific analysis to support the technical team
    - Availability of guiding sources
    - Impact of the differential atmospheric diffraction on the IQ
    - Impact of the thermal background on the sensitivity
  - Trade-off and flow-down of top-level science requirements
  - ESO ELT Working groups
    - Detectors
    - PSF simulations
    - Telluric correction
    - Skylines subtraction
    - STD
  - HARMONI pointing model (Gonzalo J. Carracedo's poster)



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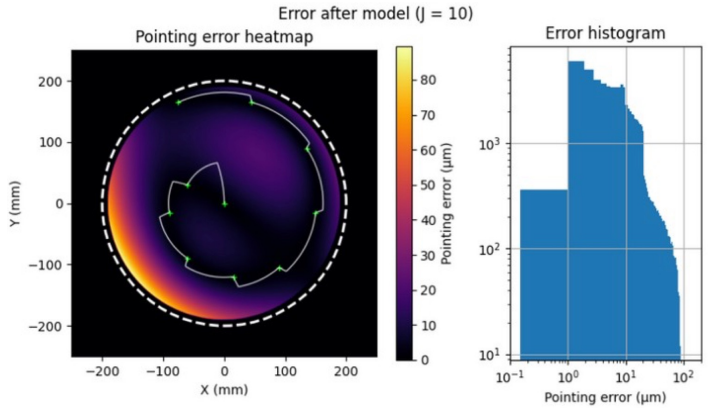
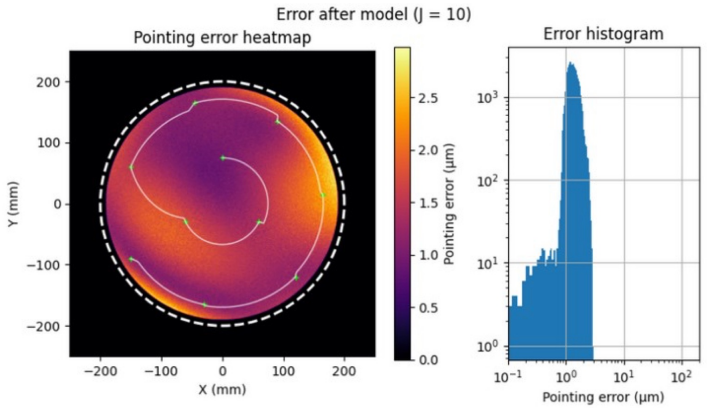
HARMONI Pointing Model

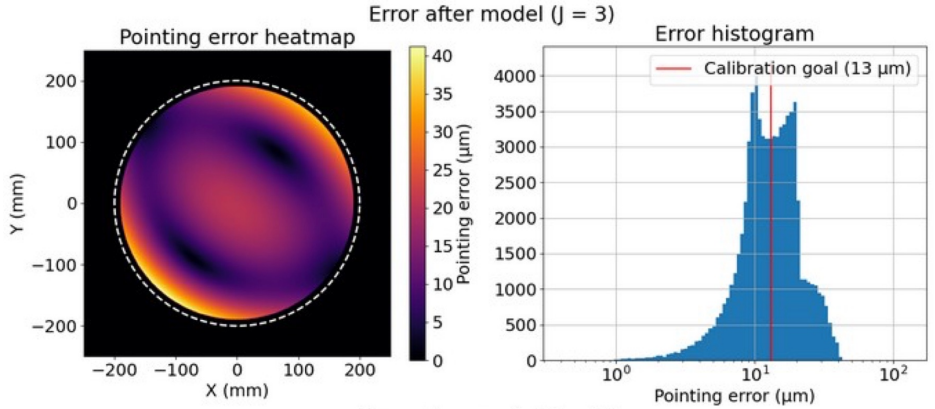
Check Gonzalo's poster

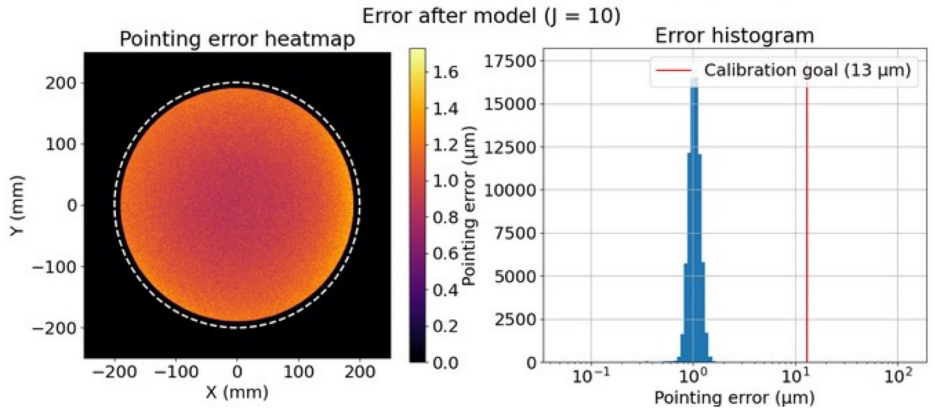
Sampling strategy

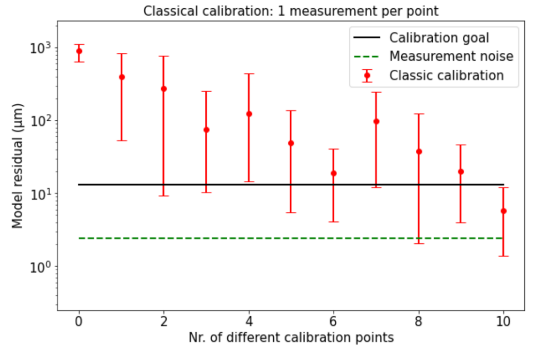


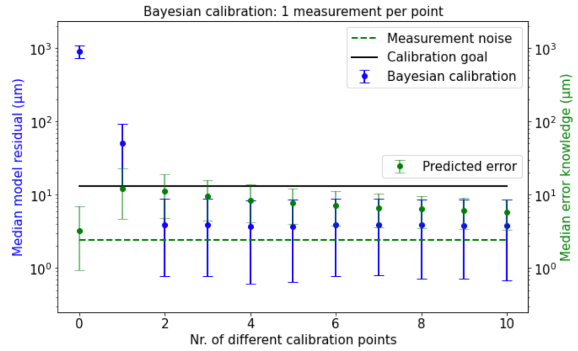


Bayesian approach









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CAB Contribution to HARMONI

- Team at CAB
  - Santiago Arribas Mocoroa – HARMONI Co-I and Science Team
  - Miguel Pereira Santaella – HARMONI Simulation Scientist, HSIM and Science Team
  - Javier Piqueras López – HARMONI Calibration Scientists, IPM and Science Team
  - Alberto Estrada – System Engineer and LOWFS WP Manager
  - Heribert Argelaguet – AIV specialist and CM WP Manager
  - Alonso Álvarez – Electronic Engineer
  - Gonzalo José Carracedo Carballal – PhD Student and Software Engineer
  - Michele Perna – Science Team
  - Miriam García – Science Team
  - José Antonio Caballero – Science Team
  - Members of the Space Instrumentation Group (Eduardo Sebastián, Ricardo Ferrandiz)
- INTA Collaborators
  - LINES (Tomás Belenguer, Luis Miguel González, Marianela Fernández, Daniel Garranzo)
  - Santiago Martín Iglesias - Prototyping
- Former members and collaborators
  - Adolfo García Marín – Optical Engineer
  - Cecilia Martínez – Electronic Engineer
  - Javier Moreno-Ventas – Optical Engineer
  - Ismael Martínez Delgado – IPM Phase-A
  - AVS – Phase B CM design
  - SENER – Conceptual designs of the WP and Phase B POA design

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