Integrating High Resolution Solar Physics

Ongoing work on post-focus instrumentation with IBIS 2.0

Solarnet WP8 SPRING Meeting
February 18-19 2021

G. Viavattene (1), I. Ermolli (1), R. Cirami (2), G. Calderone (2), D. Del Moro (3), P. Romano (4), I. Coretti (2), F. Giorgi (1), V. Baldini (2), P. Di Marcantonio (2), L. Giovannelli (3), S. L. Guglielmino (4), M. Murabito (1), M. Oliviero (5), F. Pedichini (1), R. Piazzesi (1), M. Aliverti (6), E. M. Redaelli (6), F. Berrilli (3), F. Zuccarello (7)

(1) INAF-OAR, (2) INAF-OATs, (3) Università degli Studi Tor Vergata Roma, (4) INAF-OACt, (5) INAF-OAC, (6) INAF-OAB, (7) Universià degli Studi di Catania

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824135.

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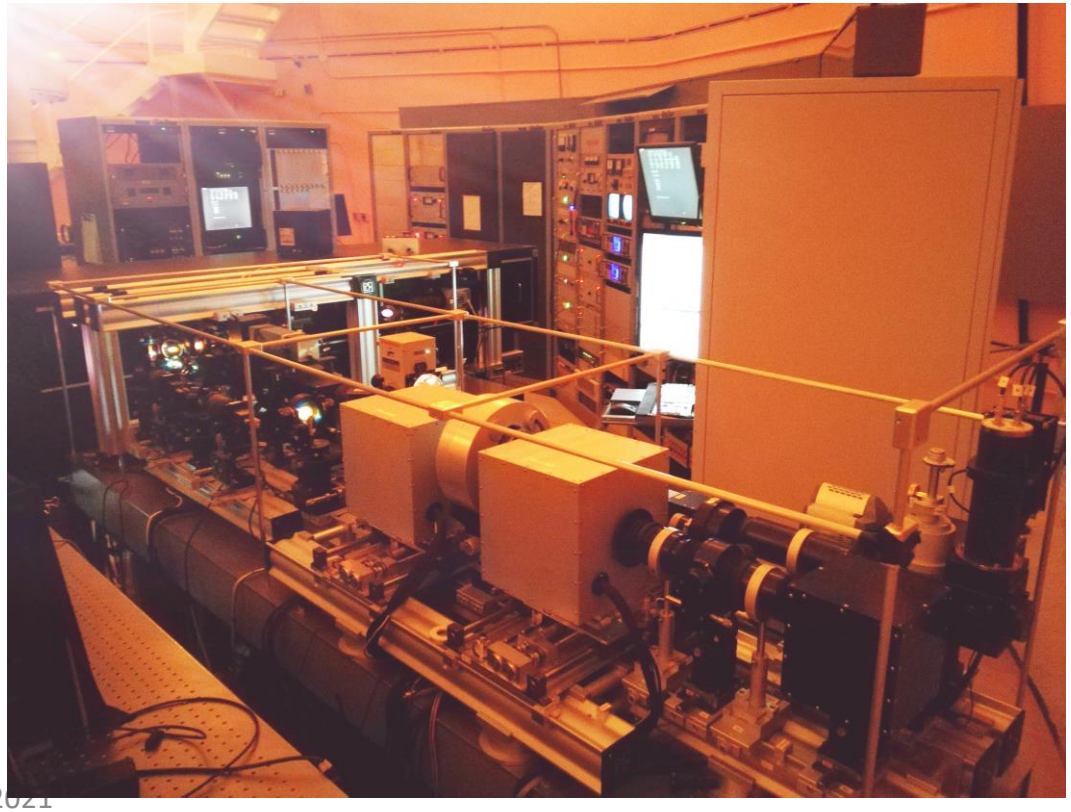
Background

Post-focus Instrument for High-Res Solar 2D Spectropolarimetry (580-860 nm) installed at the DST (USA) from 2003 to 2019



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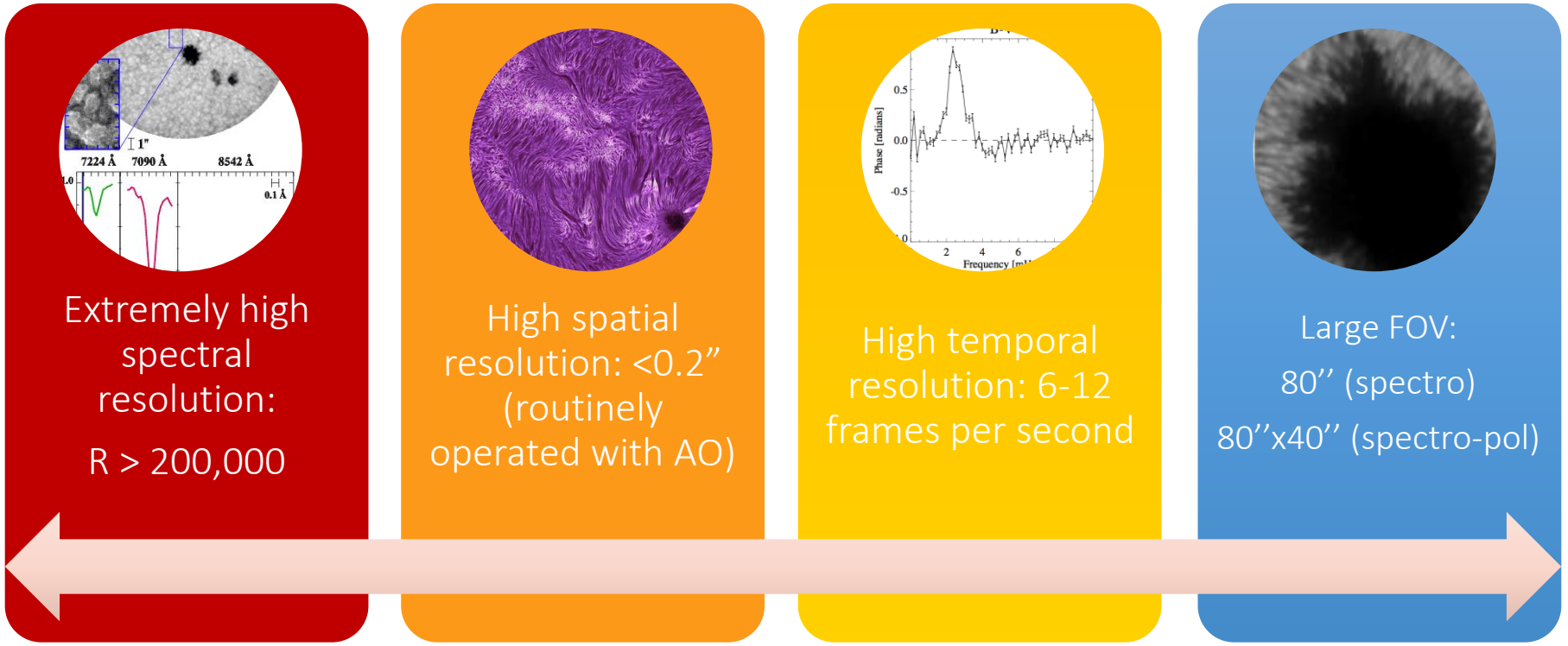
Instrumental performances



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IBIS dismantling and shipping (2019)

- Dismantling and shipping (2019) following changes at DST
- Instrument upgrade and update to reinstall it at a telescope at the Canary Islands

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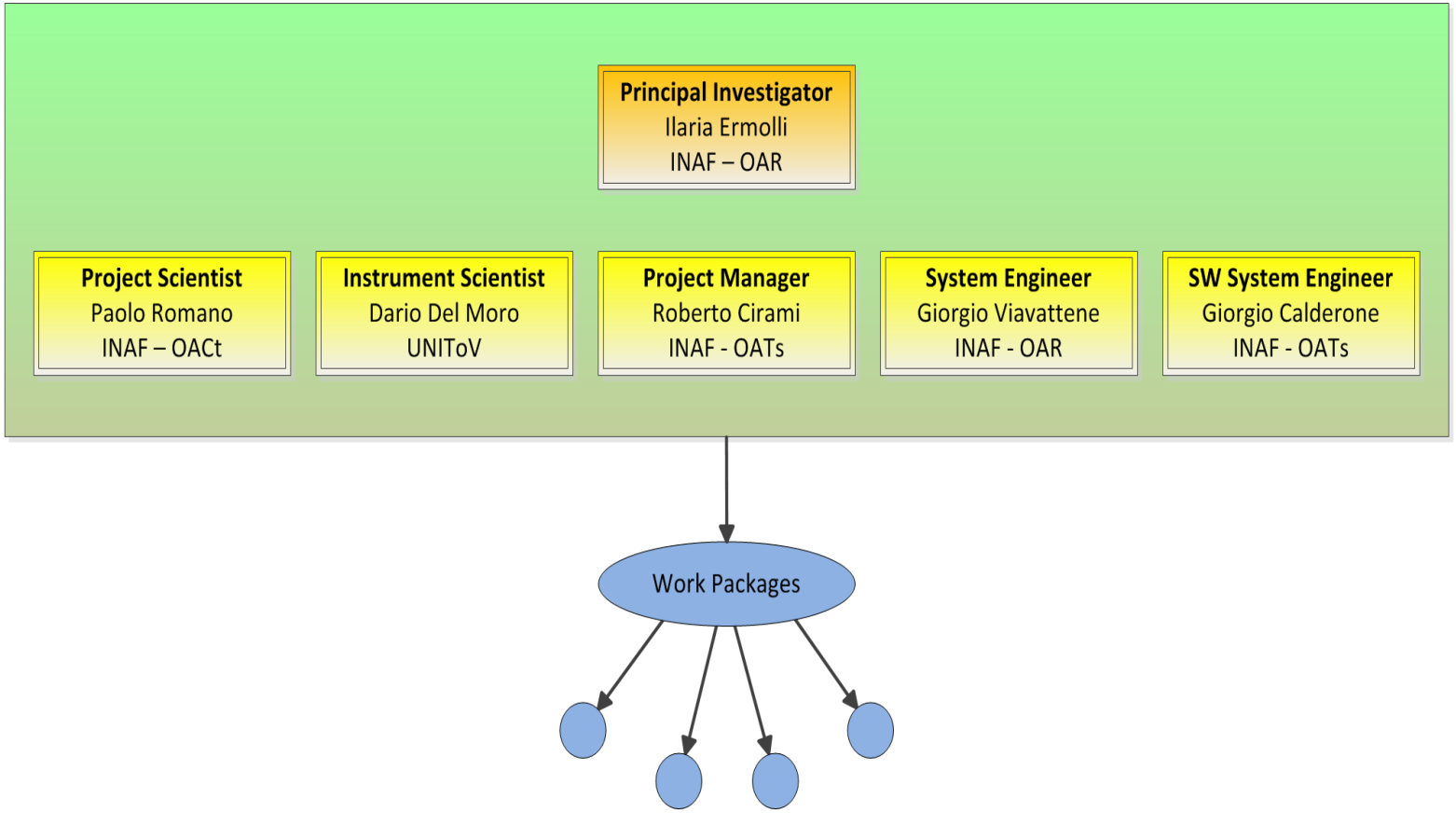
The new IBIS: **IBIS 2.0**

IBIS 2.0

Involved institutes

- INAF – Osservatorio Astronomico di Roma (INAF – OAR)
- INAF – Osservatorio Astronomico di Trieste (INAF – OATs)
- INAF – Osservatorio Astronomico di Catania (INAF – OACt)
- INAF – Osservatorio Astronomico di Brera (INAF – OAB)
- INAF – Osservatorio Astronomico di Capodimonte (INAF – OAC)
- Università degli Studi di Roma "Tor Vergata" (UNITov)
- Università degli Studi di Catania (UNICt)

Project organization



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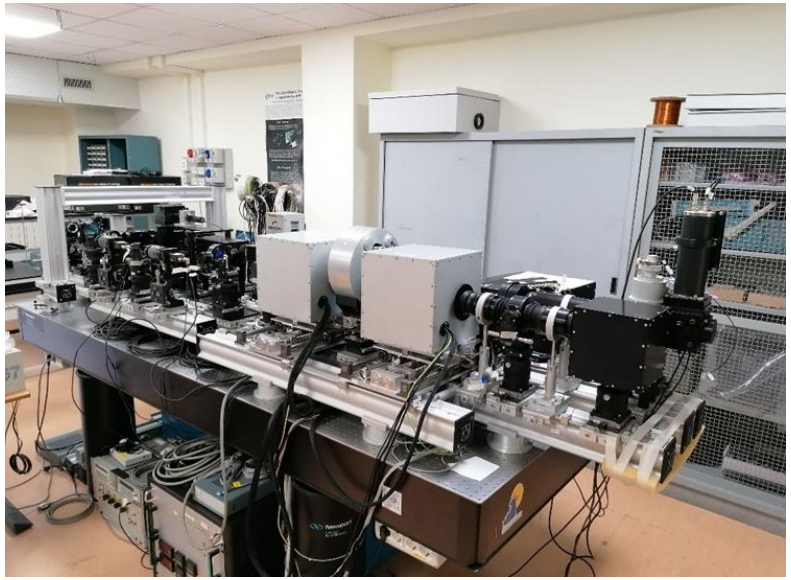
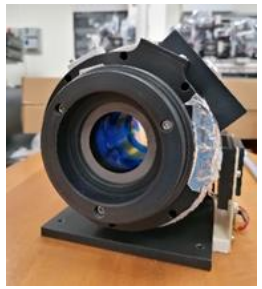
Remount, redesign and update

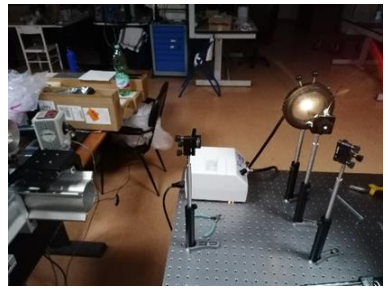
- Remounted with the optical layout used at DST
- Functionality tests on all the optical, mechanical and electrical components

- Repair some parts (CS100, FP1)
- Optomechanical redesign (Zemax, QCAD)
- Remove obsolescence (PMT, TV cameras)
- New instrumental parts (cameras, polarimeter, movements)

- Software and electronics update for a full automation of the operation and calibration procedures







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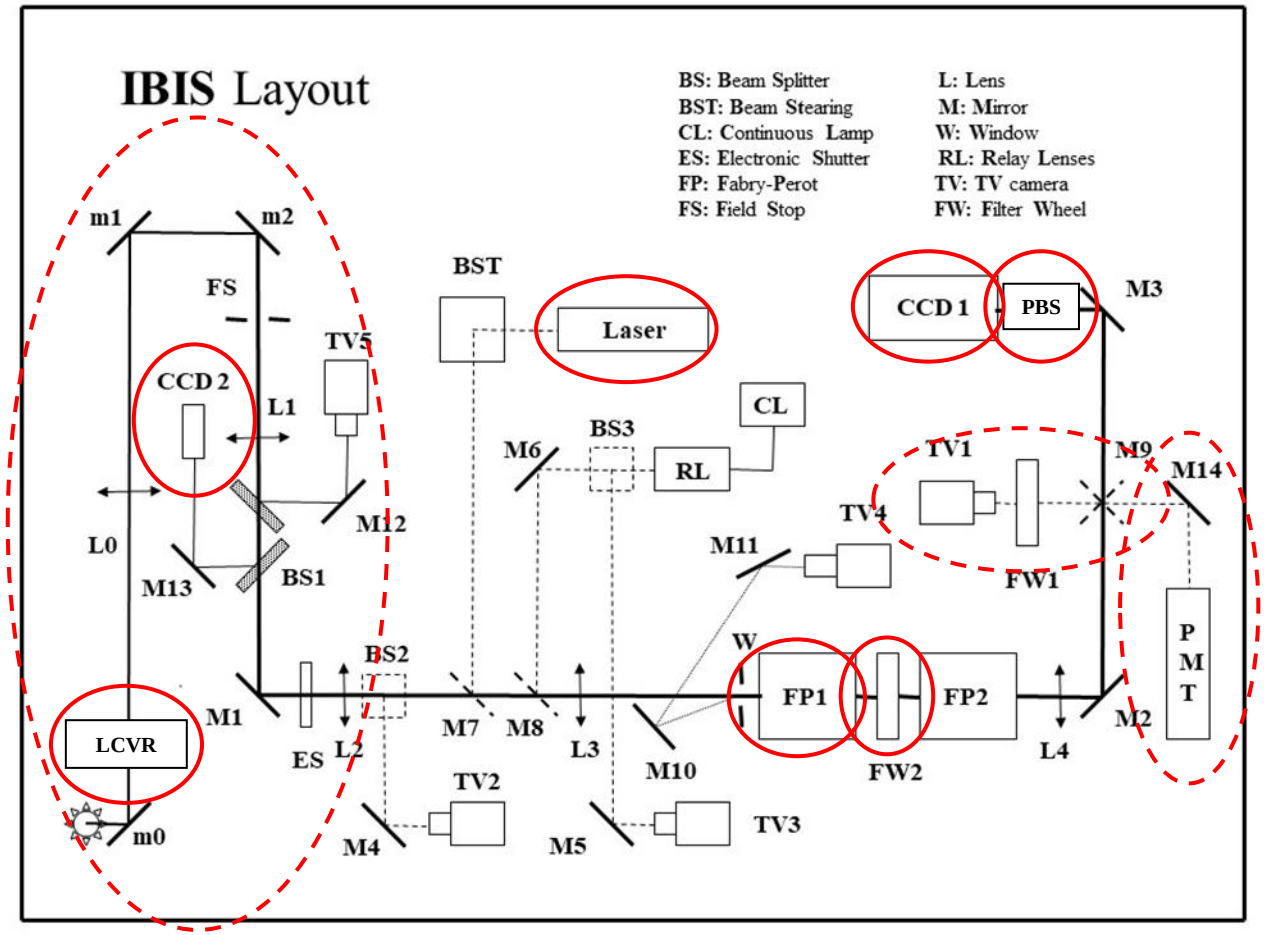
Optical scheme of IBIS at DST



IBIS instrumental calibration

- Check:
1. Solar alignment
2. Lamp alignment
3. Laser alignment

- Tuning:
1. Parallelism FPIs' plates (laser)
2. FPI tuning (lamp)
3. Polarimeter calibration

To replace, repair, or missed

Planned changes

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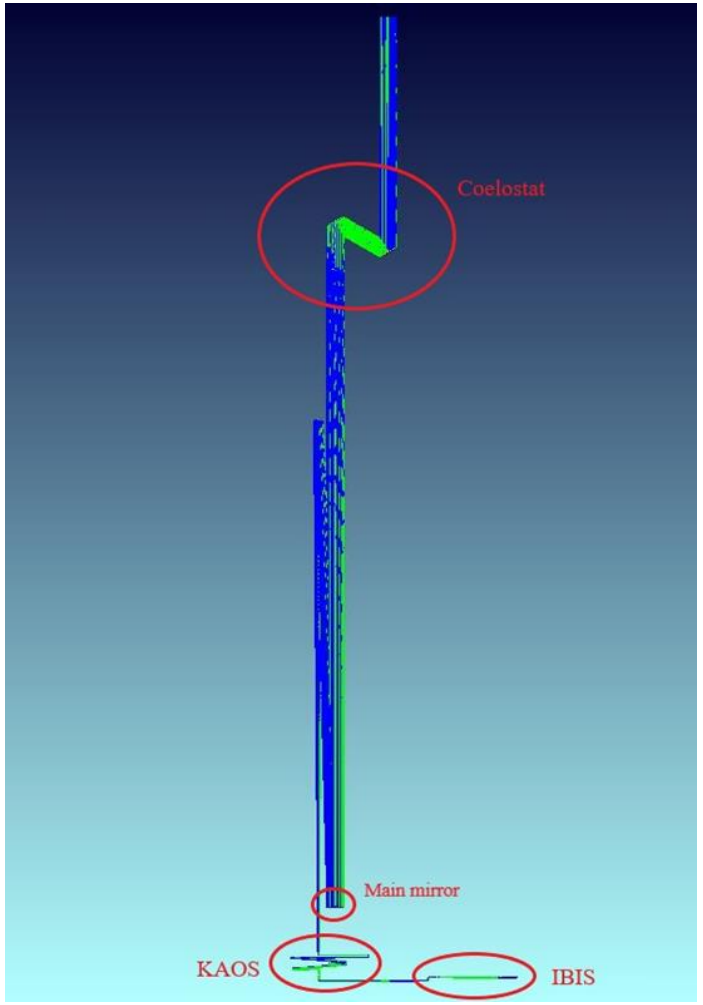
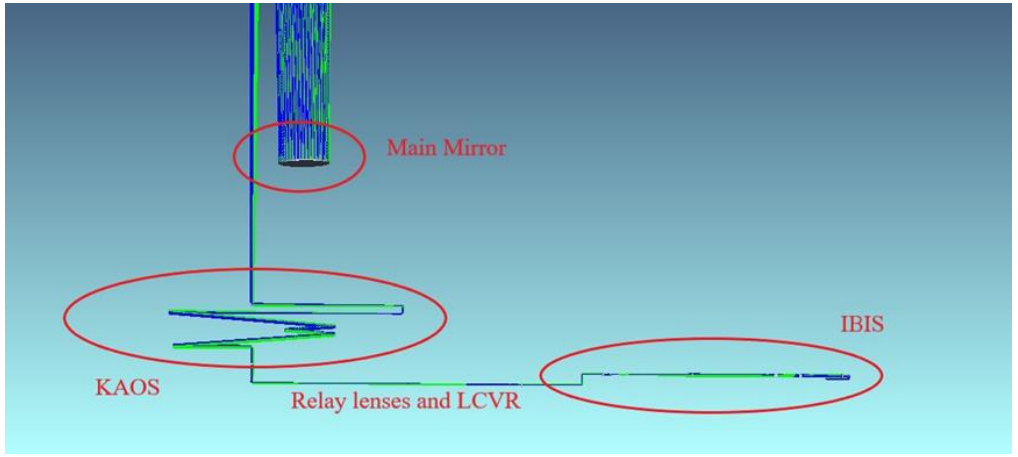
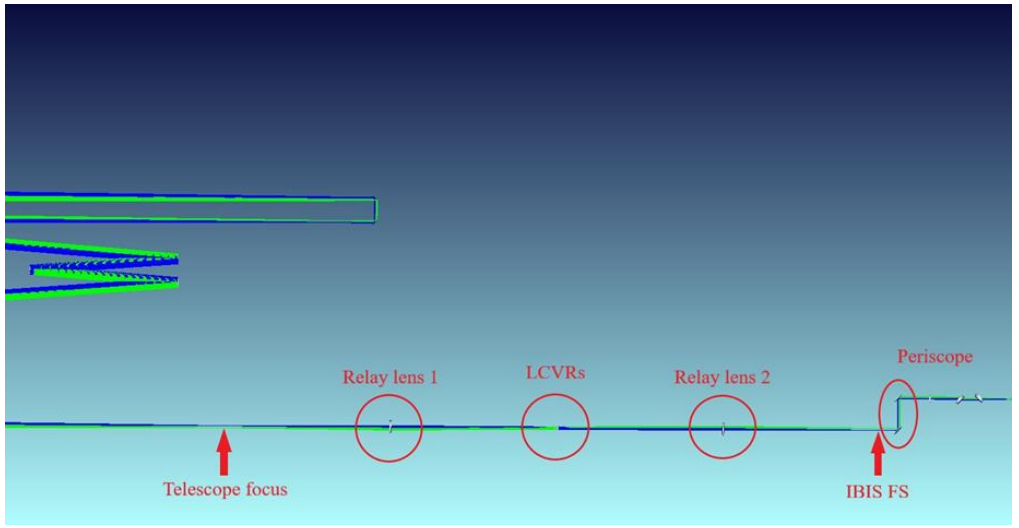
Optical design with Zemax of IBIS 2.0







Instrumental performances:

- Spectral range 580-860 nm
- Spectral resolution up to 270.000
- Spectral sampling 2-6 pm
- FoV 80''
- Spatial resolution from 0.17'' @ 580 nm to 0.23'' @ 860 nm
- Temporal cadence tens of frames per second

IBIS 2.0

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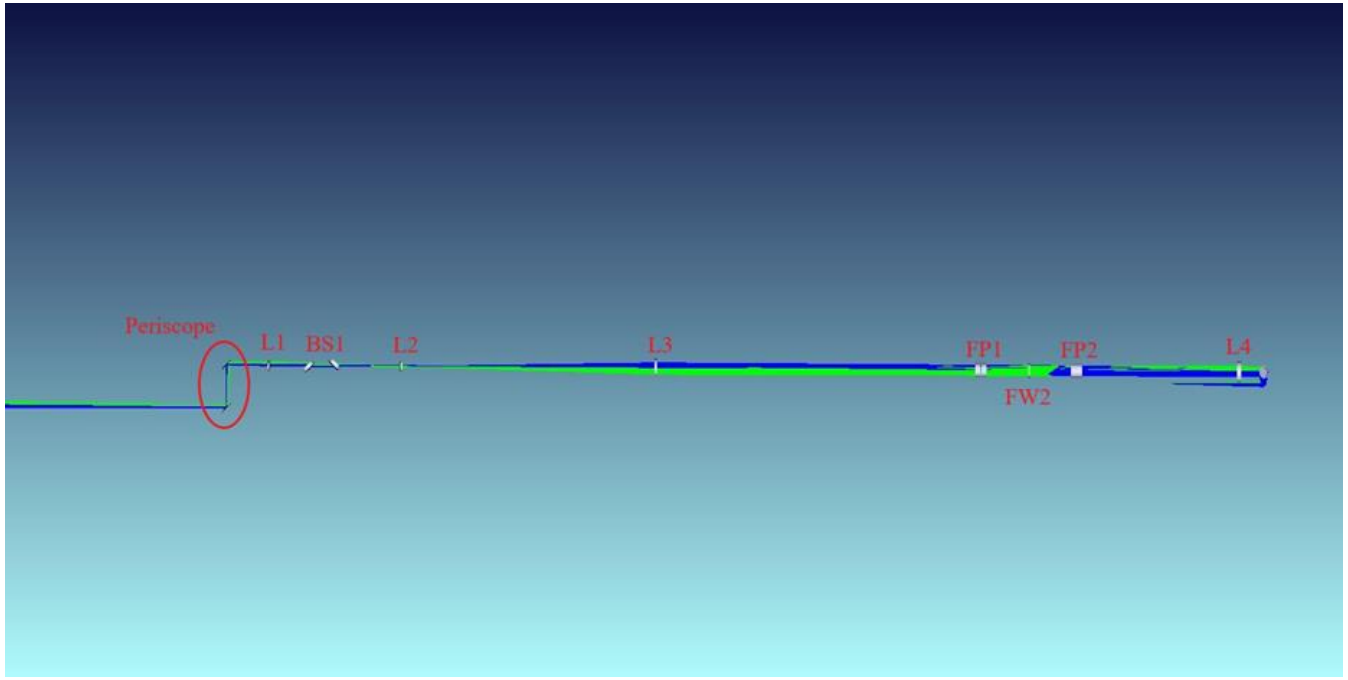
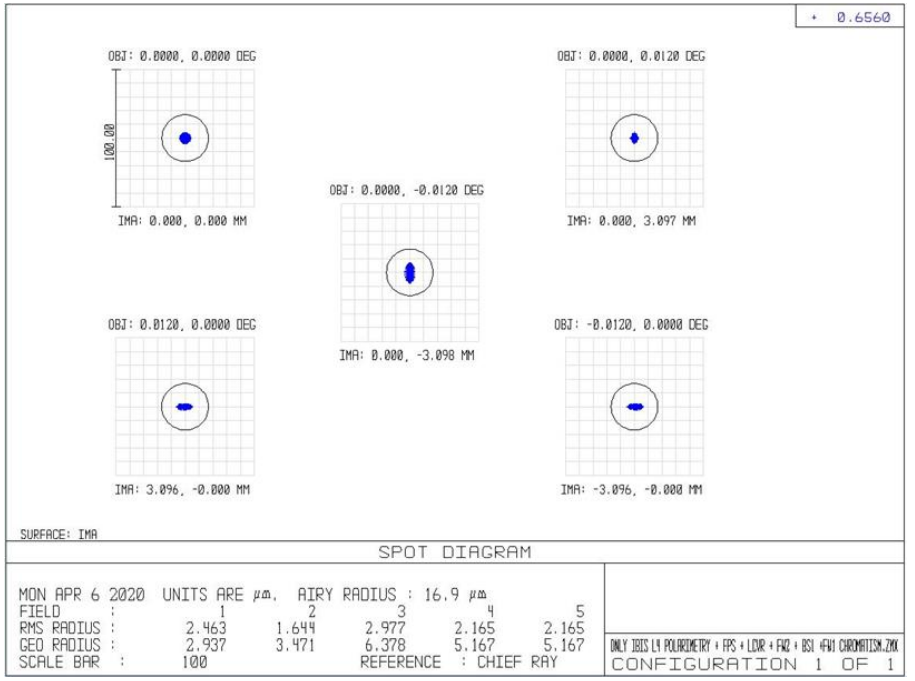
Optical design with Zemax of IBIS 2.0



Diffraction limited of the whole spectral range (580-860 nm)



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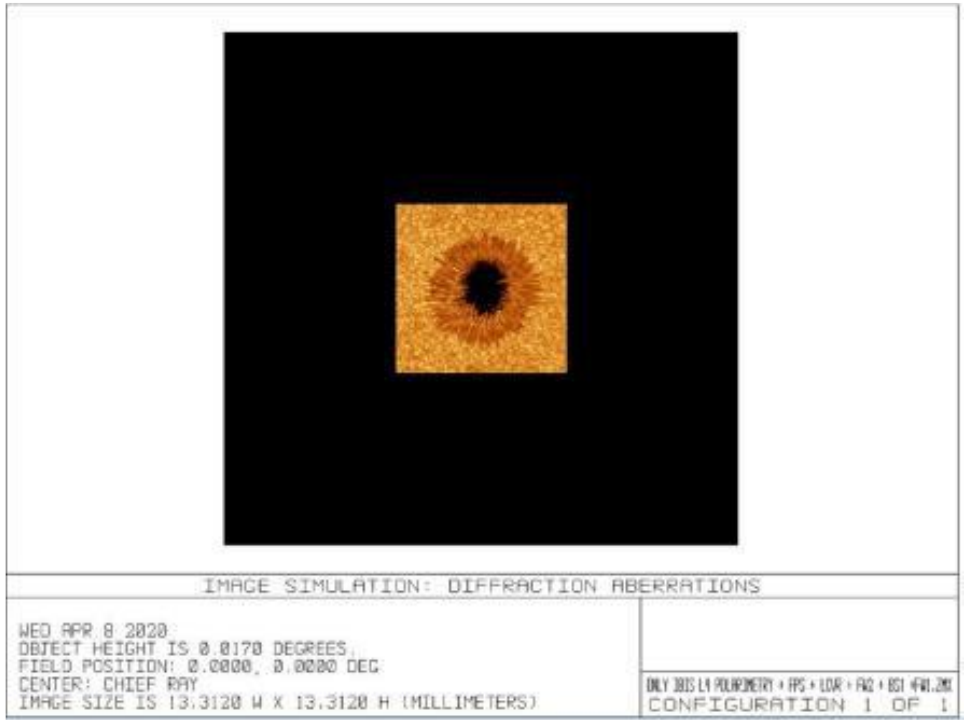
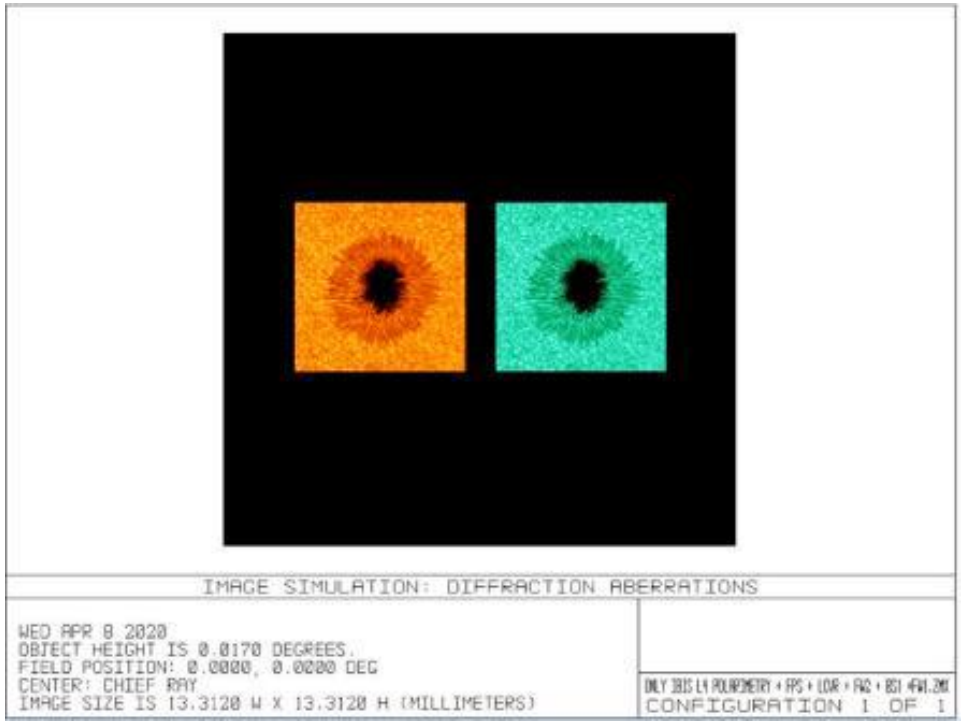
Spectroscopic and spectropolarimetric mode





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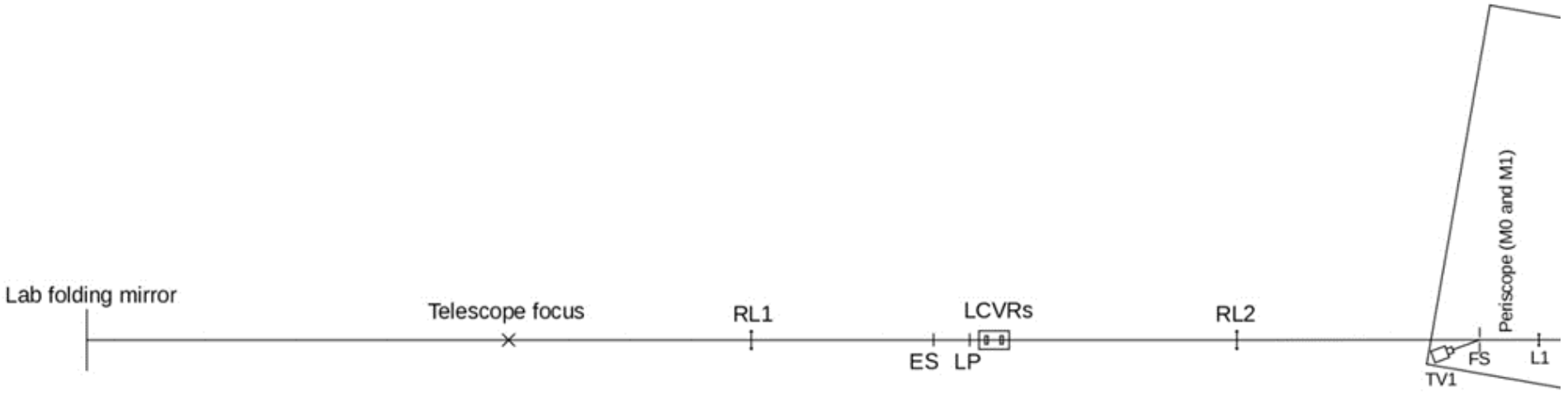
Transfer optics and polarimeter



Polarimetric strategies:

- Spatial and temporal modulation
- 2 LCVRs with 6 modulation states
- Polarizing Beam Splitter

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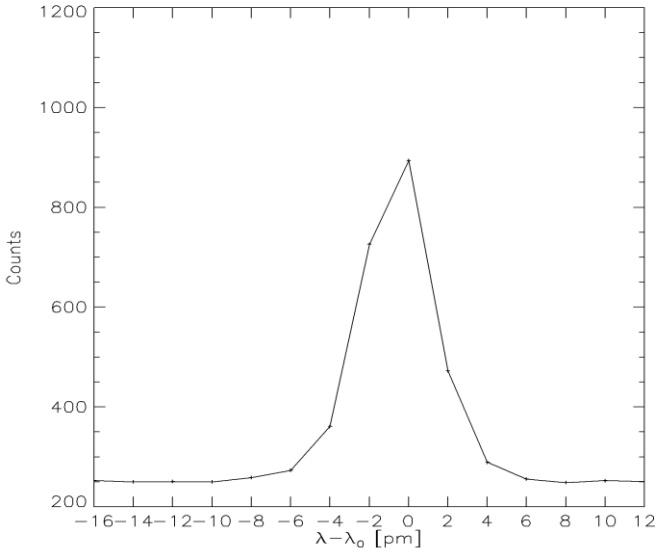
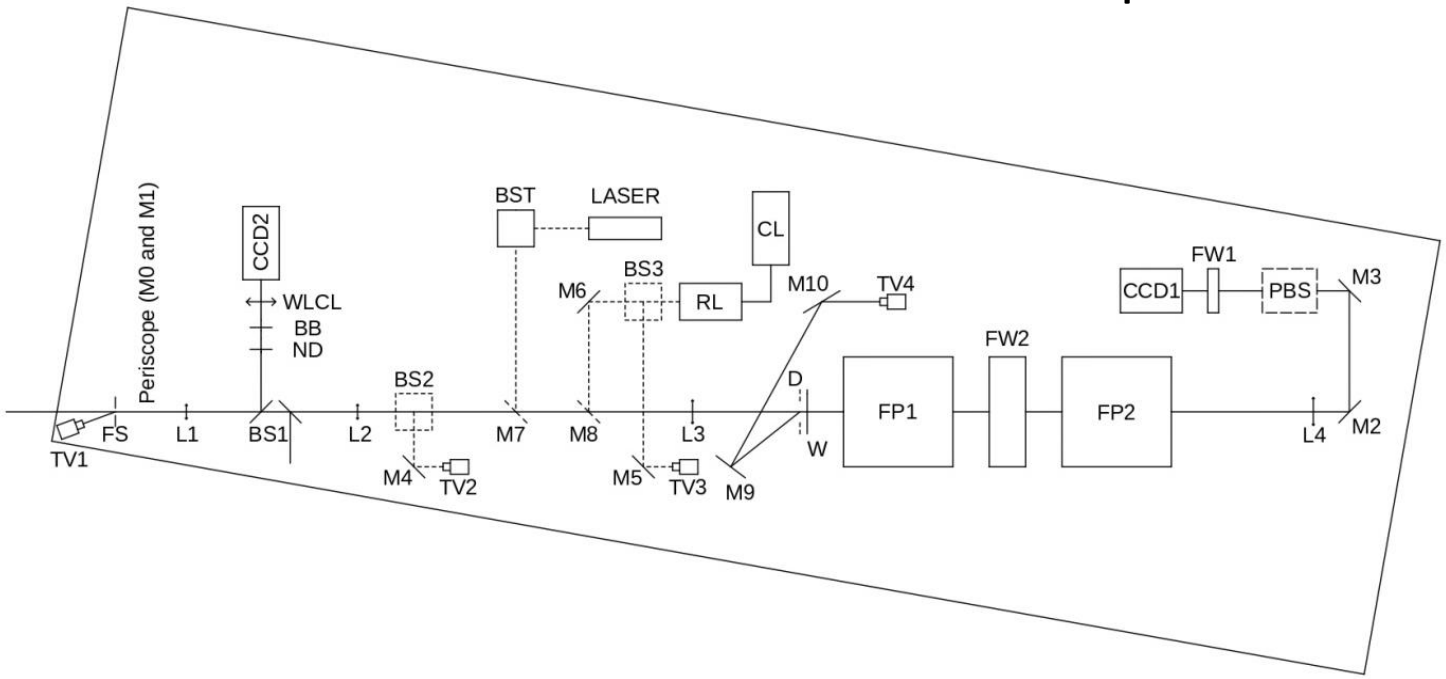
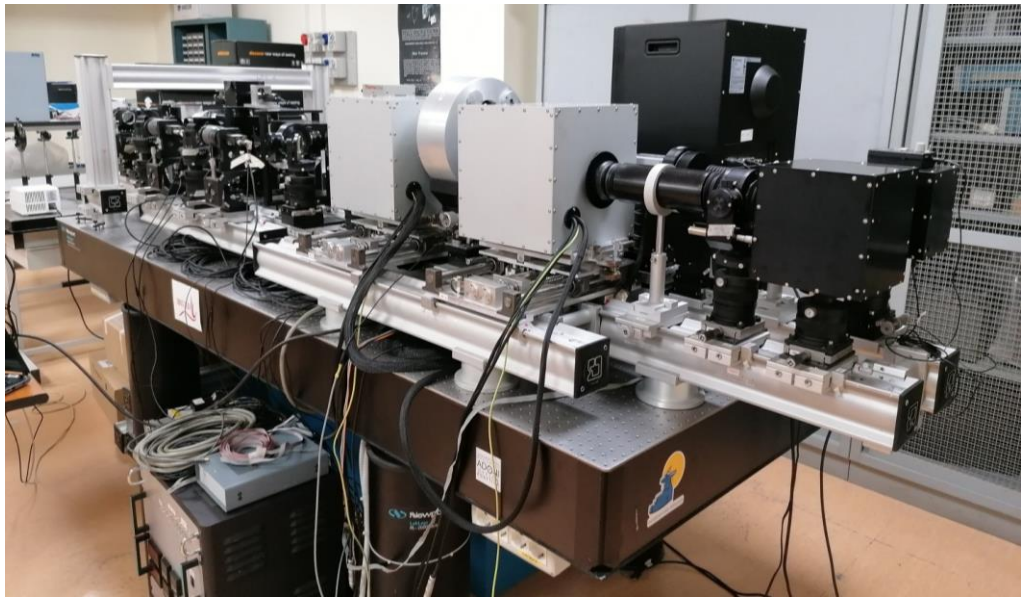
Optical design with Zemax of IBIS 2.0

First spectral scan







IBIS 2.0

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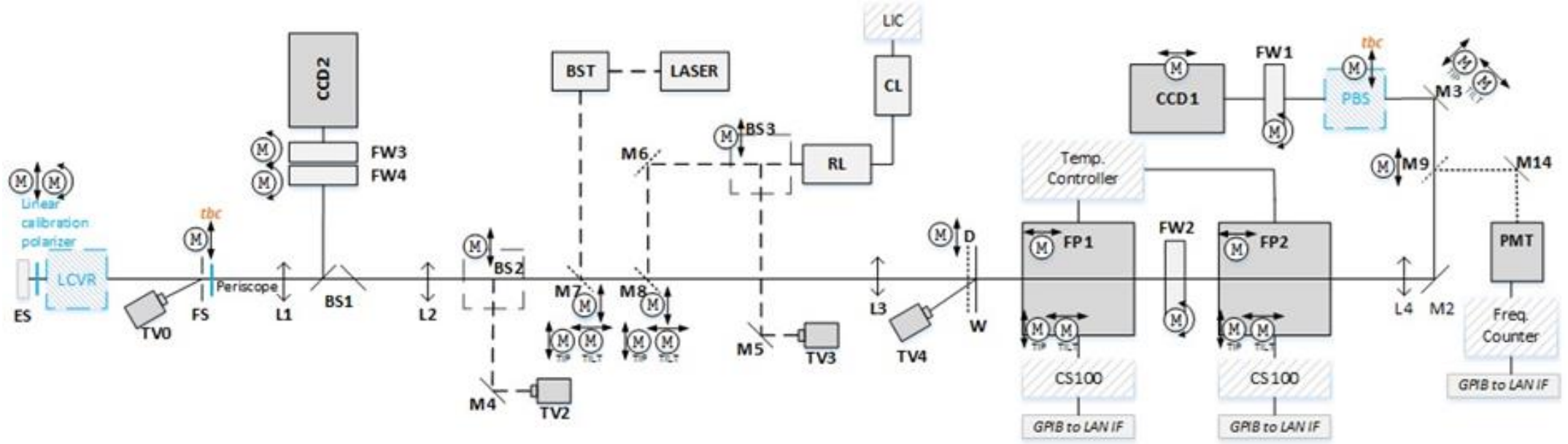
Electronics update for full automation of operation and calibration procedures



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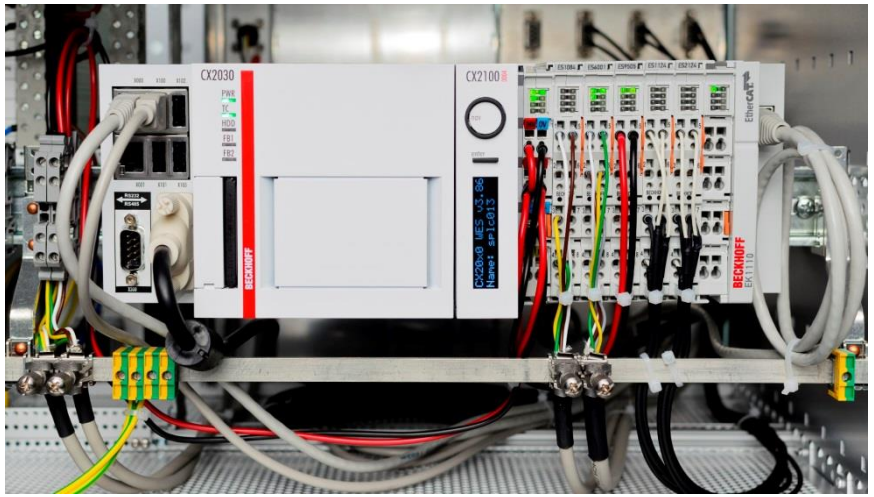
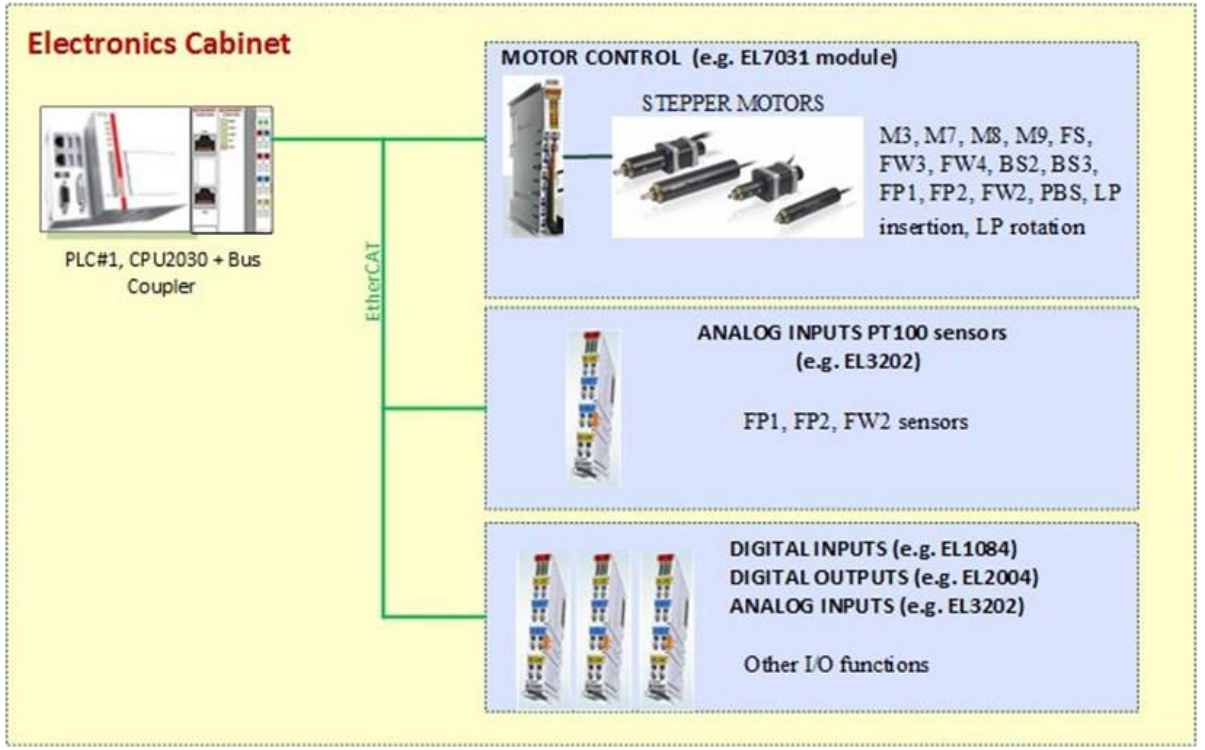
Electronics update for full automation of operation and calibration procedures

- Control system based on Beckhoff Programmable Logic Controller (PLC)
- Actuators and stages for movements





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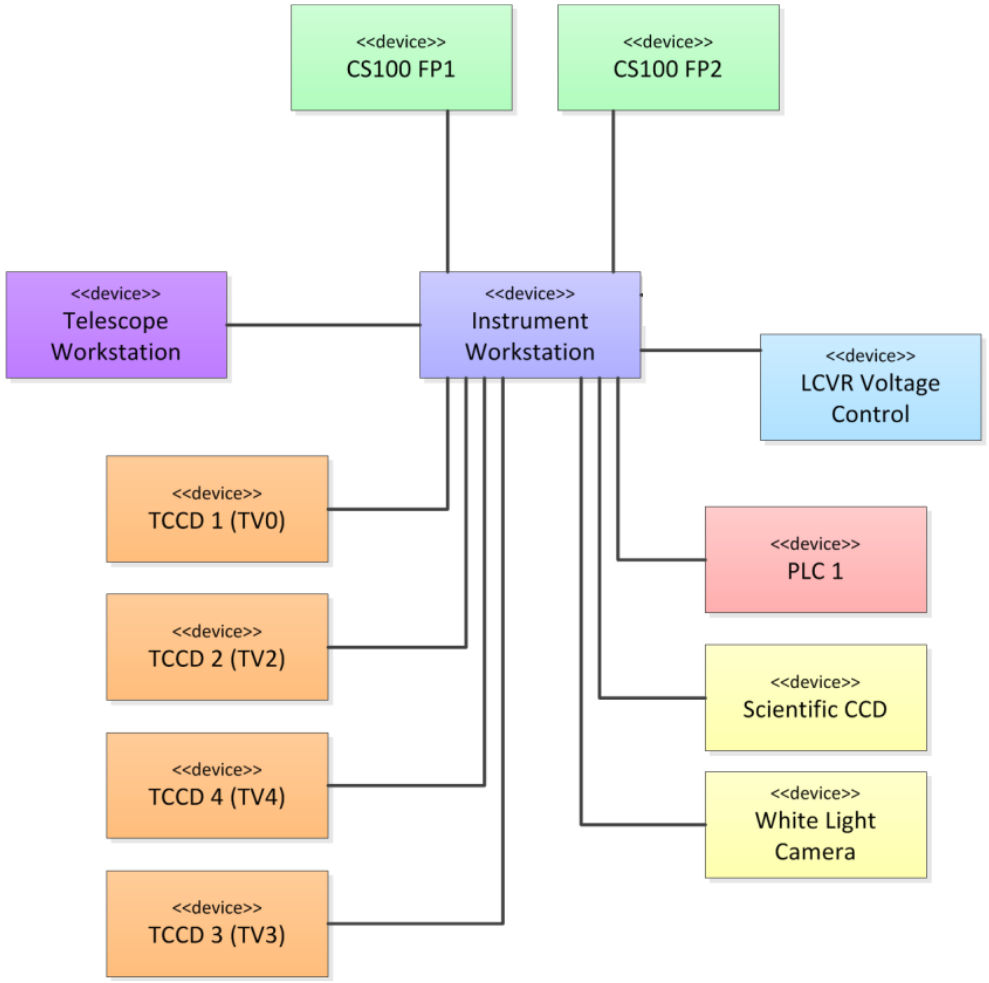
Software update for full automation of operation and calibration procedures

- Control software architecture based on VLT control software:
- Instrument Control Software (ICS)
- Detector Control Software (DCS)
- Observation Control Software (OS)
- Maintenance Software (MS)



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Next steps

IBIS 2.0

- Final design (Summer 2021)
- Hardware procurement (Fall 2021)
- Assembly, integration and verification in the Lab (Summer 2022)

- Developing knowledge for SPRING post-focus instrumentation

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Thanks for your attention