



METIS Imager



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MPIA

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Science & Technology Facilities Council

UK Astronomy Technology Centre



KU LEUVEN

ETH zürich



METIS

METIS Imager

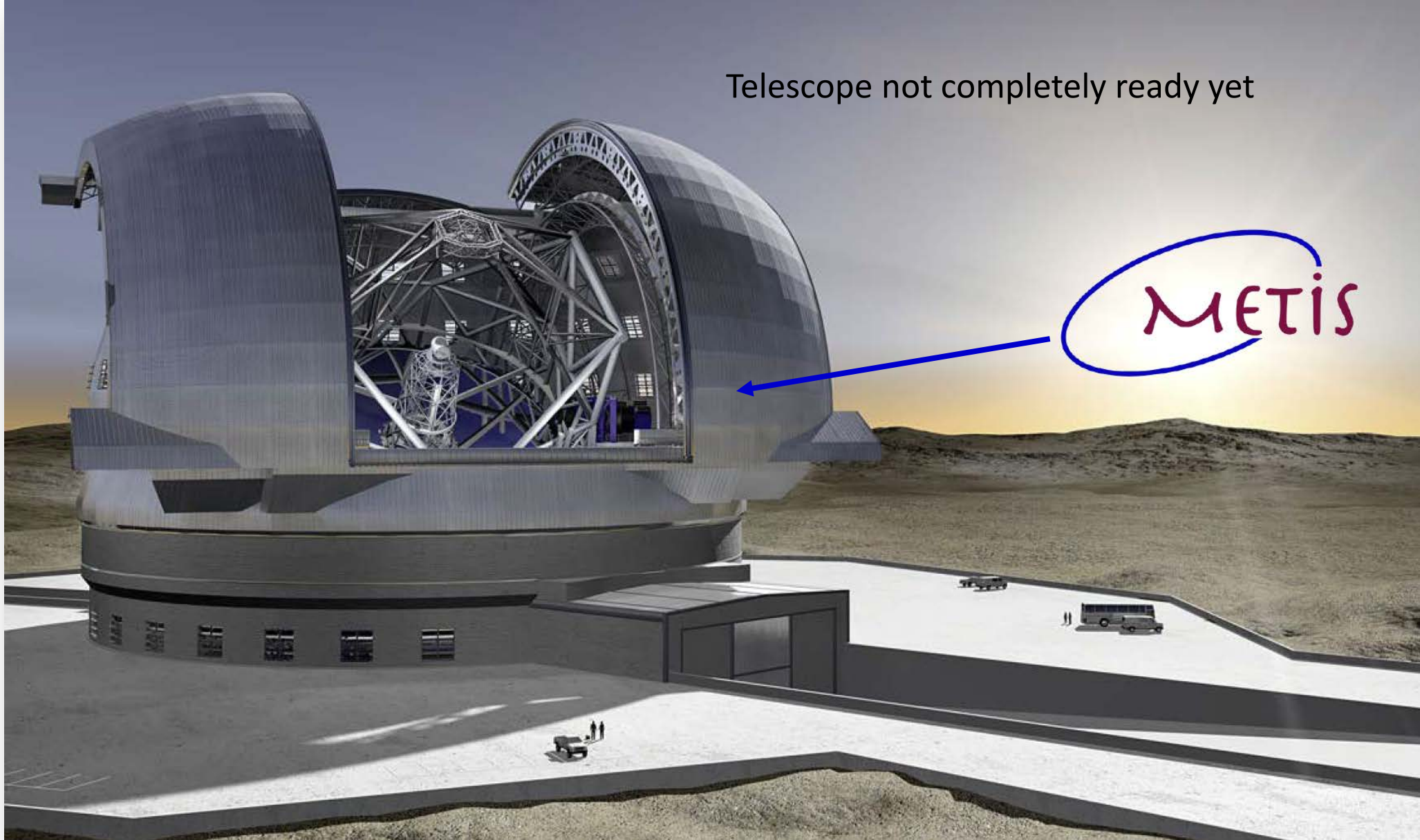
What it is ...

... and how we do it

Today's

- Overview
- METIS, the instrument
- MPIA contribution
- The Imager
- Outlook

Overview



Telescope not completely ready yet

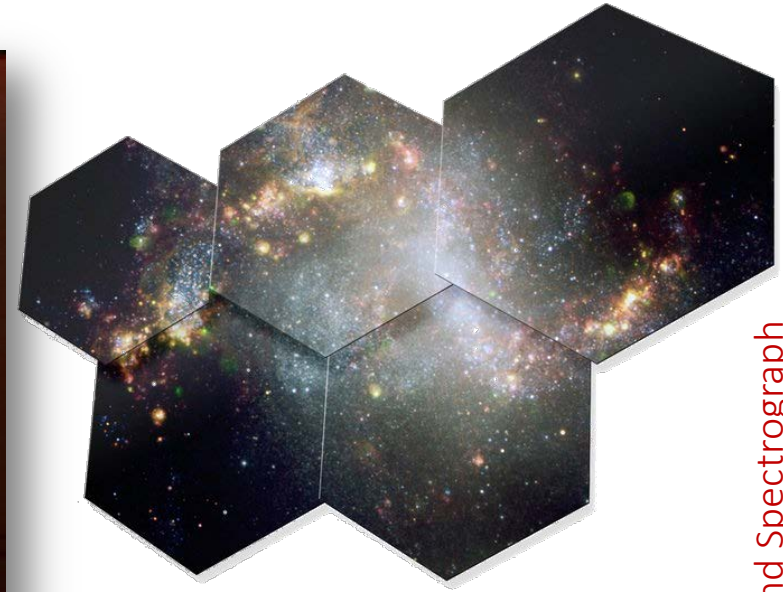
METIS

Mid Infrared E-ELT Imager and Spectrograph

METIS

Overview

Current state of the telescope

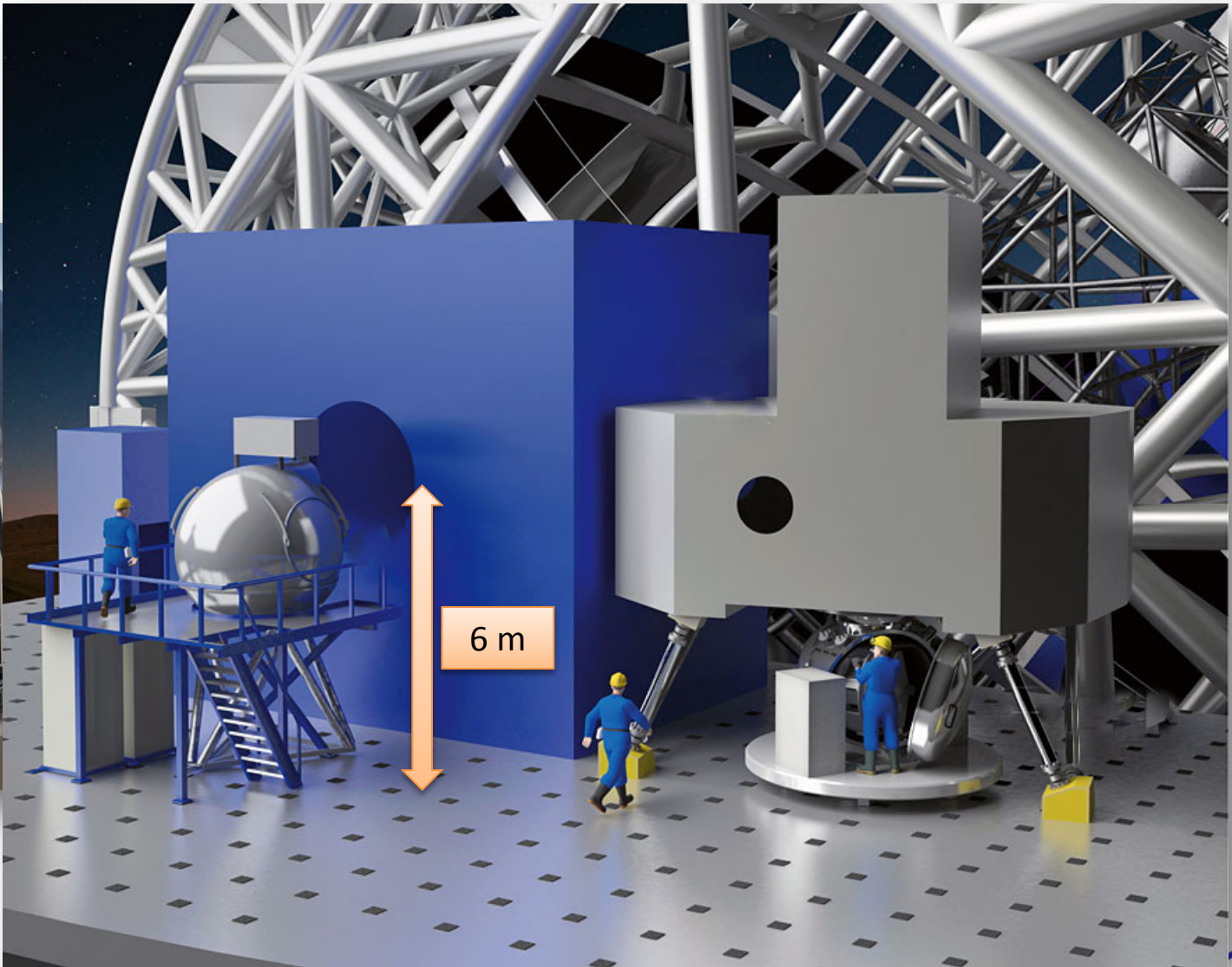
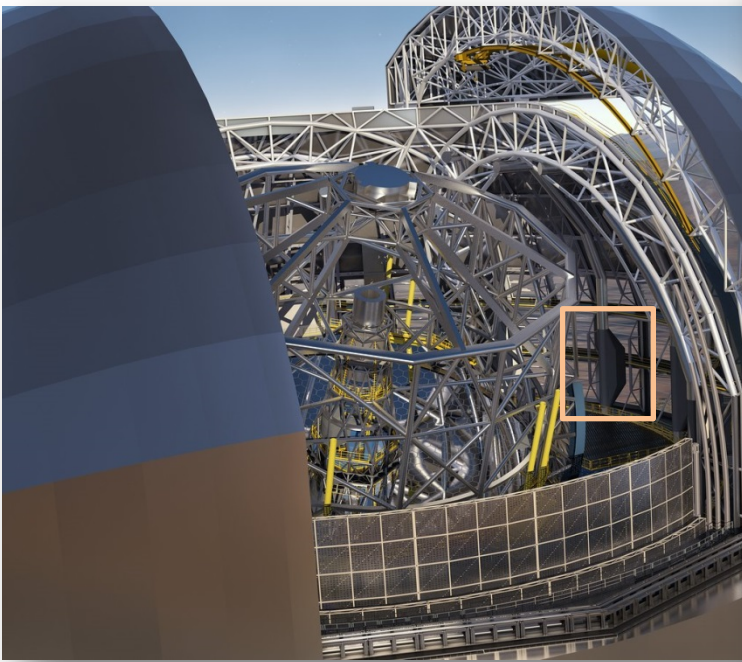


Primary: 798 segments

Credit: Schott/ESO



Overview



Mid Infrared E-ELT Imager and Spectrograph



METIS, the instrument



Camera

Infrared



METIS, the instrument

- Mid-Infrared Camera & Spectrometer
- Wavelength range 3 μm – 19 μm
- Adaptive Optics @ NIR – diffraction limited performance

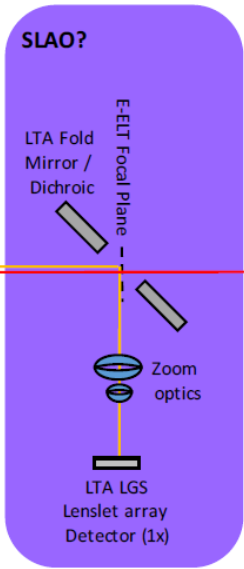
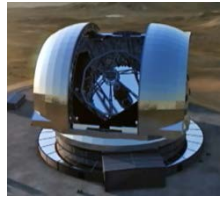
Diff. limited Imaging 10 arcsec x 10 arcsec in L, M, N, and partially Q
Long slit spectroscopy for full L, full M and full N band
Integral field spectroscopy
Imaging and spectroscopy also combined with coronagraphic modes

Key application: High Contrast Imaging

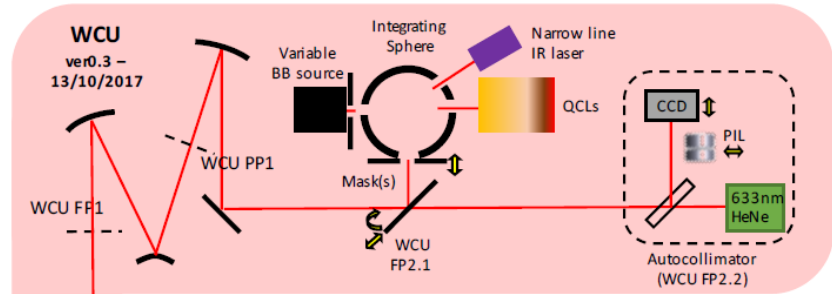
Simple instrument



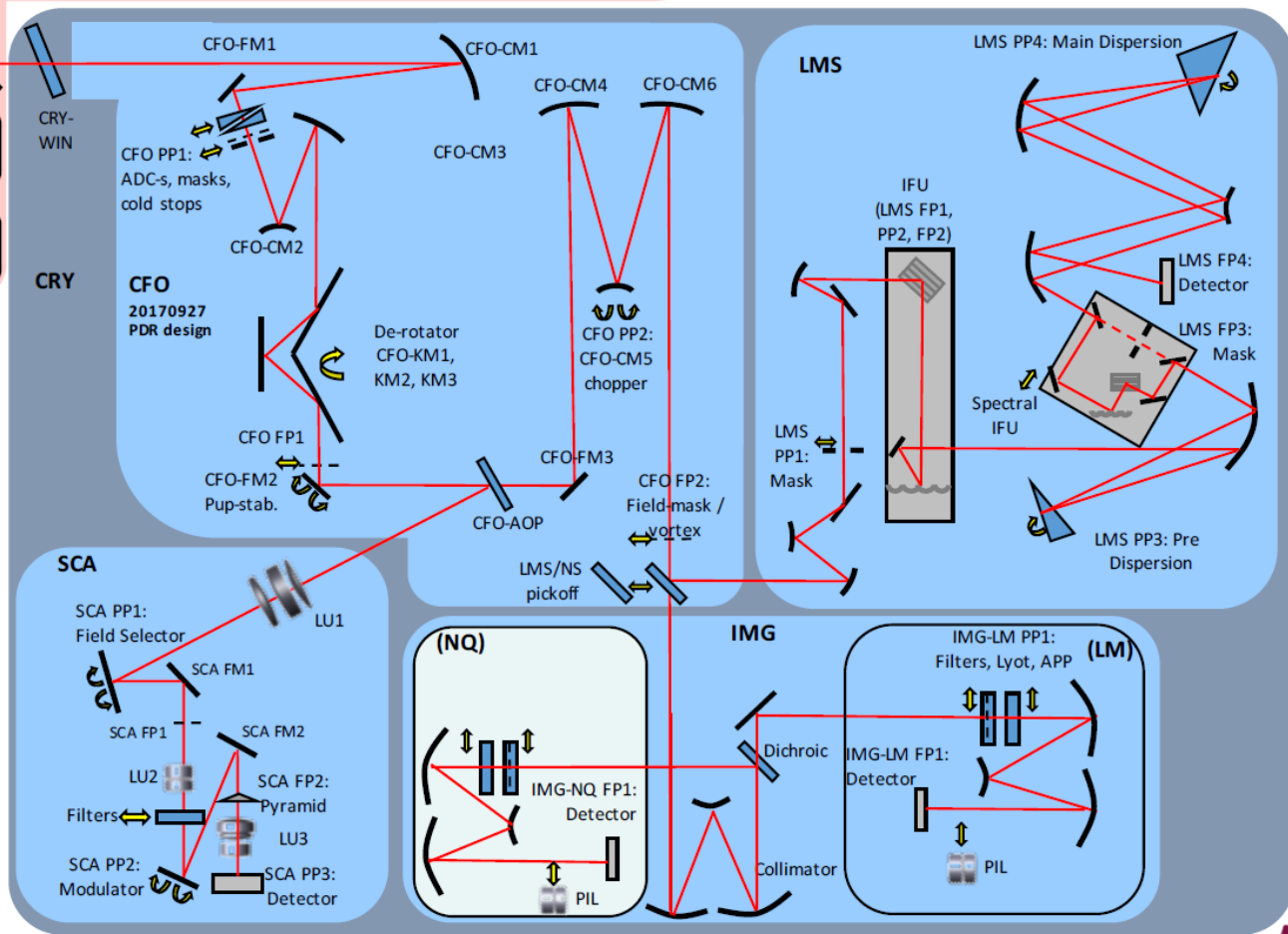
METIS, the instrument



Laser AO



Warm calibration unit



METIS instrument

Quite complex



METIS, the instrument

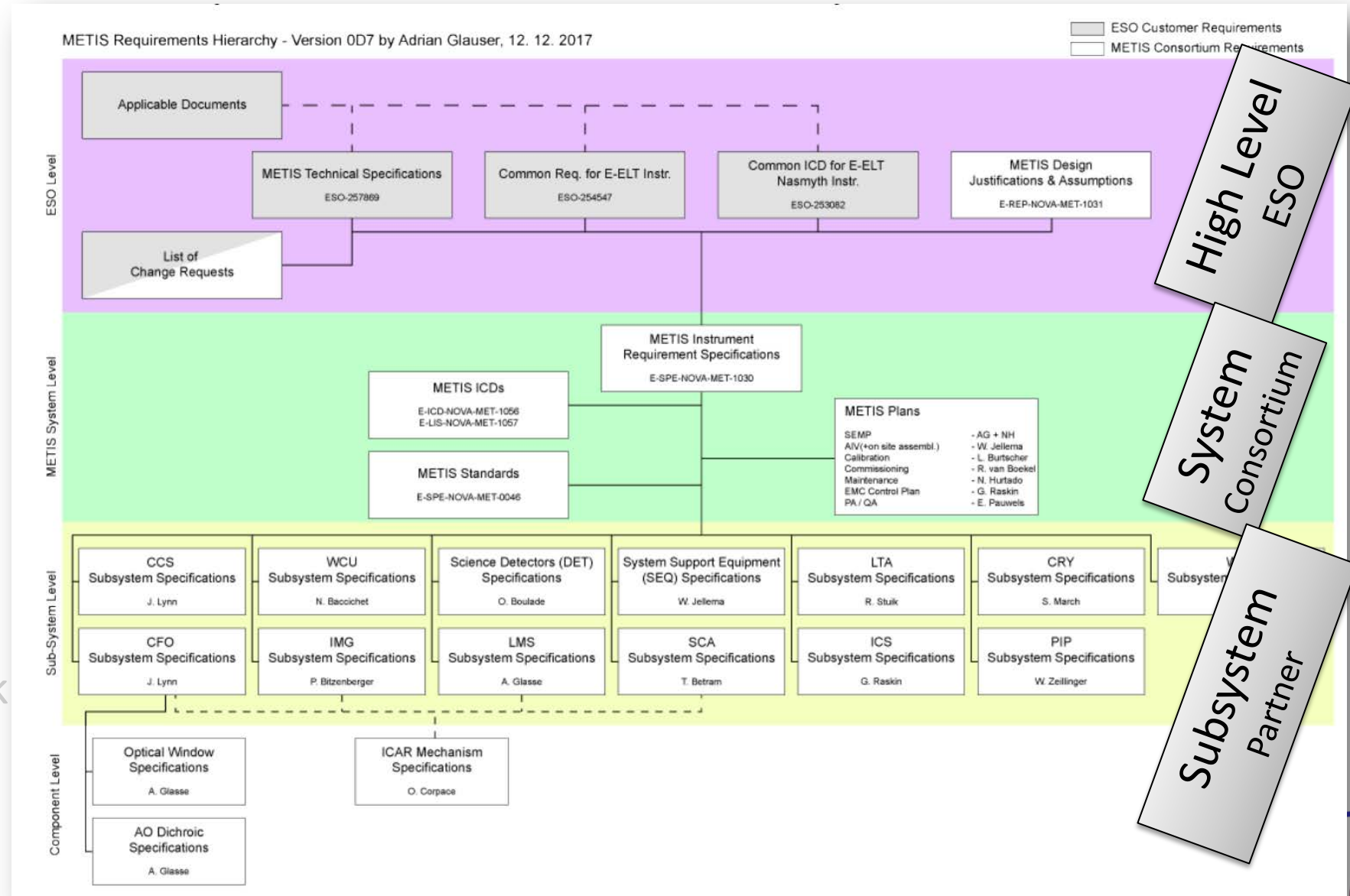
Many partners, sub-systems, work packages, interactions
..... across 8 countries,

They need to be managed: System Engineering

- Requirements
- Interfaces
- Error budgets
- Functional break down

METIS, the instrument

- Requirements
- Interfaces
- Error budgets
- Functional break



METIS, the instrument

- Requirements
- Interfaces
- Error budgets
- Functional breakdown

The screenshot displays the METIS system requirements management interface. The main table lists requirements with the following columns: ID, Outline Number, Title, Priority, Assignee(s), Status, and Author. The requirement 'METIS-1095 - Imager FoV' is highlighted in yellow. Below the table, a detailed view of this requirement is shown, including its type, outline number, author, assignees, and status.

ID	Outline Number	Title	Priority	Assignee(s)	Status	Author
METIS-223	IRS-3.2.3.2.2	IFS spectral resolution	50.0	Alistair Glasse	✓	Adrian Glauser
METIS-1088	IRS-4.3-1	Dimensions	50.0	Gabby Kroes	✓	Adrian Glauser
METIS-1090	IRS-3.1-1	General wavelength coverage	50.0	Roy van Boekel	✓	Adrian Glauser
METIS-1091	IRS-3.1-2	Instrument modes	50.0	Adrian Glauser, R	✓	Adrian Glauser
METIS-1093	IRS-3.2.1.5	Imaging wavelength coverage	50.0	Adrian Glauser	✓	Adrian Glauser
METIS-1094	IRS-5.1.2.1	Applicable wavelength ranges	50.0	Roy van Boekel, 1	✓	Adrian Glauser
METIS-1095	IRS-3.2.1-2	Imager FoV	50.0	Tibor Agocs, Roy	✓	Adrian Glauser
METIS-1097	IRS-3.2.1-1	Imager Pixel Sampling	50.0	Tibor Agocs, Roy	✓	Adrian Glauser
METIS-1098	IRS-3.3.3-3	Chop Throw	50.0	Adrian Glauser, R	✓	Adrian Glauser
METIS-1102		Dark frame around image	50.0	Tibor Agocs, Leor	✗	Adrian Glauser
METIS-1184	IRS-5.1.2.2	Optical Transmission	50.0	Tibor Agocs	✓	Adrian Glauser
METIS-1186	IRS-3.2-2	Instrument Thermal Background	50.0	Roy van Boekel	✓	Adrian Glauser
METIS-1189	IRS-5.1.4-1	Scattered light due to mirror roughness	50.0	Adrian Glauser, Ti	✓	Adrian Glauser
METIS-1194	IRS-3.3.4.2-1	Imager LM-Band Science Filters	50.0	Roy van Boekel	✓	Adrian Glauser
METIS-1203	IRS-3.5.1-3	Photometric stability	50.0	Leonard Burtsche	✓	Adrian Glauser
METIS-1222	IRS-3.1-5	Low resolution slit spectroscopy	50.0	Roy van Boekel	✓	Roy van Boeke
METIS-1358	IRS-3.1-6	Medium resolution slit spectroscopy	50.0	Adrian Glauser	✓	Adrian Glauser
METIS-1360	IRS-3.2.2-3	Slit position repeatability	50.0	Adrian Glauser	✓	Adrian Glauser

METIS-1095 - Imager FoV

Type: **System Requirement**

System Leads: **Optical Instrument Scientist**

Status: **Approved**

Outline Number: **IRS-3.2.1-2**

Applicable Subsystems: **CFO, IMG**

Priority: **Medium [50.0]**

Author: **Adrian Glauser**

Maturity: **TBD**

Assignee(s): **Tibor Agocs, Roy van Boekel**

Owner:

POLARION

382 system requirements

Mid Infrared E-ELT Imager and Spectrograph

METIS

METIS, the instrument

- Requirements
- Interfaces
- Error budgets
- Functional bre

Internal Interfaces		CCS	CFO	IMG	LMS	NS	SCA	DET	CRY	WCU	WSS	PIP	ICS	SEQ
METIS Subsystems	CCS													
	CFO	MT												
	IMG	MT	O											
	LMS	MT	O											
	NS	MT	O											
	SCA	MT	O											
	DET			OMT	OMT	OMT								
	CRY	MT	OMT	T	T	T	T	MT						
	WCU		O						M					
	WSS								M					
	PIP							S						
	ICS	ME	E	E	E	E	ES	E	MTE	ET	ME	S		
	SEQ	MT	OMT	OMT	OMT	OMT	OMT	OMT	OMT	MT	OMT	M	S	ES
Component	ICAR		MT	MT	MT	MT	MT						E	MT
	SCAO dichroic		OMT											OMT
	Window		O						MT					OMT
External Interfaces														
Platform	Platform + Dome								T	T	MT		M	
	SCP								T				ET	
	Optical Telescope		O							O				
Control Room	Compressors								TE				E	
	CCS Central Control System												S	
	Observation Block Preparation Software												S	
	Observatory Data Archive										S		S	
	AO Adaptive optics module						S						S	
	DCS Detector Control Software												S	

Many interface documents

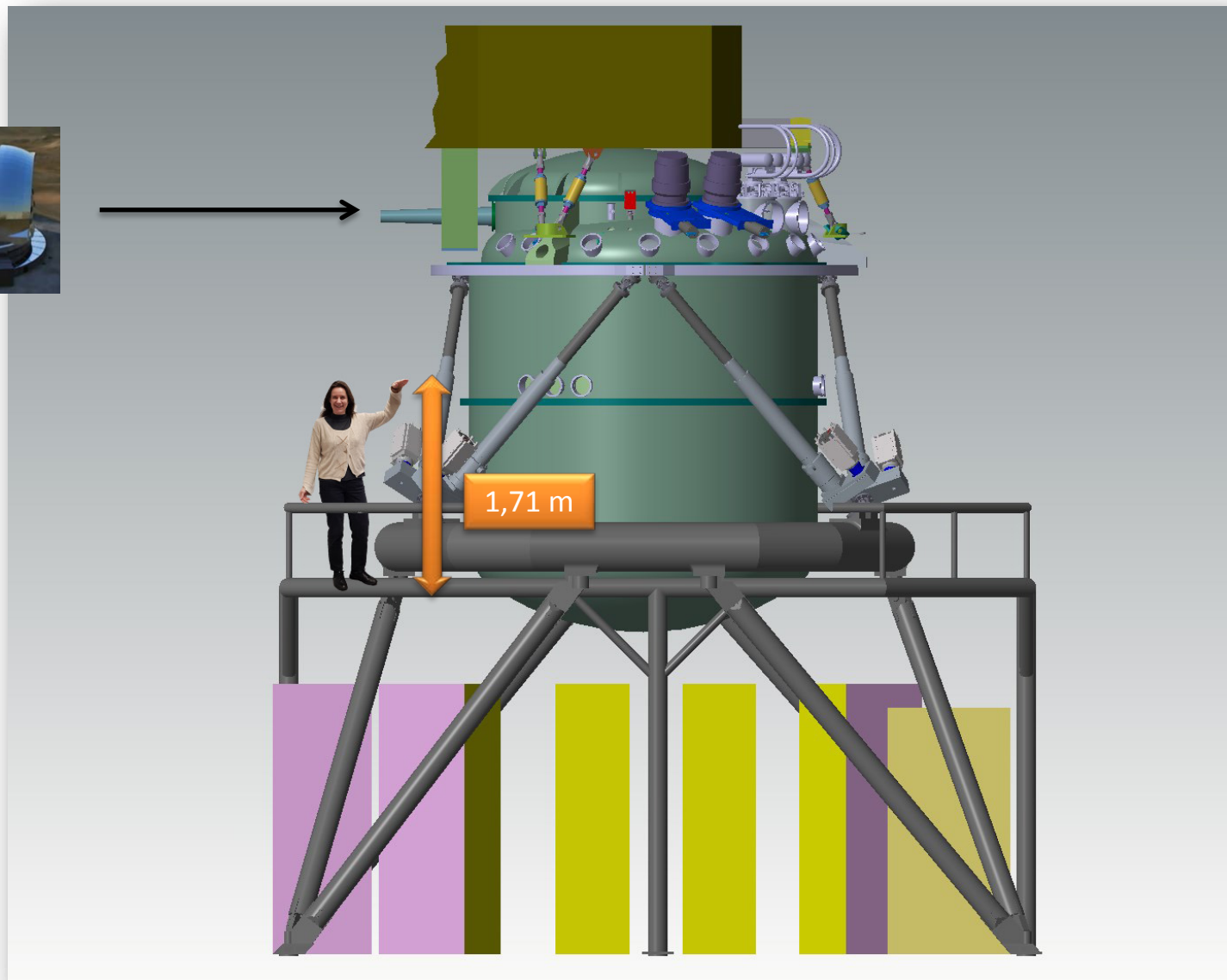
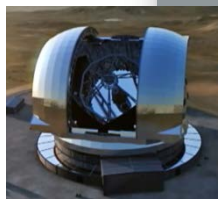


METIS, the instrument

- Requirements
- Interfaces
- Error budgets
- **Functional break down**

Just a moment, we address this
in the imager section

METIS, the instrument

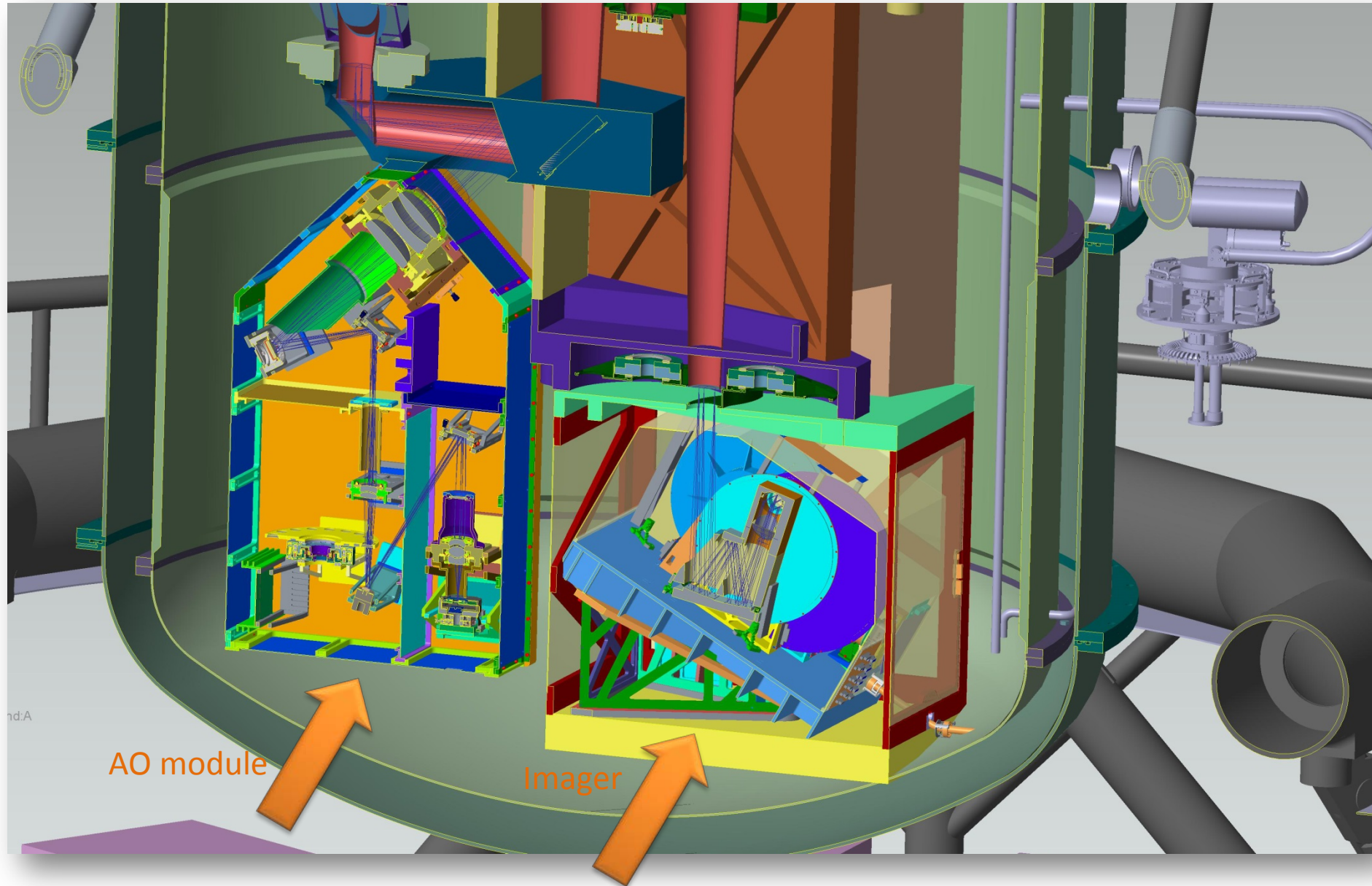


→ inside



Mid Infrared E-ELT Imager and Spectrograph

METIS, the instrument



Mid Infrared E-ELT Imager and Spectrograph

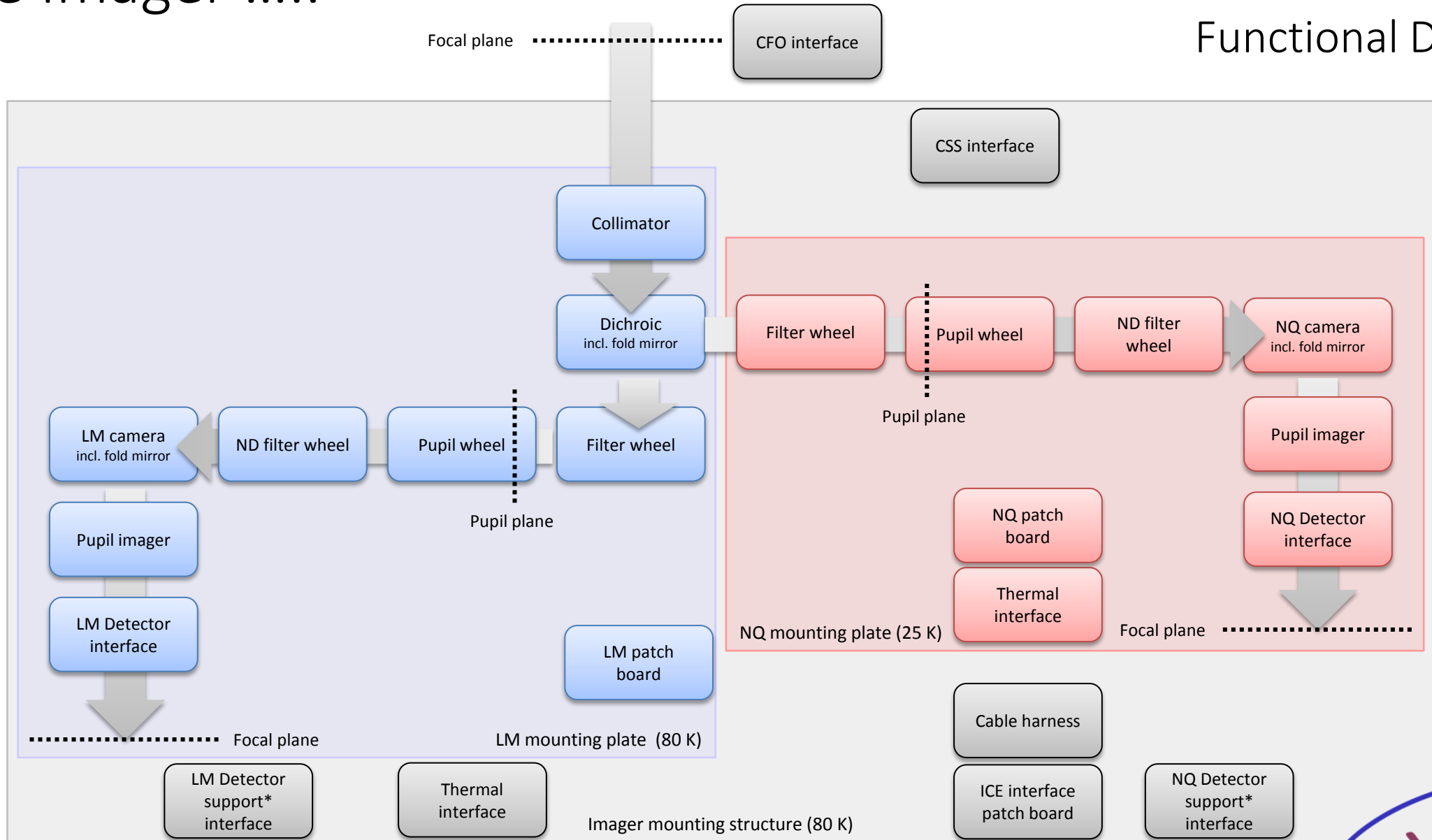


MPIA contribution

- Wavefront Sensor (AO Module)
- Imager
- AO Control System
- AO lead (Thomas Bertram)
- Thermal lead (Werner Laun)

The Imager

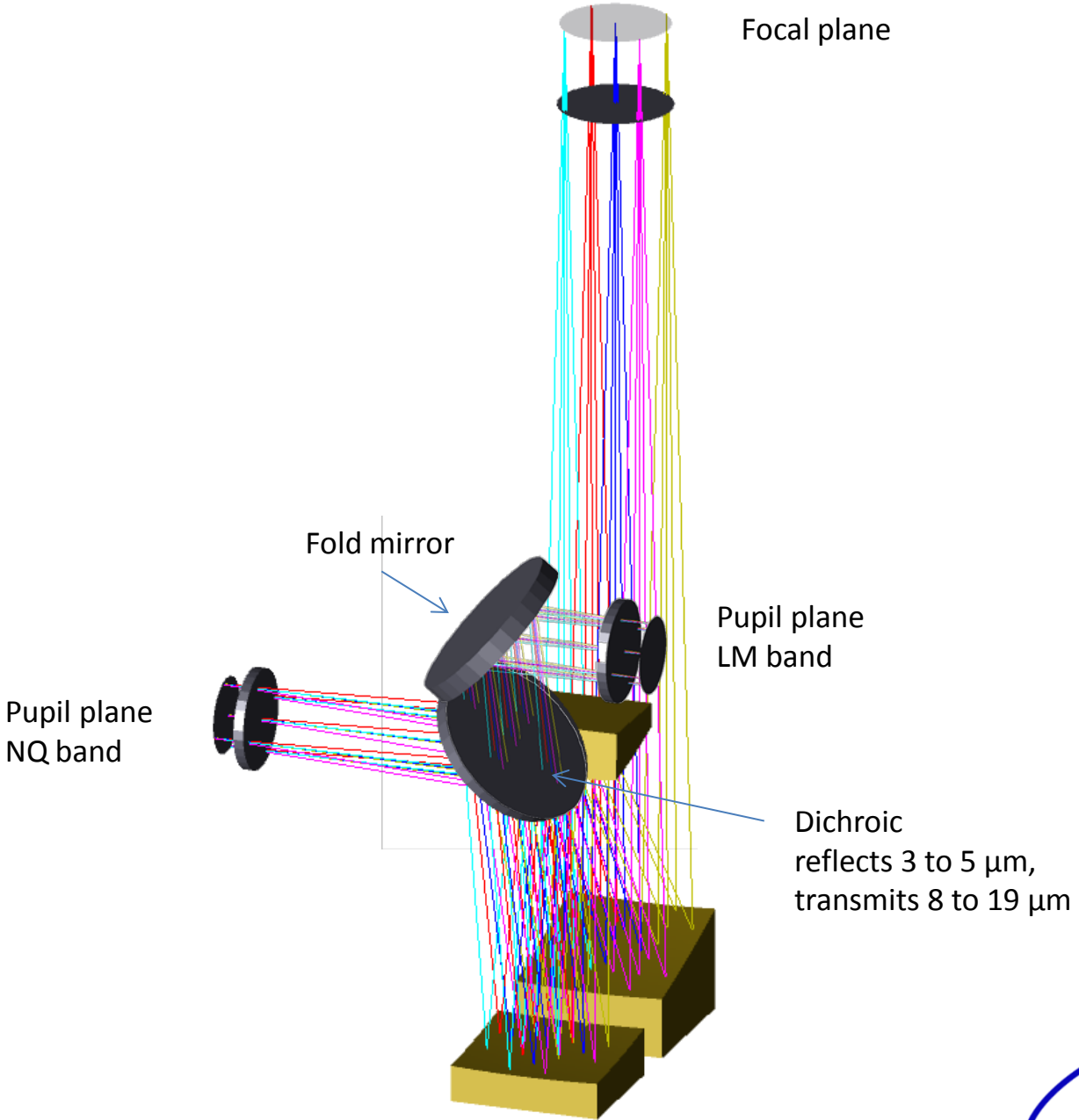
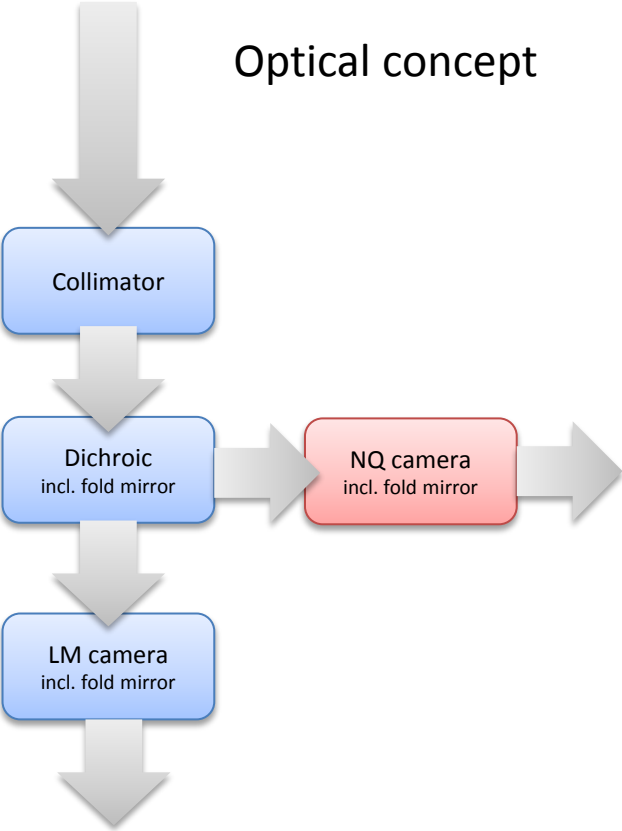
Functional Diagram



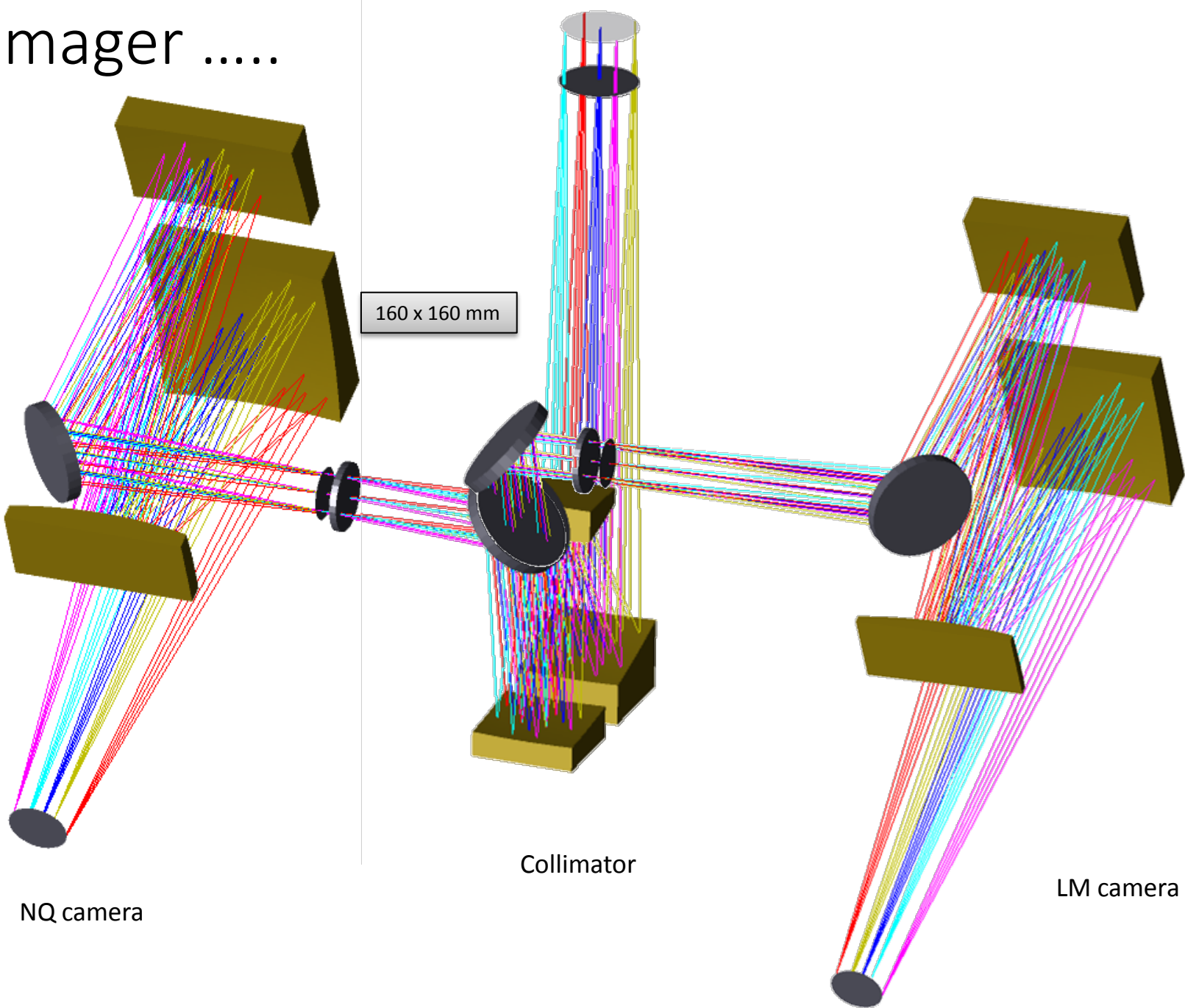
*Detector support interface: cable feedthrough, thermal feedthrough, access port



The Imager



The Imager

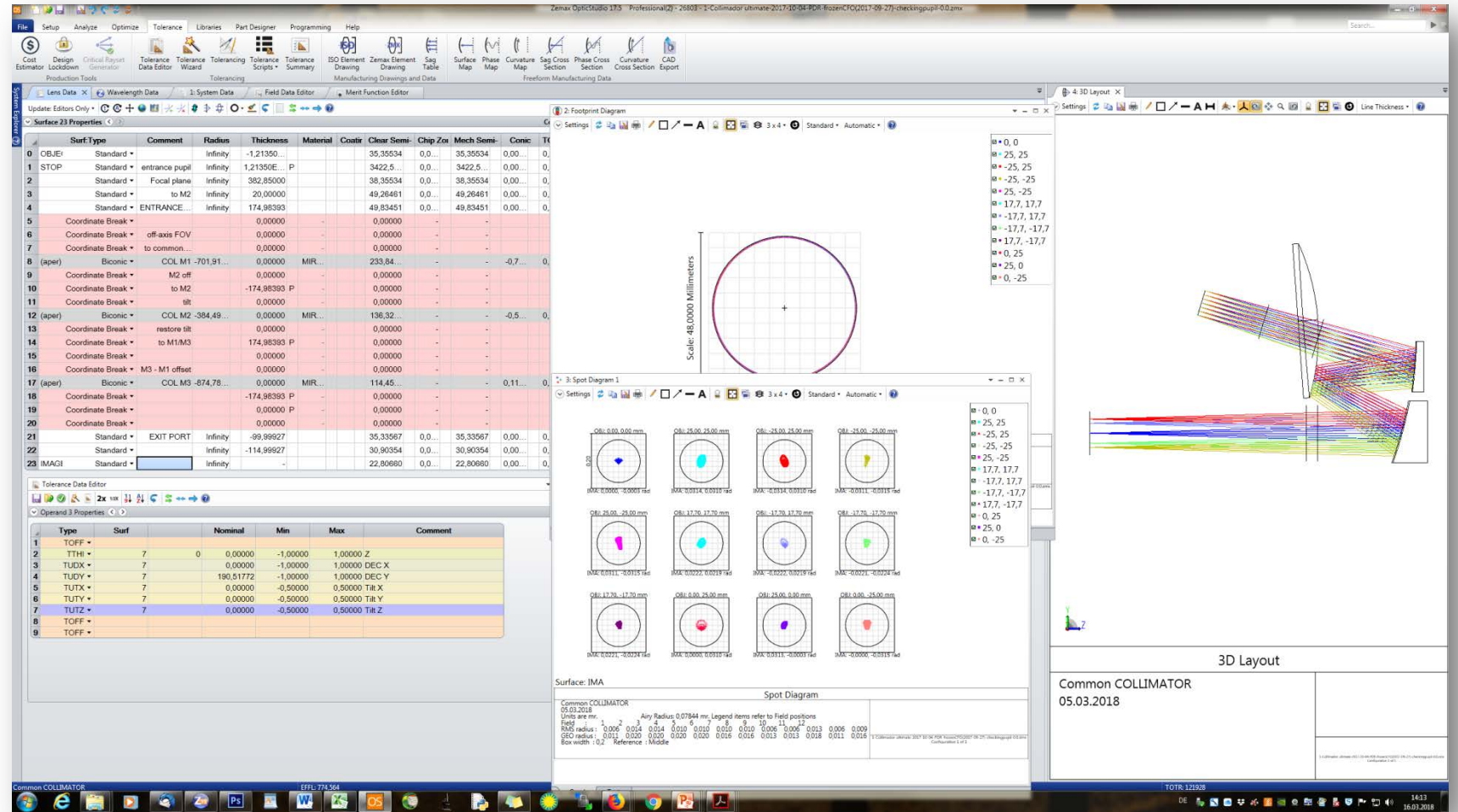


NQ camera

Collimator

LM camera

The Imager



Optical design

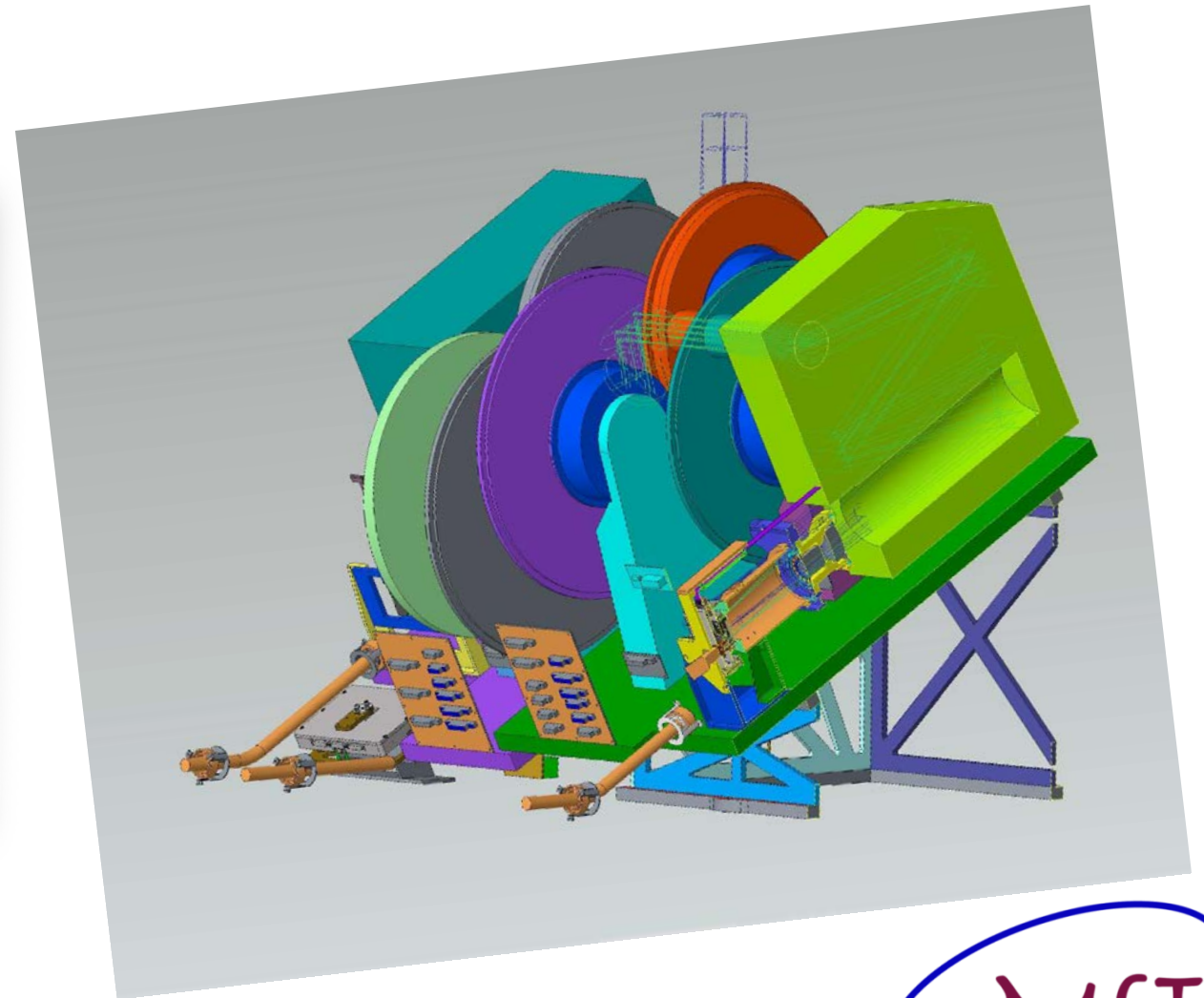
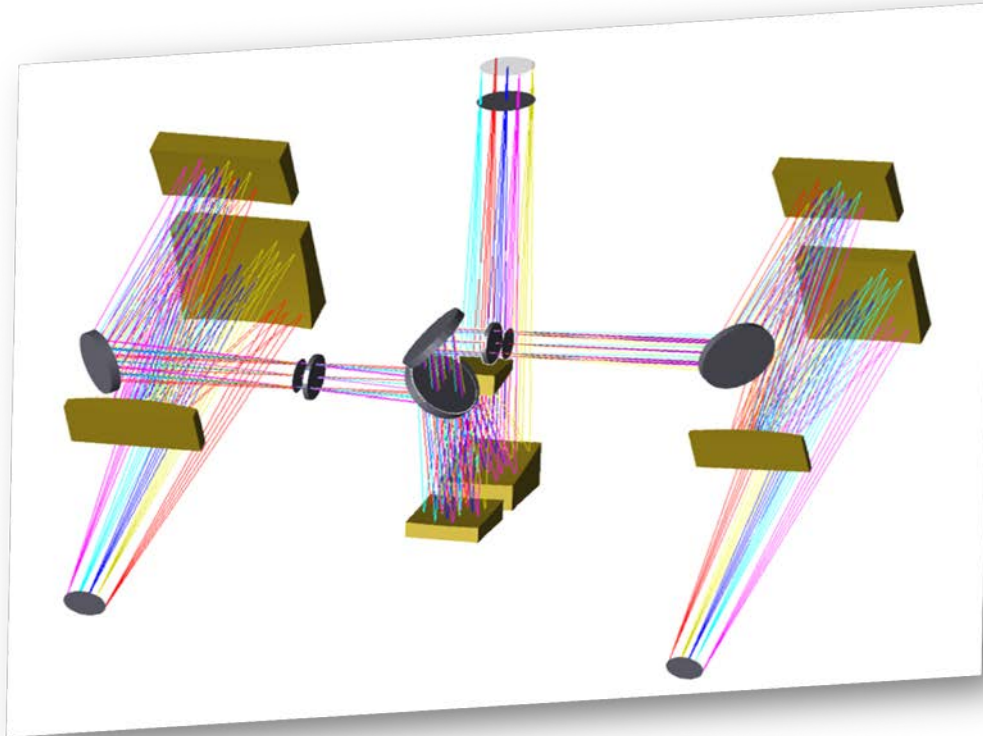
- Optics Studio
- Wavefront error but also pupil performance (HCI)
- Free Form Mirrors (bi-conics)
- Diffraction effects (spectroscopy)

Mid Infrared E-ELT Imager and Spectrograph



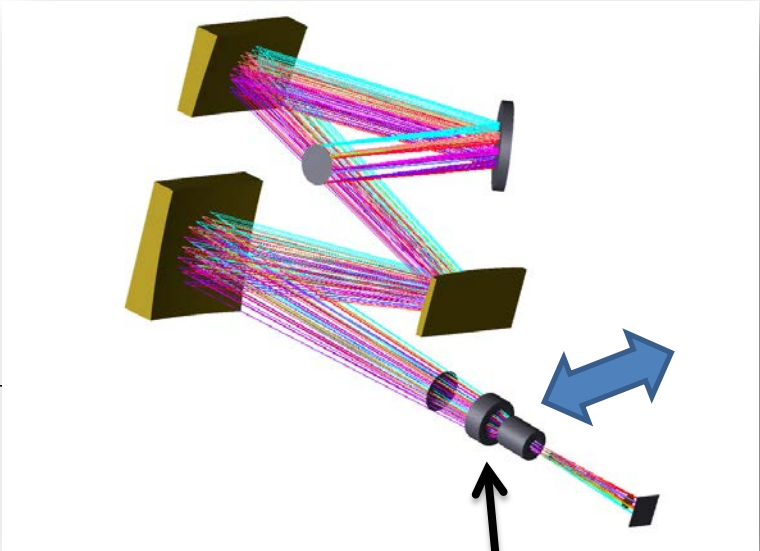
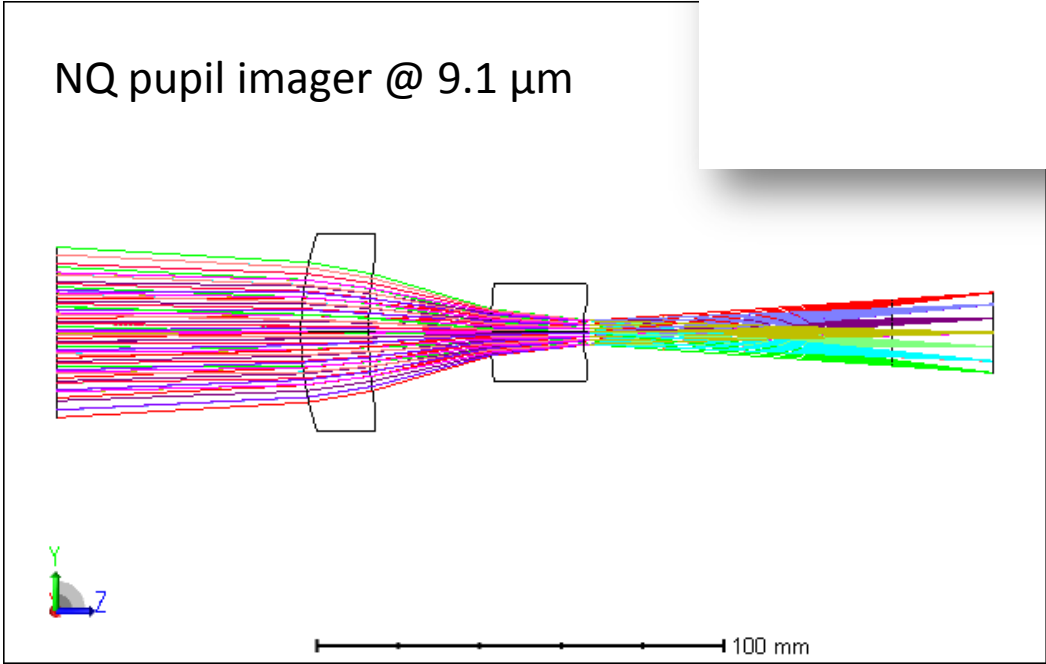
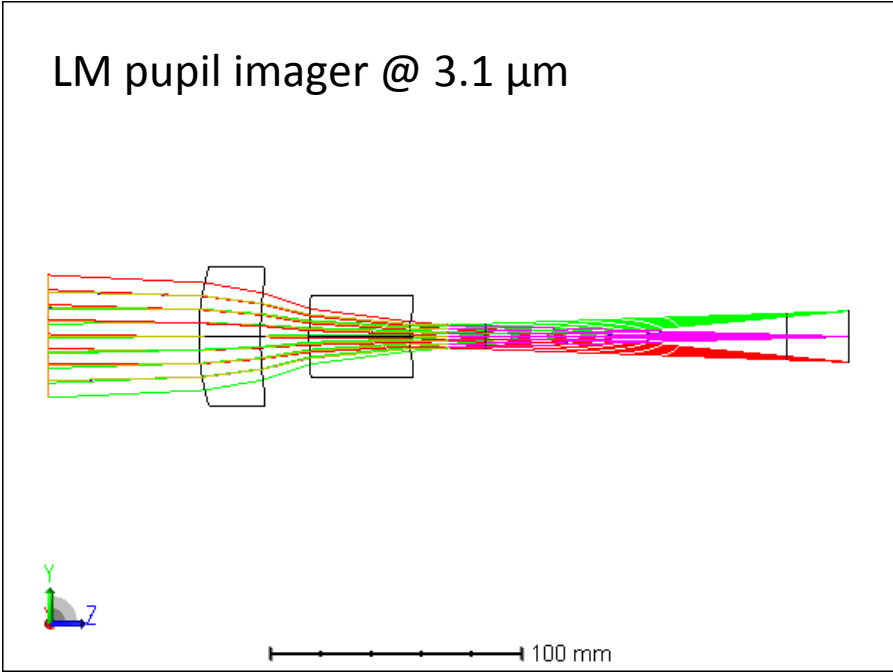
The Imager

From optics to mechanics



Pupil imager forgotten

The Imager

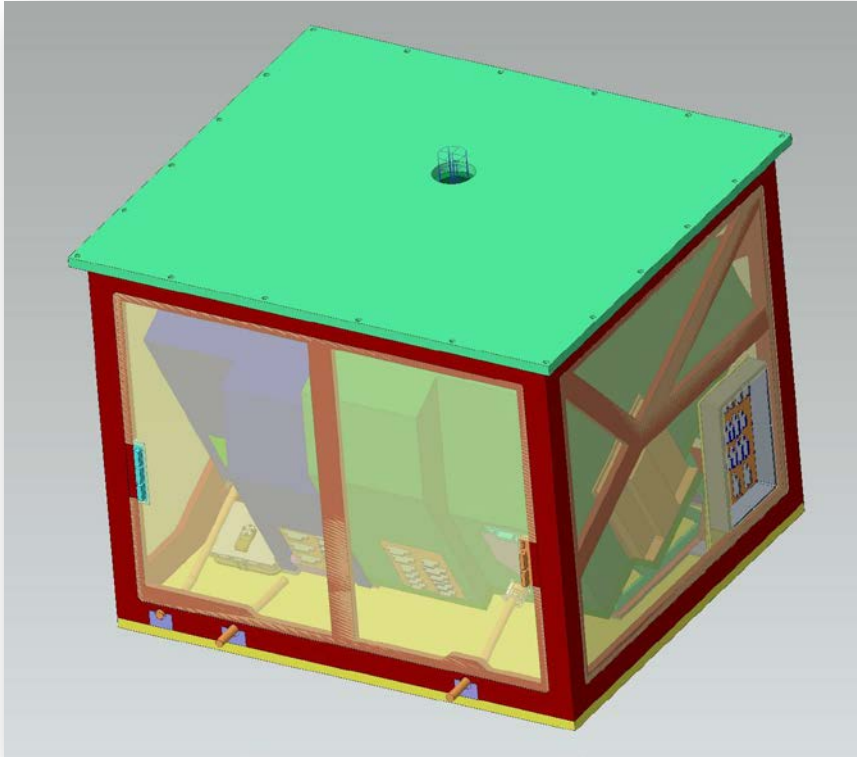
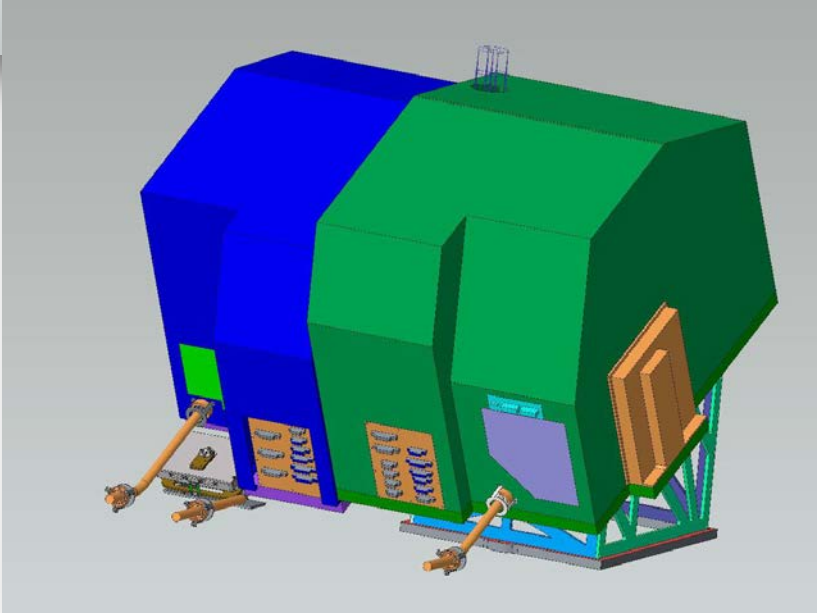
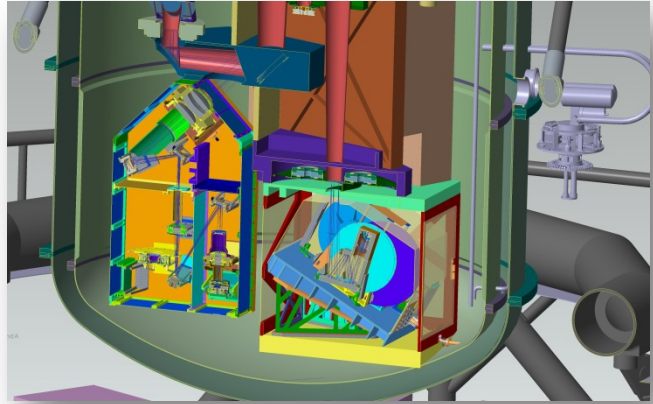
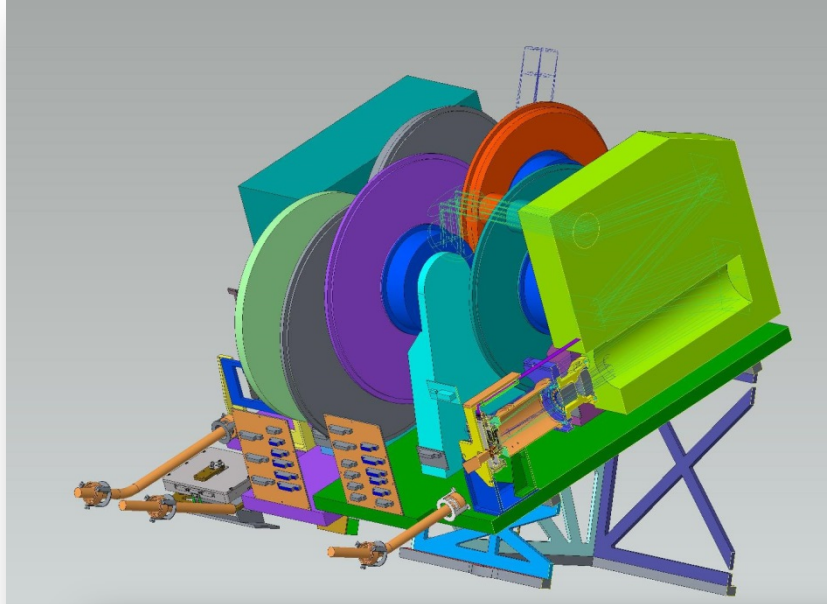


Between camera optics and detector

Materials: Si / Ge
One toroidal surface



The Imager

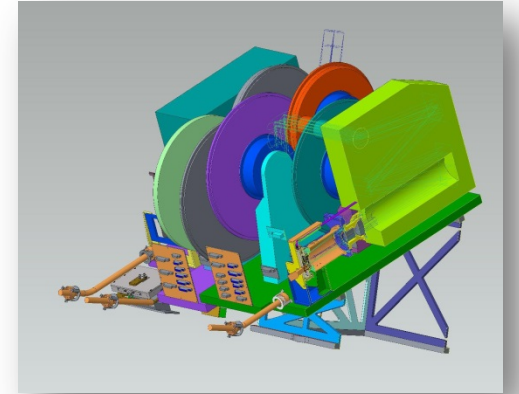


Total ~ 350 kg



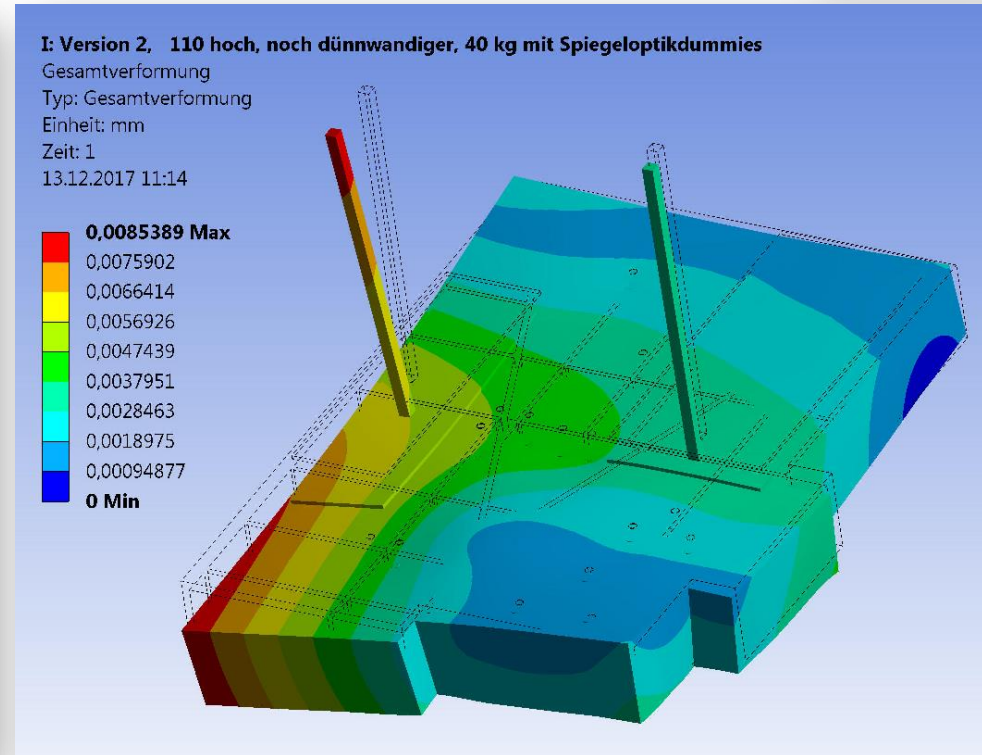
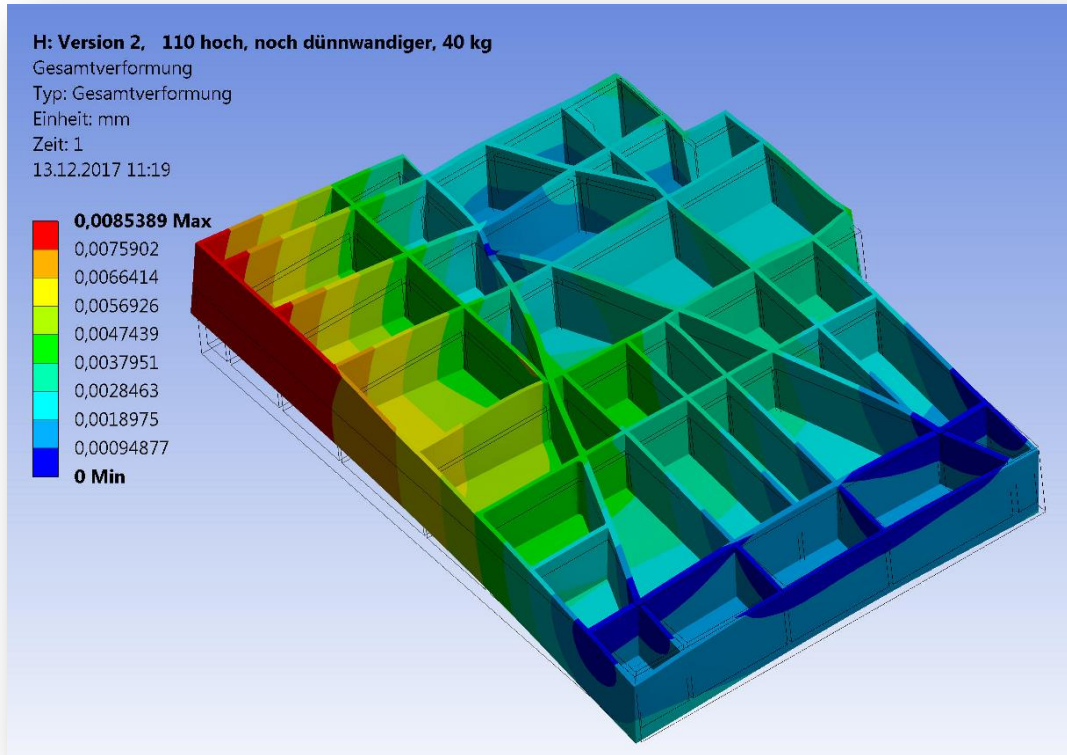
Mid Infrared E-ELT Imager and Spectrograph

The Imager

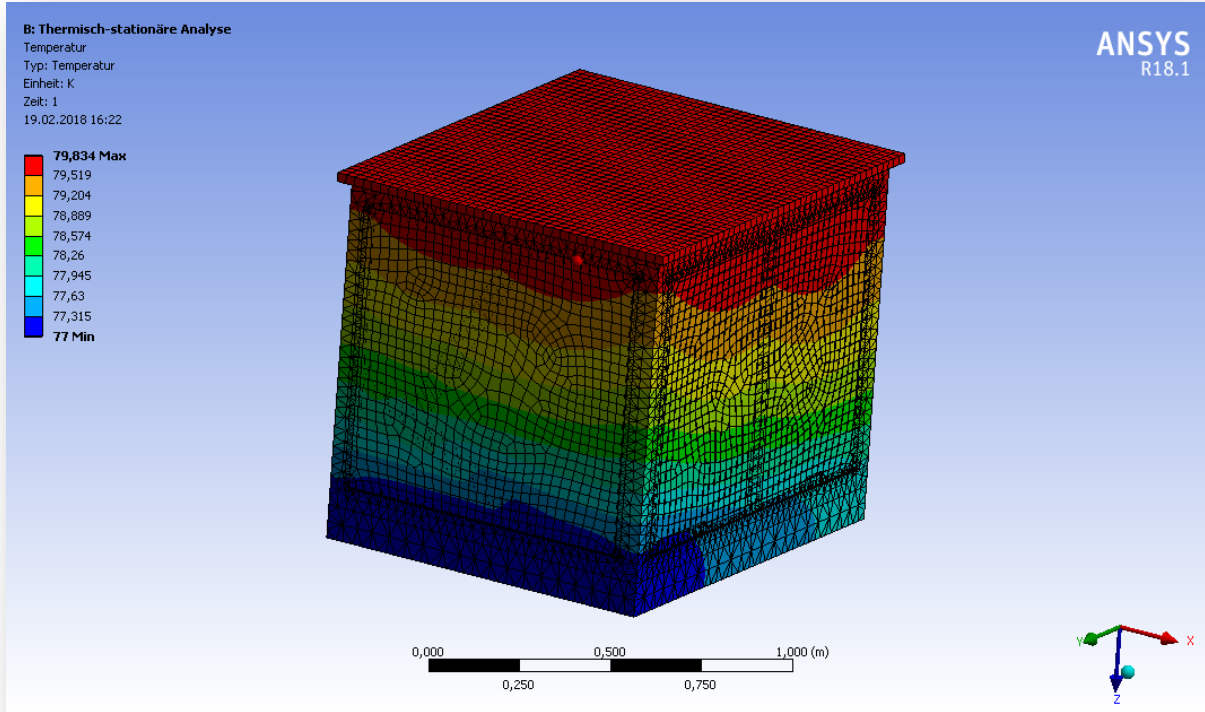


FEA of the base plate

- Static conditions

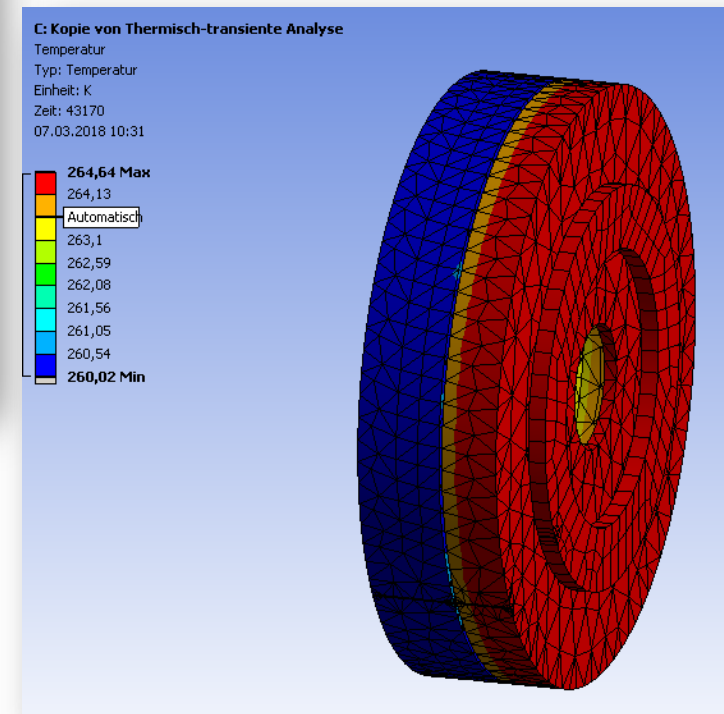


The Imager



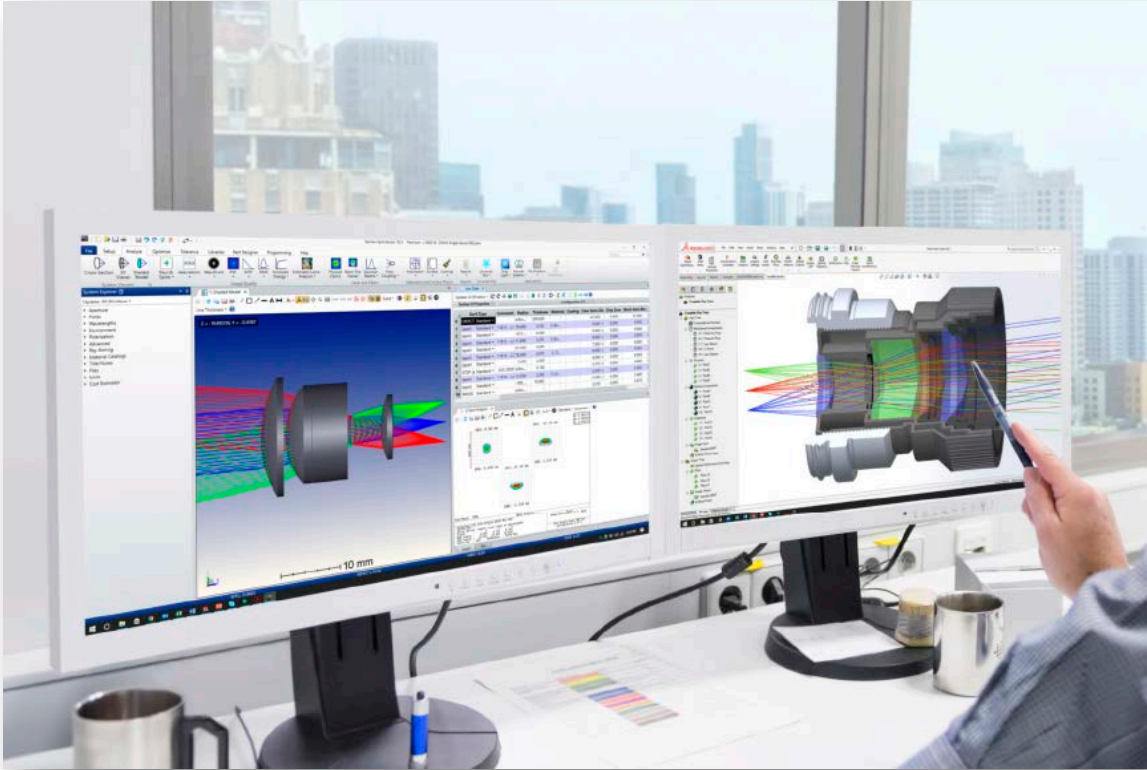
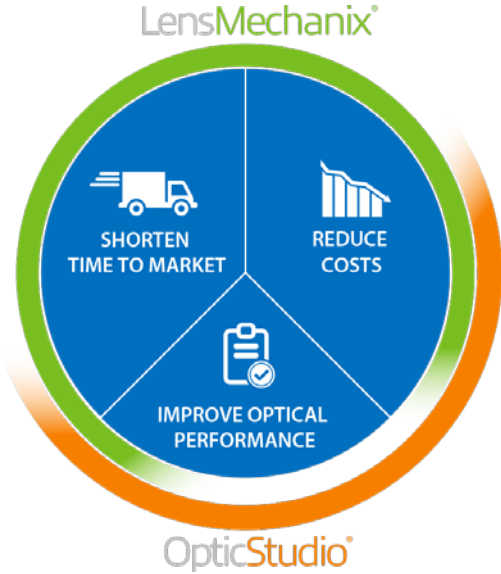
Thermal calculations

- Simulated with ANSYS workbench
- Static temperature gradients
- Transiency calculations



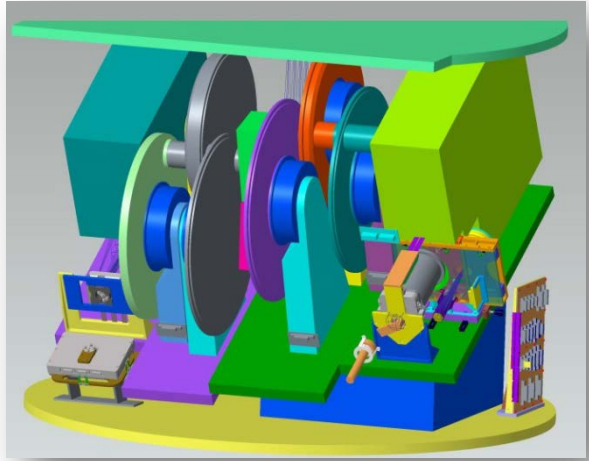
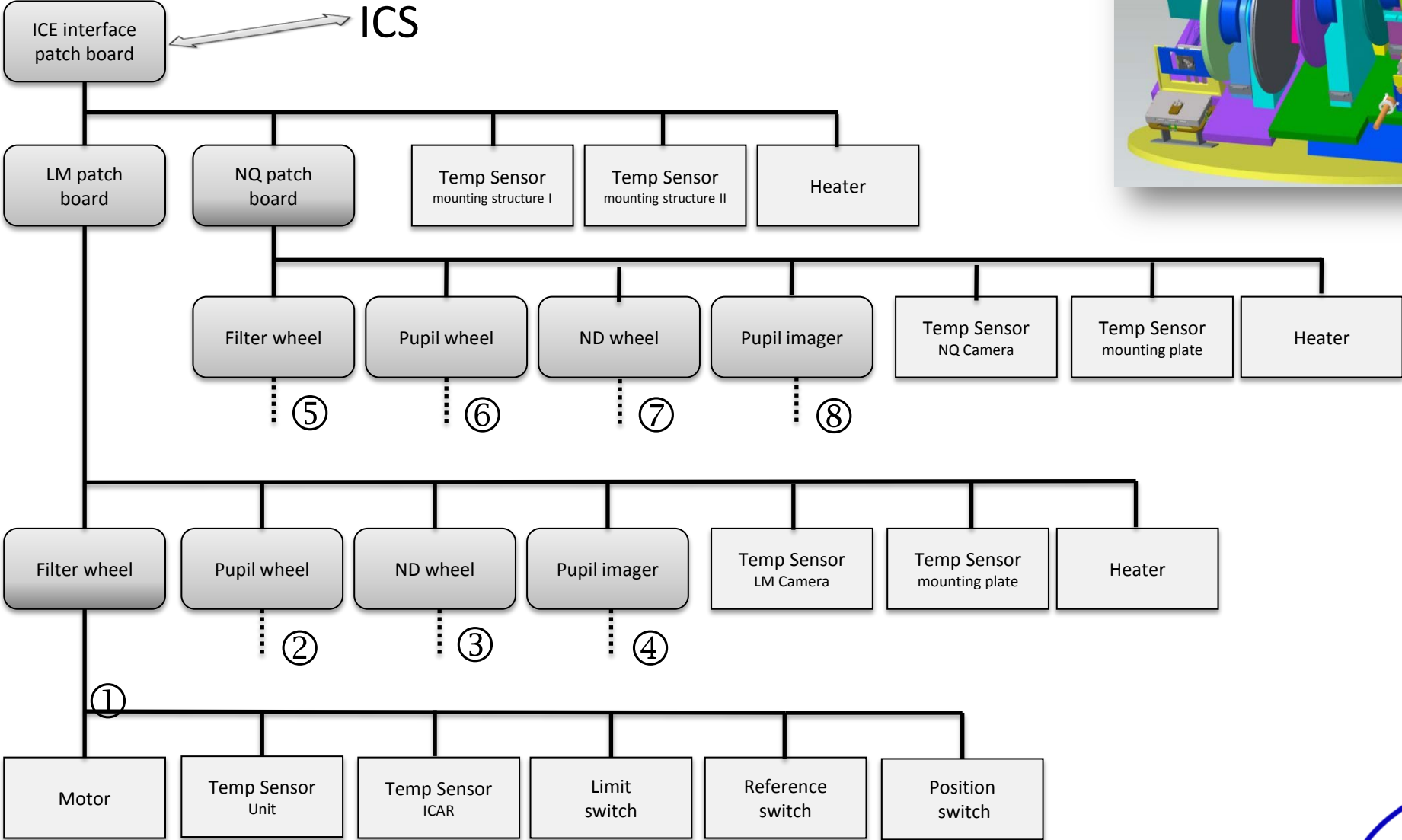
The Imager

Mechanics: Creo & ANSYS
Optics: Optics Studio



The Imager

Wiring Diagram



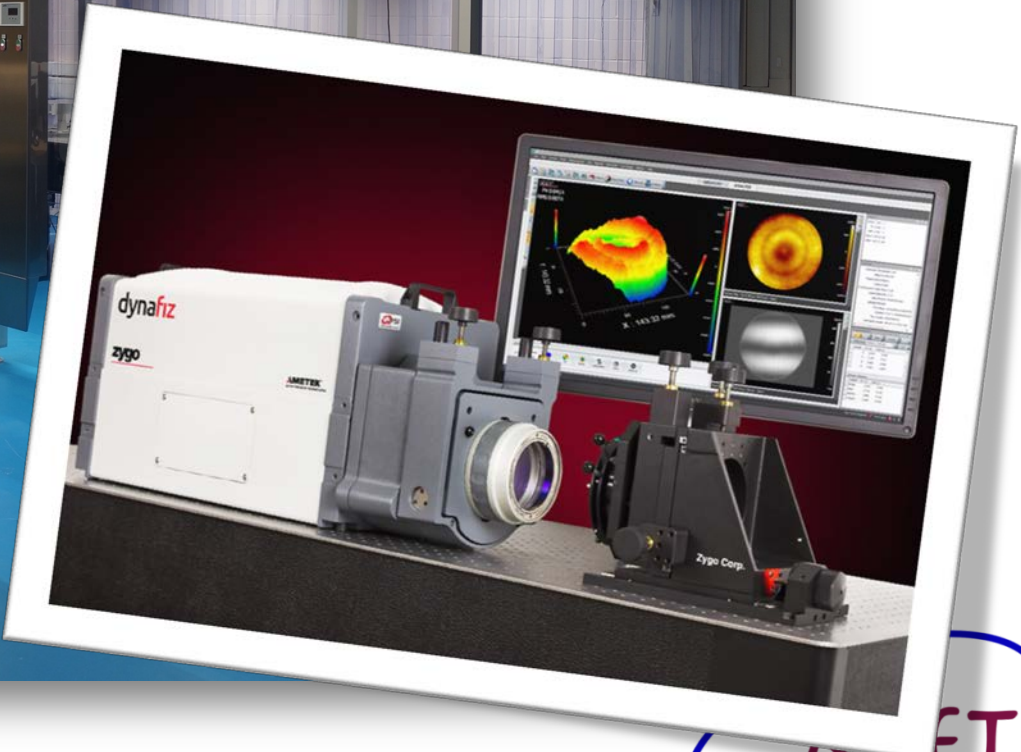
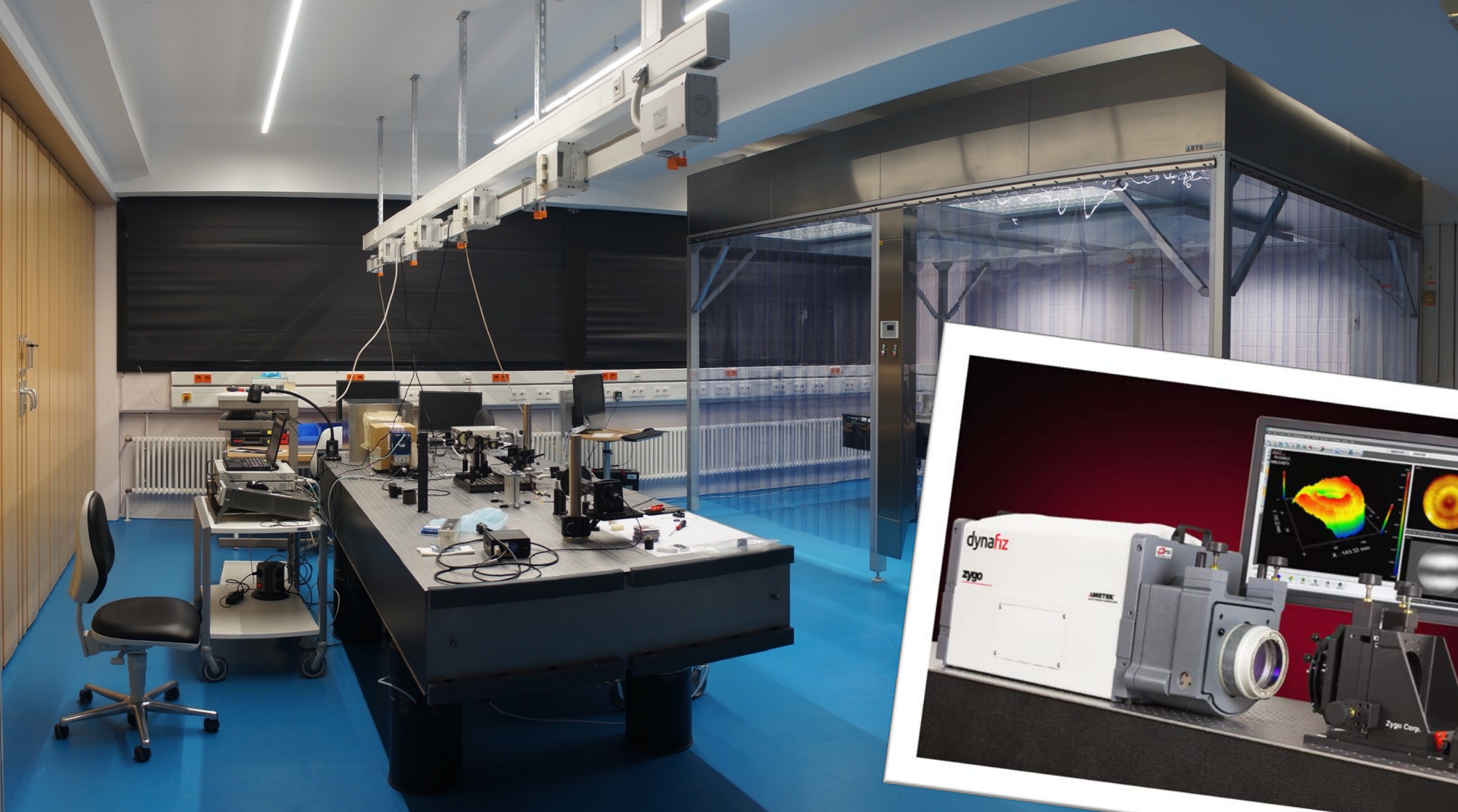
Outlook

- | | |
|------------------|----------|
| • PDR | Apr 2019 |
| • Optics Pre-FDR | Sep 2020 |
| • FDR | Apr 2021 |
| • MAIV in HD | |
| • System AIV | Jan 202x |

- Verification of units in Optics Lab 002
- Integration of the imager in the 'Experimentierhalle'
- End to end test in a new test cryostate

We are already preparing

Outlook



Mid Infrared E-ELT Imager and Spectrograph

The End

Thank you



Mid Infrared E-ELT Imager and Spectrograph