

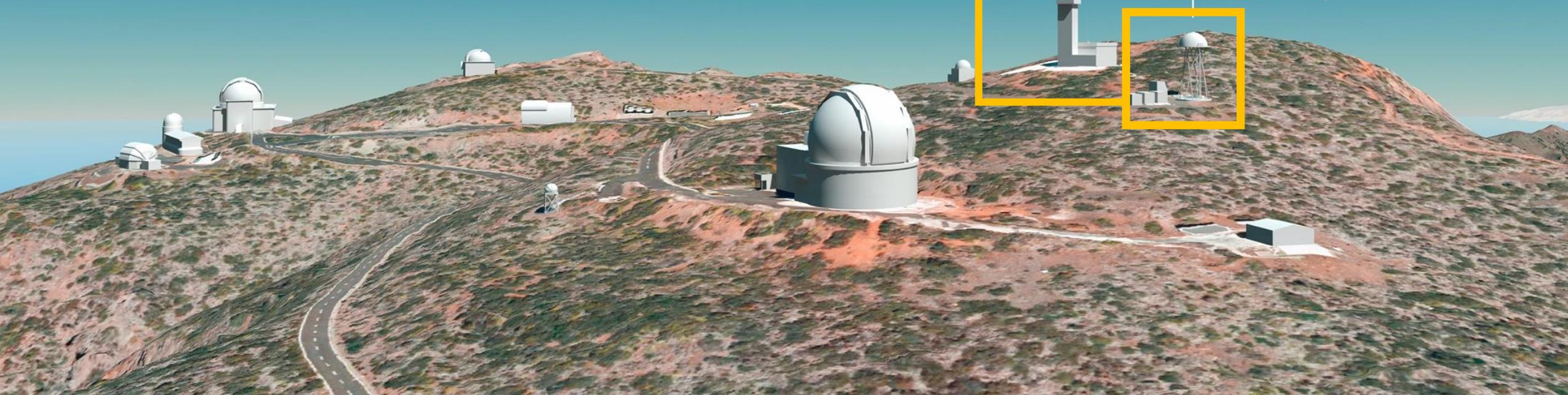
European Solar Telescope





Swedish
Solar
Telescope

Dutch
Open
Telescope



ROQUE DE LOS MUCHACHOS OBSERVATORY (Garafía, La Palma, Spain)

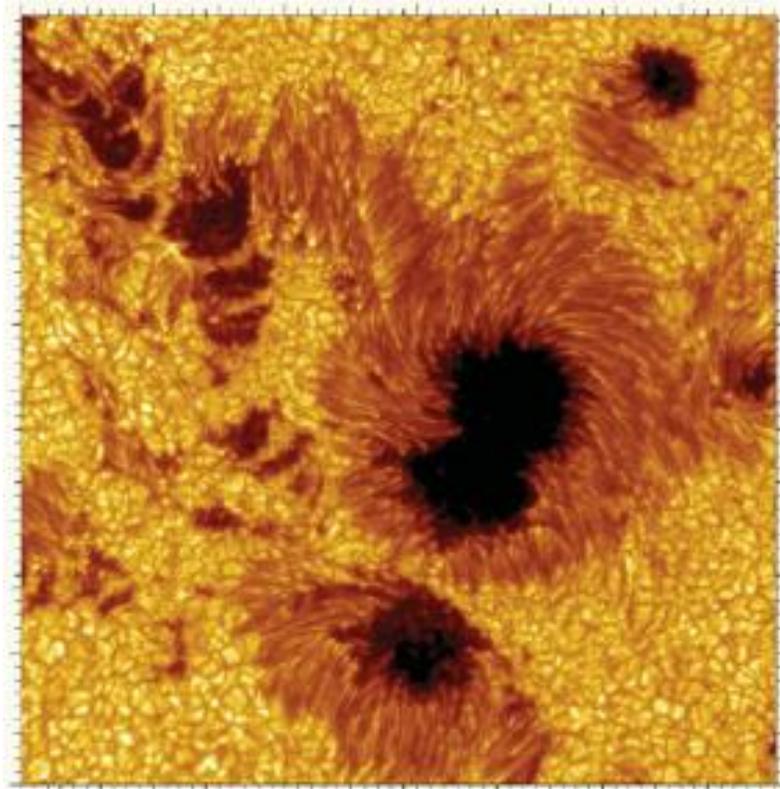
Sweden and the EST



- ❑ Sweden has contributed to EST since the beginning of the preparatory phase
- ❑ The University of Stockholm is a member of the EST foundation. Currently composed by 10 research institutions
- ❑ EST is included in Swedish Research Council Guide to Research Infrastructure
- ❑ The Swedish Research Council will take decision about a 42 MSEK grant to EST before end of March
- ❑ Sweden is actively contributing to the design of powerful instrumentation for EST
- ❑ EST will welcome Sweden as a member of the future EST-ERIC

Swedish Solar Telescope (SST) on La Palma Island

- ❑ First light in 2002
- ❑ Operated by the Institute for Solar Physics of the Stockholm University
- ❑ SST has a combination of high image quality and powerful instrumentation, developed in-house, which is unique

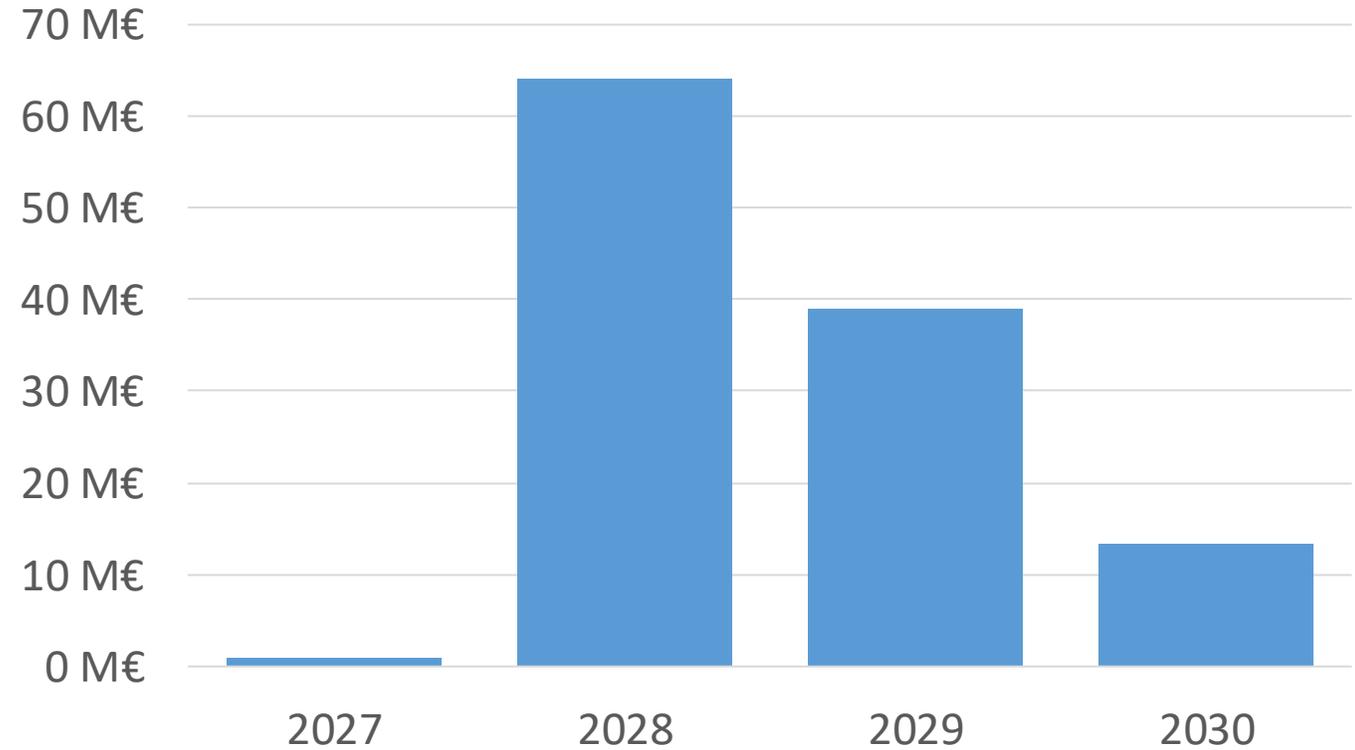


EST STATUS AND TENDERS BUDGET



- Present status: closing actions after PDRs
- Detailed design. **Starting in 2026**
- Construction tenders. **Starting in 2028**
- First light planned for **2036**

EST Tenders budget



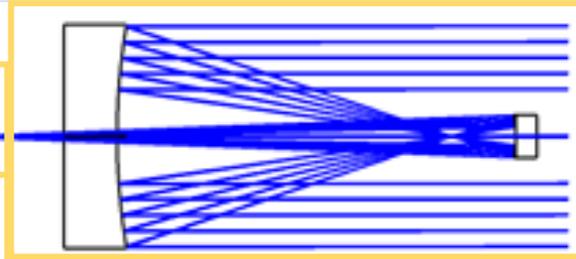
- Countries getting into the EST-ERIC can provide **cash or in-kind contributions.**



OPTICAL DESIGN



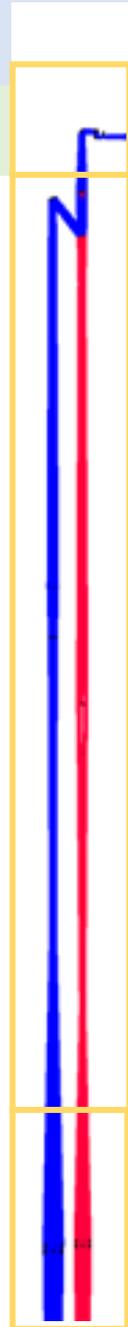
Transfer Optics and Calibration Assembly



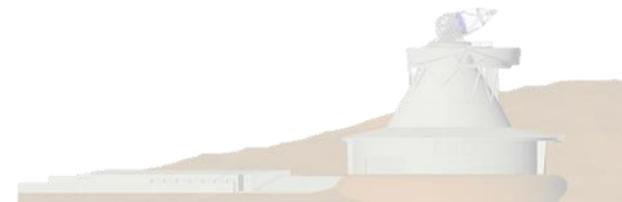
Telescope Structure Optics

- 4,2 meter Solar Telescope
- Adaptive optics
- Spectral range: 380 - 2300 nm

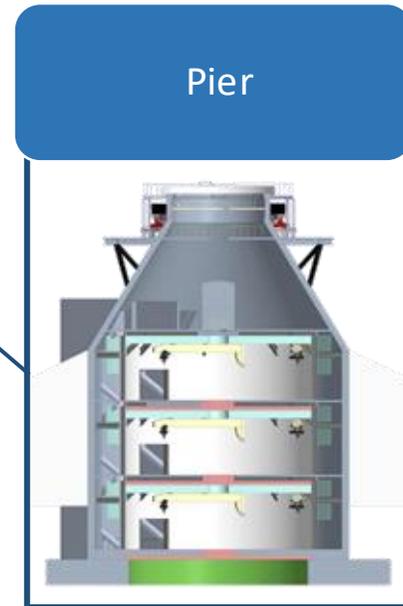
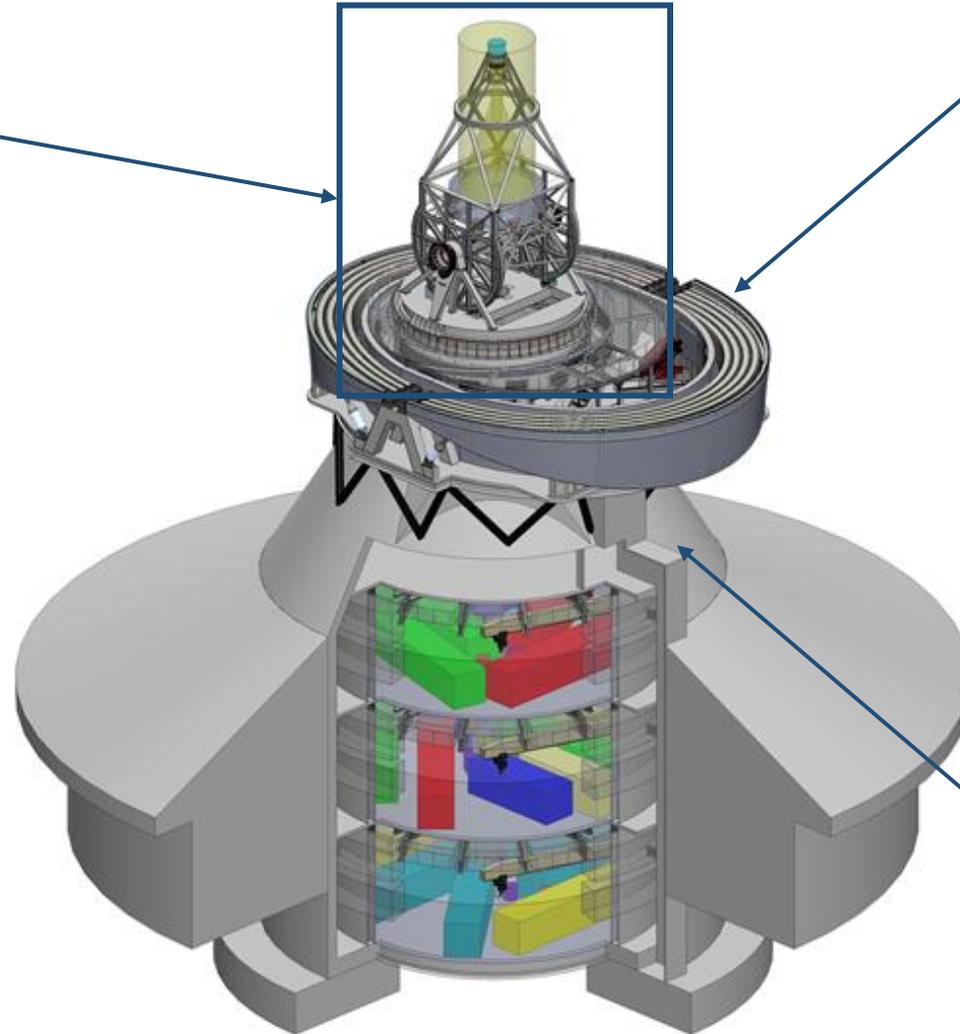
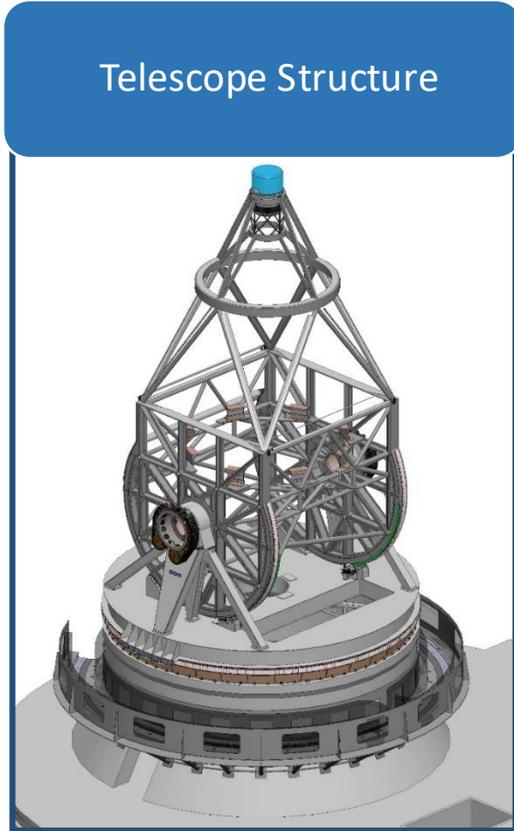
Pier Optical Path



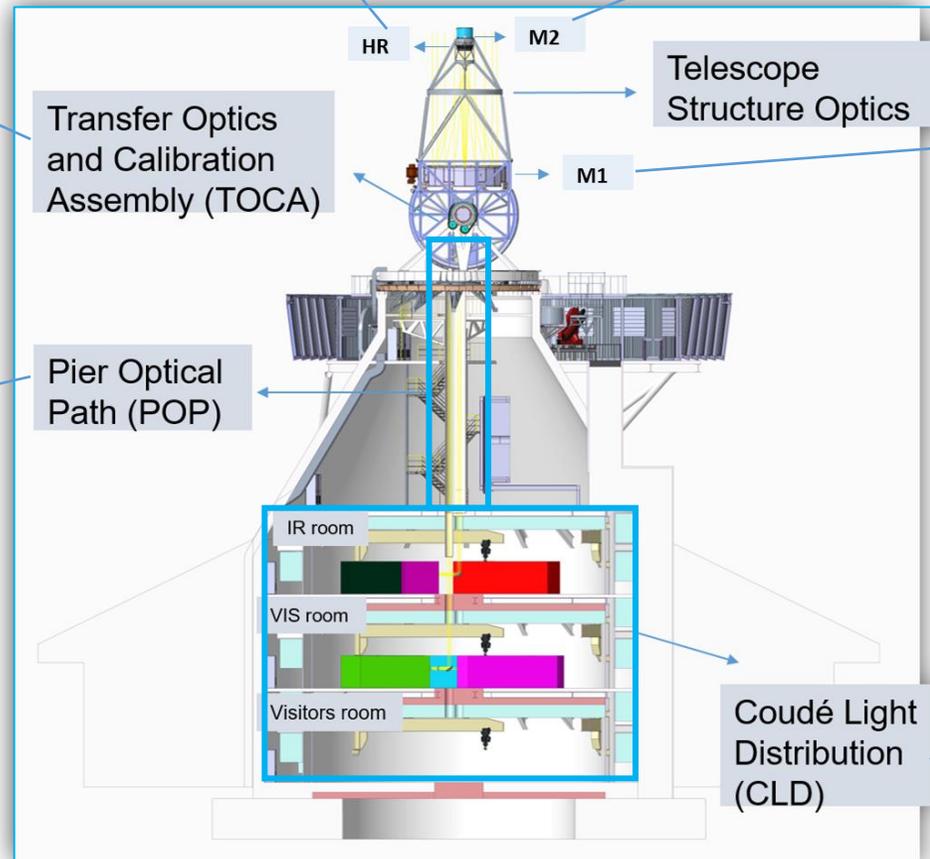
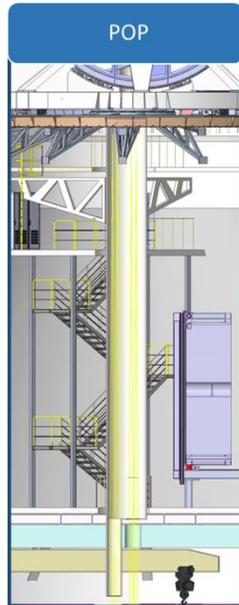
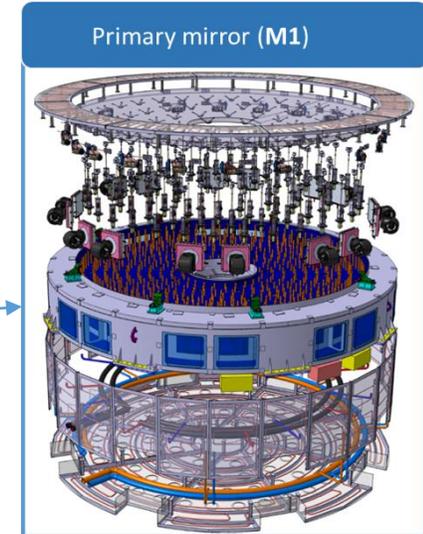
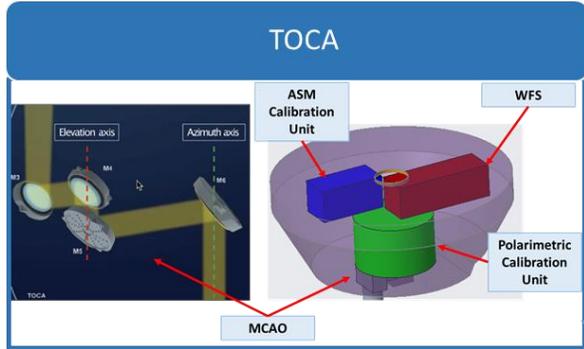
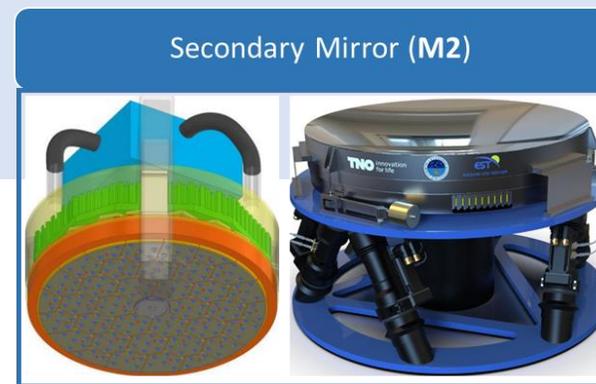
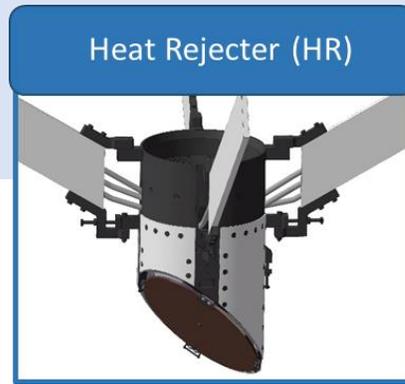
Coudé Light Distribution



MECHANICS

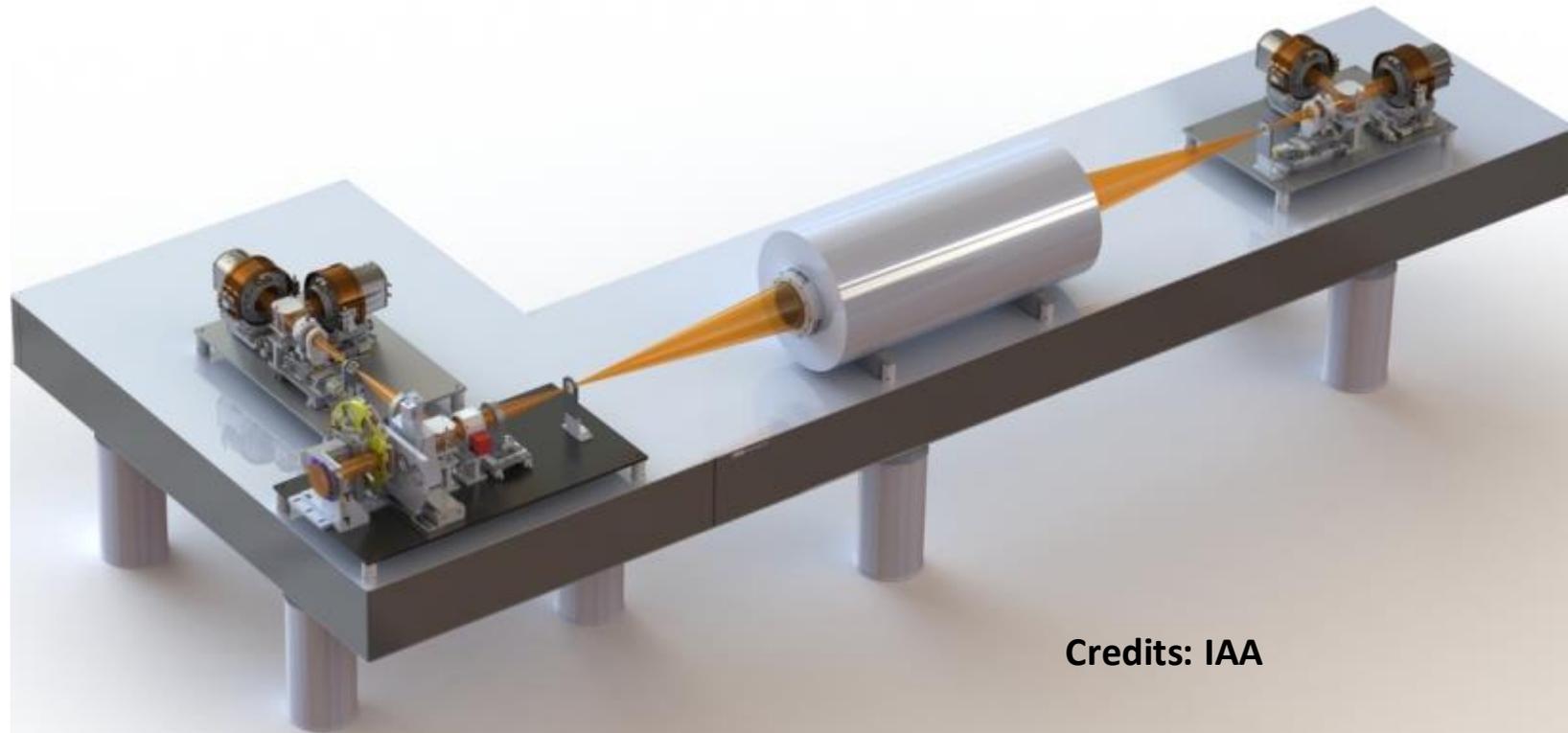


OPTOMECHANICS



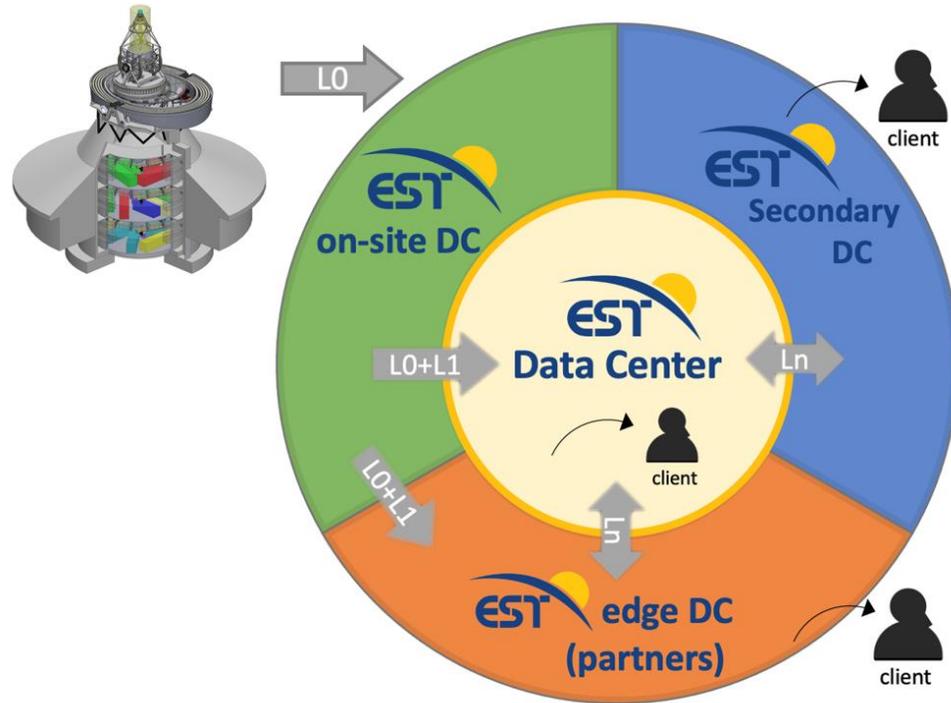
7 instruments

- ❑ 3 based on tunable filters and imaging cameras. Participation of Stockholm University
- ❑ 3 Integral field spectro-polarimeter based on microlenses
- ❑ 1 Integral field spectro-polarimeter based on image slicer



Credits: IAA

EST DATA CENTER



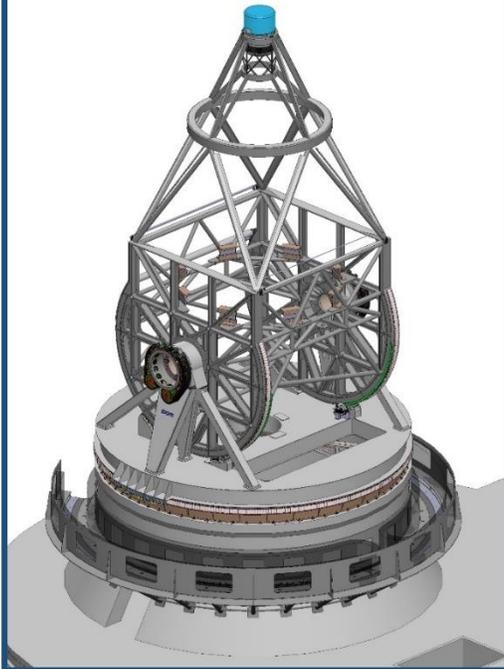
- EST will produce up to 2 Peta Bytes of scientific data per day.
- The EST Data Centre will be built on a distributed architecture, incorporating three distinct types of nodes
 - Data centre in the telescope
 - Data centre in sea level facilities
 - Data centre in the continent

TENDER 1

Telescope Structure



Telescope Structure



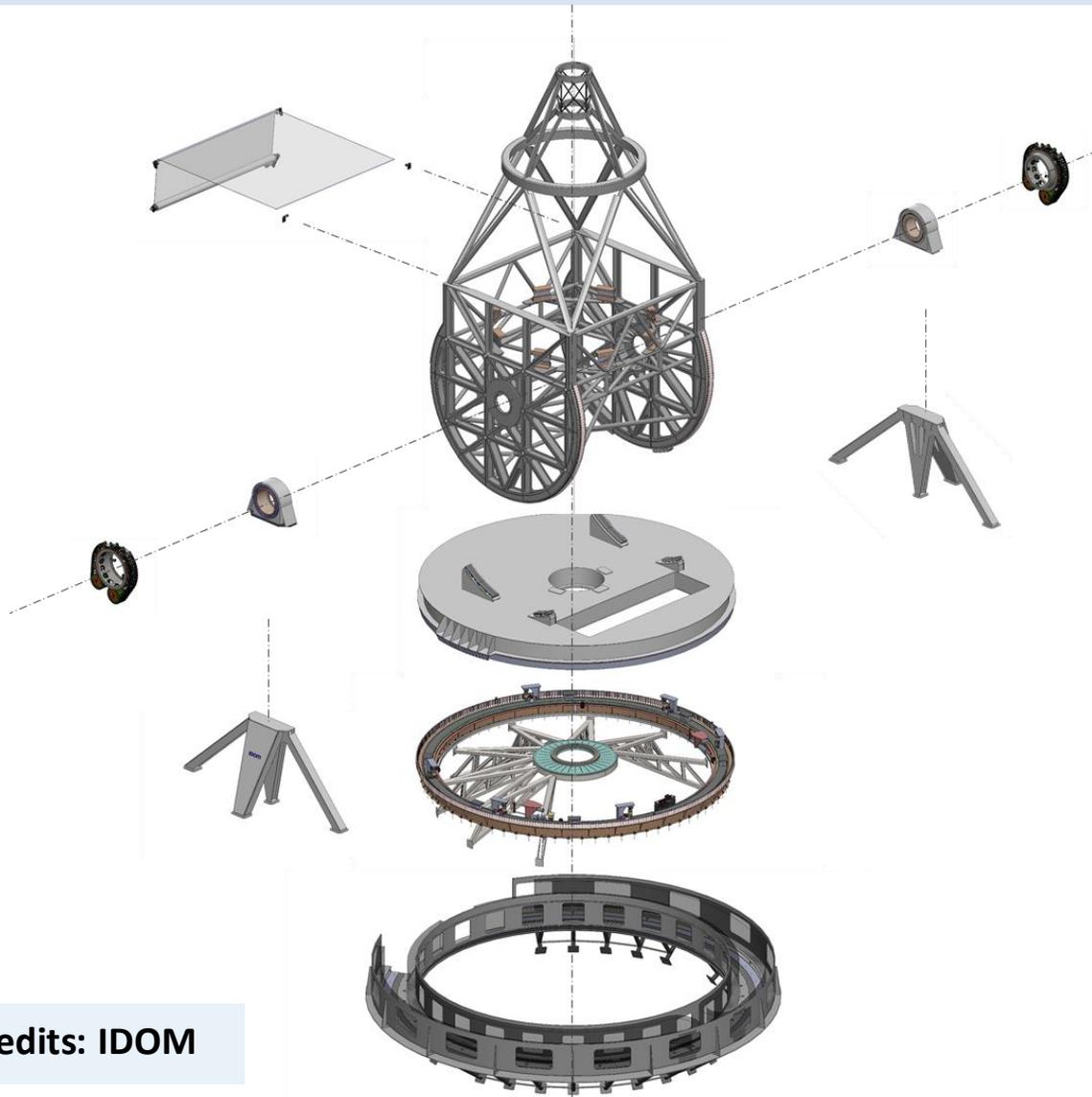
- ❑ Scope:
 - Detailed Design
 - Manufacturing
 - Transport
 - Site Integration

- ❑ Parts:
 - Elevation Structure
 - Azimuth Structure
 - Thermal and Control System
 - Local Control Unit

- ❑ Estimated Budget:
 - **24 Million Euros**



TELESCOPE STRUCTURE DRIVING REQUIREMENTS & PRELIMINARY DESIGN



DRIVING REQUIREMENTS

- The pointing error at F3 is 2,3 arcsec and 0,8 arcsec tracking.
- +/- 1°C surface thermal control.
- Lifetime: 50 years

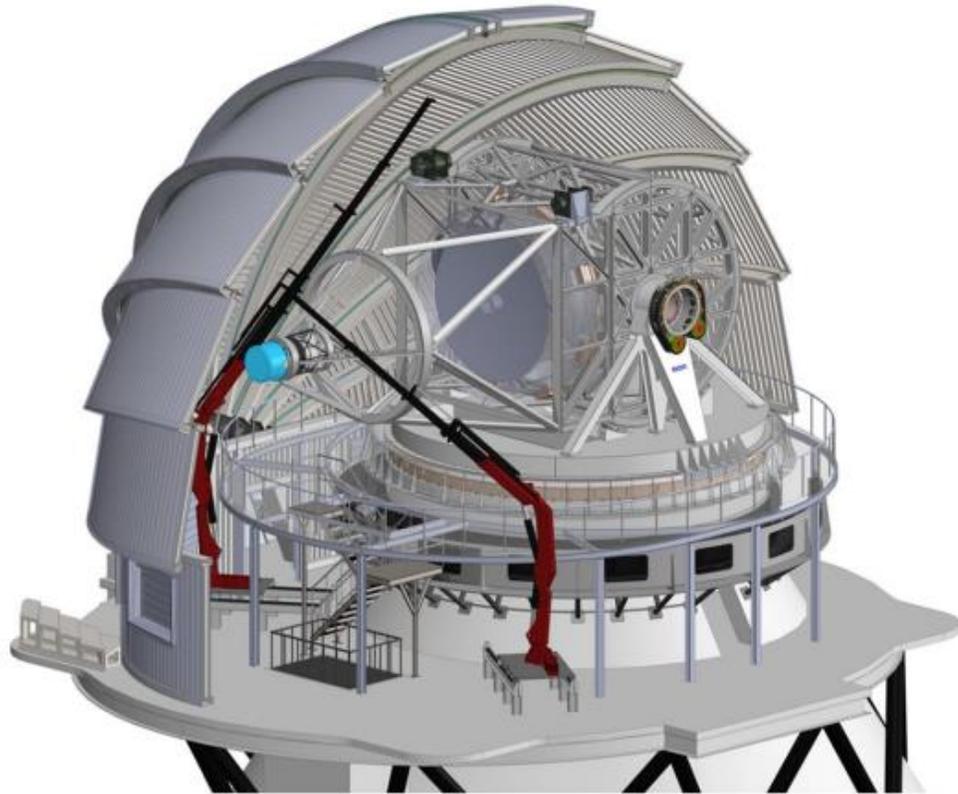
PRELIMINARY DESIGN HIGHLIGHTS

- EST Telescope Mount has hydrostatic bearings for axial loads and rolling bearing for radial loads.
- The total weight of the telescope mount is 150 tons

TENDER 2 ENCLOSURE



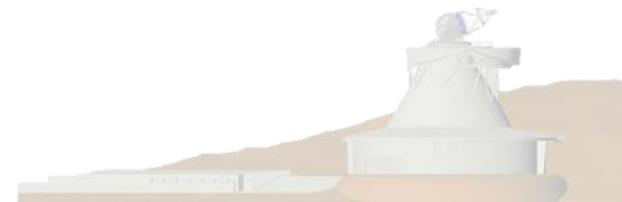
PROCUREMENT SCOPE AND BUDGET



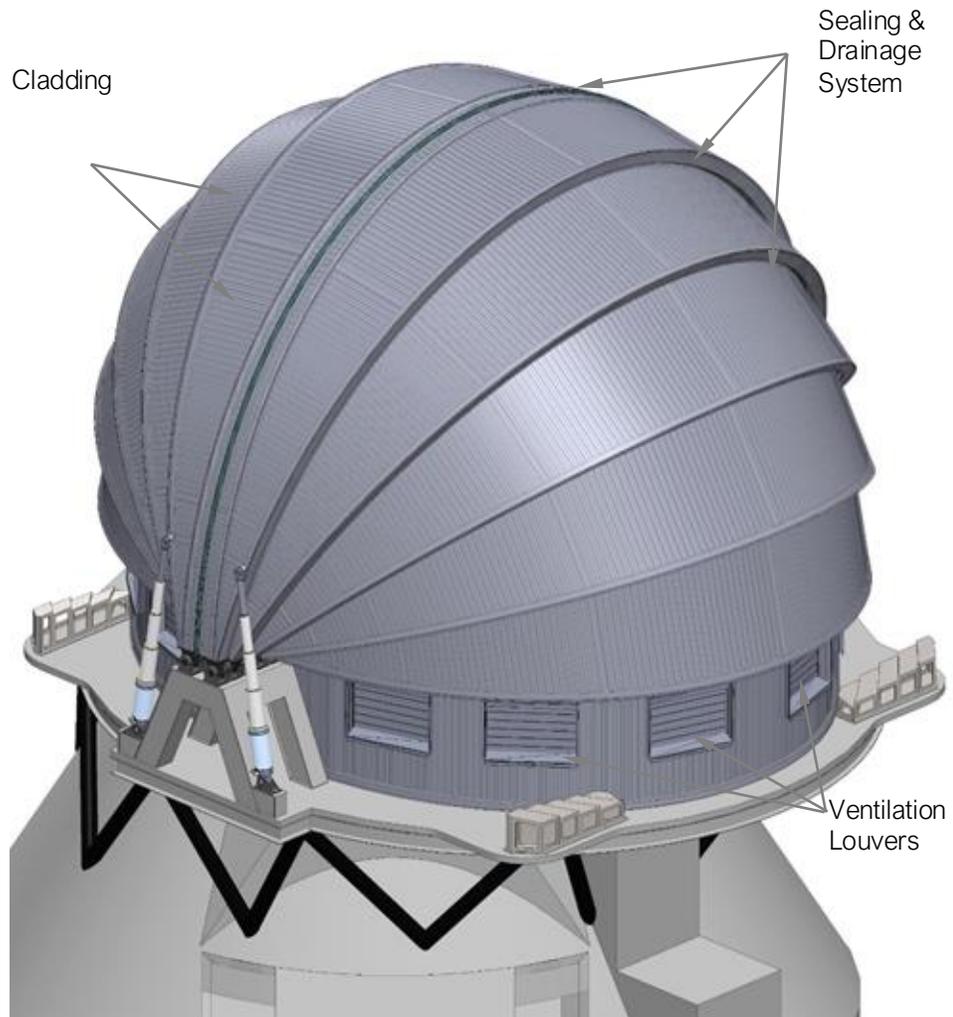
- ❑ Scope:
 - Detailed Design
 - Manufacturing
 - Transport
 - Site Integration

- ❑ Parts:
 - Fixed & Rotary Structure
 - Enclosure Mechanisms
 - Thermal and Control System
 - Local Control Unit

- ❑ Estimated Budget:
 - **10.3 Million Euros**



ENCLOSURE DRIVING REQUIREMENTS & PRELIMINARY DESIGN



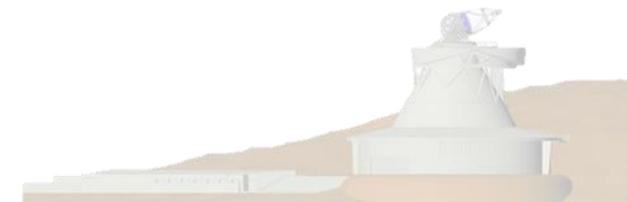
DRIVING REQUIREMENTS

- Closing time: less than 5 minutes
- Temperature kept at 3° from ambient
- 50 years lifetime

PRELIMINARY DESIGN HIGHLIGHTS:

- Rigid retractable enclosure
- 10 rotary segments and a fixed structure
- Four telescopic hydraulic cylinders

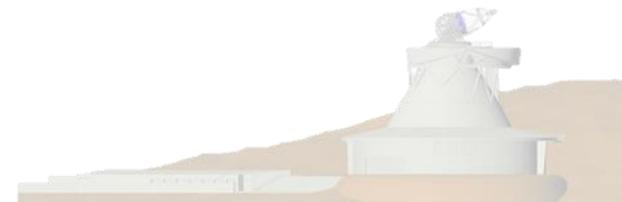
Credits: IDOM



TENDER 3

POLARIMETRIC CALIBRATION AND

ALIGNMENT (PCA)

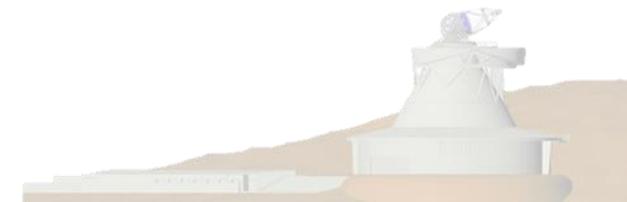
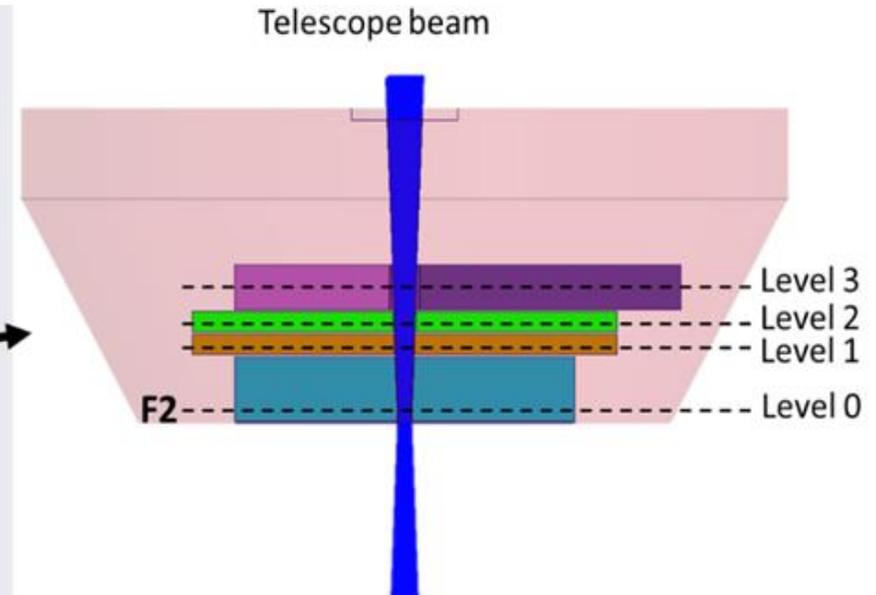
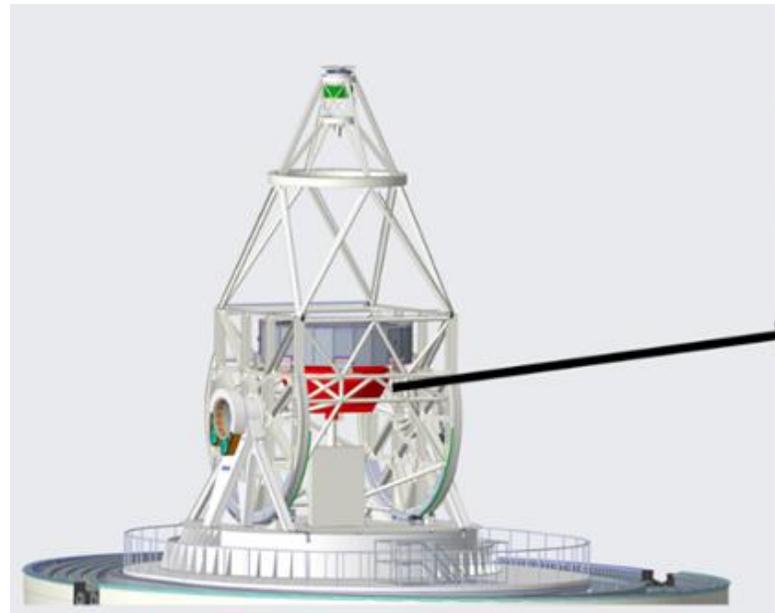


POLARIMETRIC CALIBRATION AND ALIGNMENT (PCA) SCOPE AND BUDGET



- ❑ Scope:
 - ❑ Detailed design & analysis
 - ❑ Mechanical manufacturing, Assembly, Integration, verification and delivery
 - ❑ Optics EXCLUDED
 - ❑ Specialties:
 - ❑ **Mechanical, Thermal**, Integration of commercial electronic, motion control, systems engineering, project management

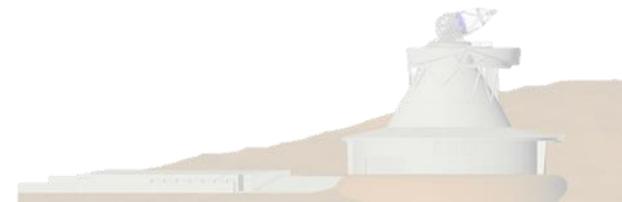
- ❑ Estimated Budget:
 - ❑ **1.4 Million Euros**



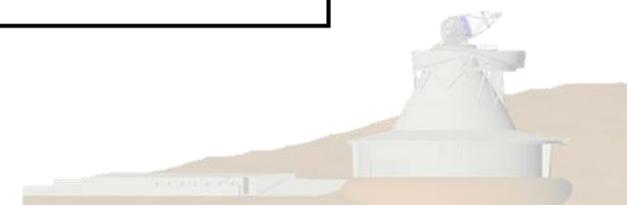
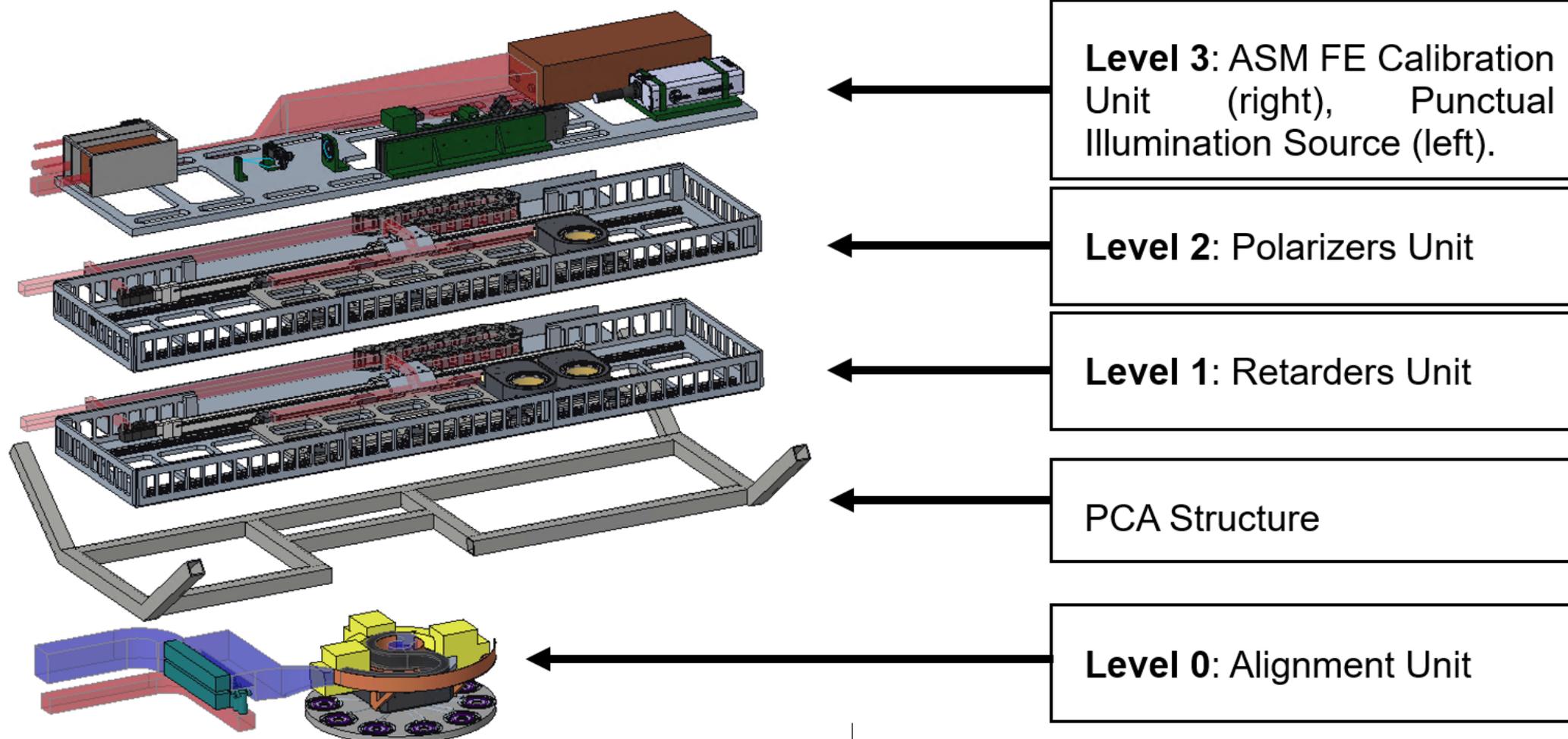
POLARIMETRIC CALIBRATION AND ALIGNMENT (PCA) DRIVING REQUIREMENTS



- Motorized position accuracy: ± 0.1 mm
- Motorized in plane rotation accuracy: $\pm 0.09^\circ$
- Motorized in plane rotation stability in 12 hours: $\pm 0.02^\circ$
- Motorized in plane rotation slow motion rotation of 0.1 ± 0.01 revolutions per minute



POLARIMETRIC CALIBRATION AND ALIGNMENT (PCA) PRELIMINARY DESIGN

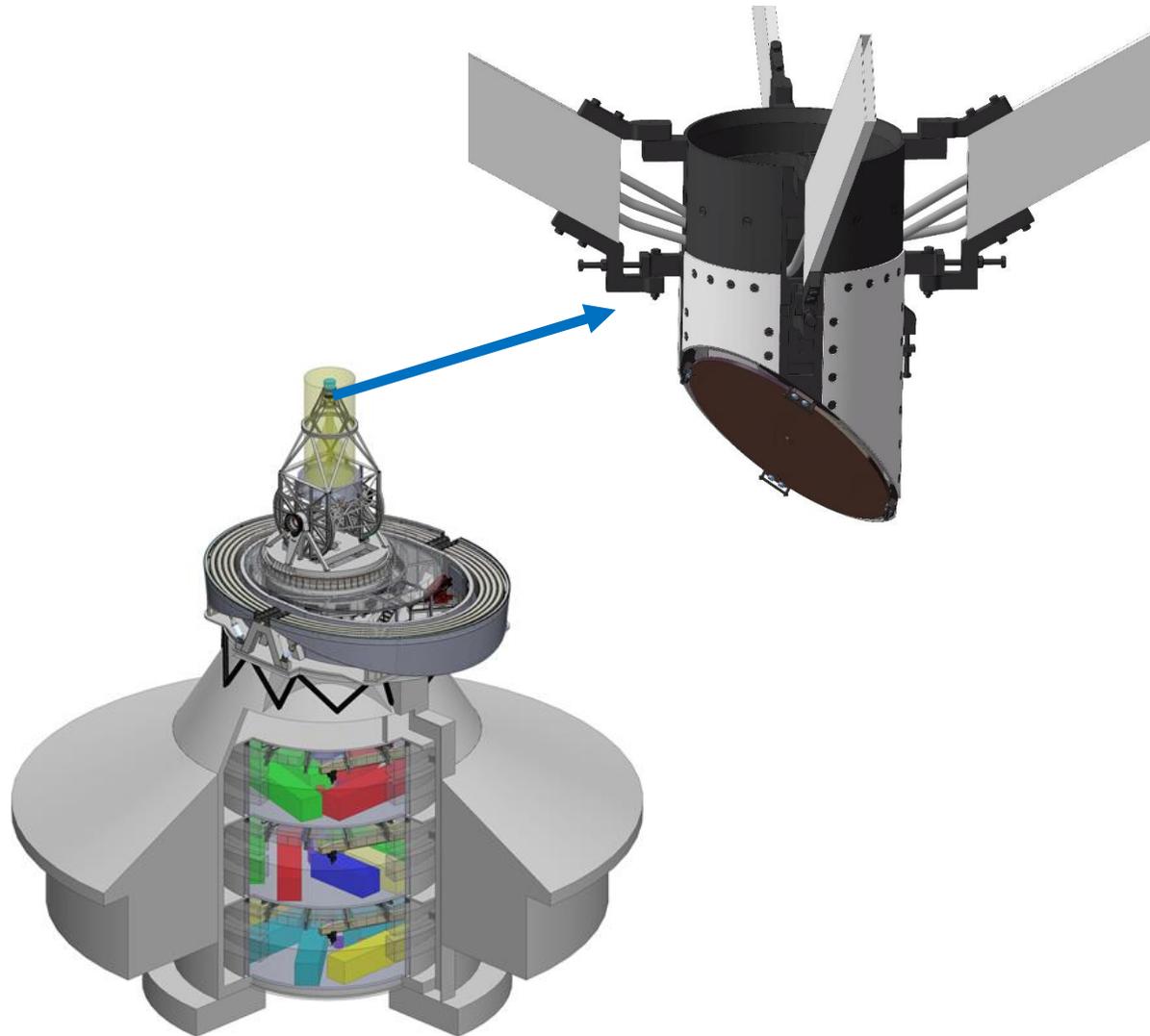


TENDER 4

HEAT REJECTER



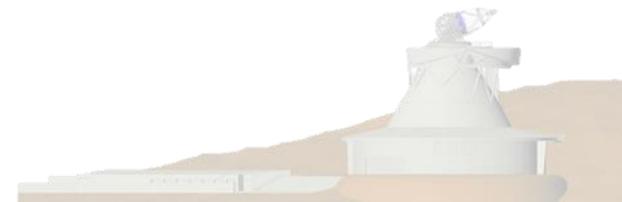
PROCUREMENT SCOPE AND BUDGET



- ❑ Scope:
 - Detailed Design & Manufacturing
 - Transport
 - Site Integration

- ❑ Parts:
 - Mirror
 - Cooling system
 - Covers
 - Local Control Units (Sensors)

- ❑ Estimated Budget:
 - **1.3 Million Euros**



HEAT REJECTER DRIVING REQUIREMENTS & PRELIMINARY DESIGN

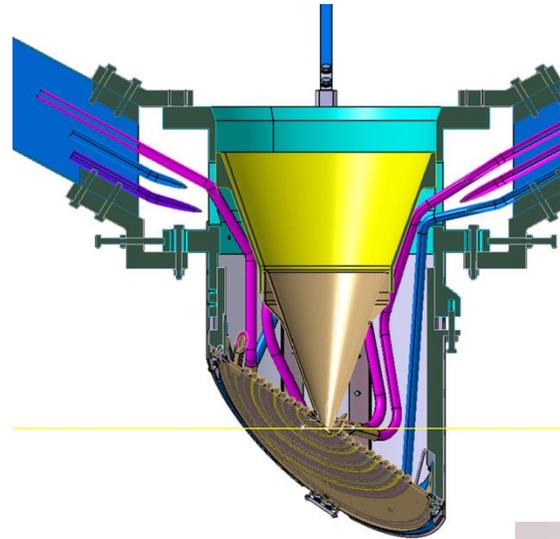


DRIVING REQUIREMENTS

- ❑ Mirror temperature limits:
 - $-3^{\circ}\text{C} < T_{\text{amb}} < 7^{\circ}\text{C}$
- ❑ HTC required from 28-32 $\text{W}/\text{m}^2\text{K}$

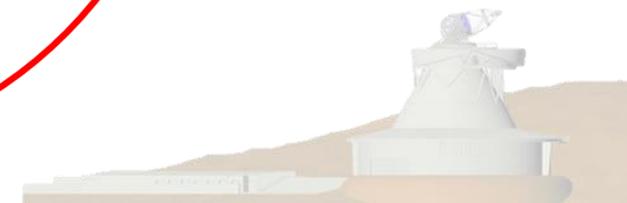
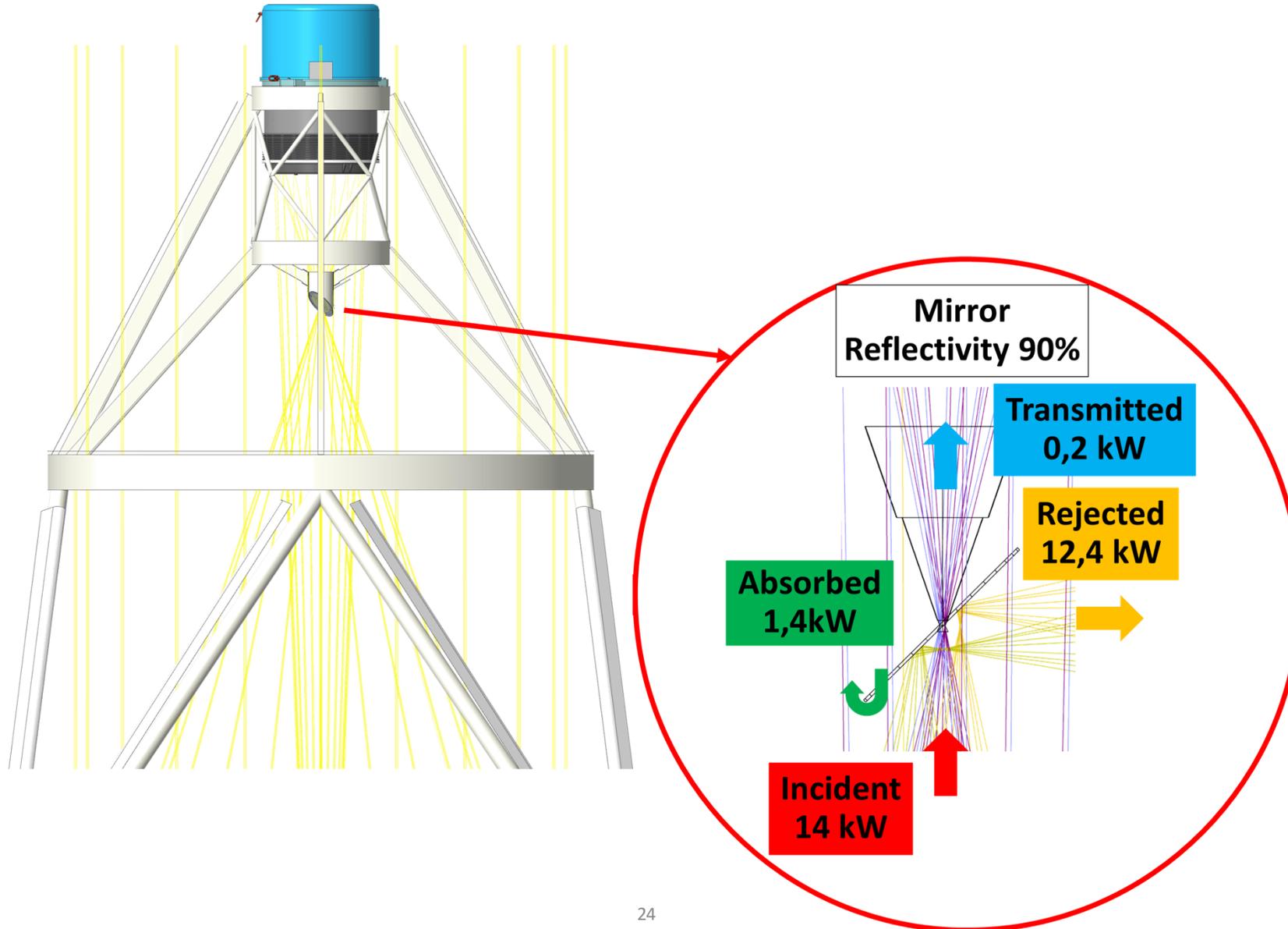
PRELIMINARY DESIGN HIGHLIGHTS

- ❑ Cooper Mirror in additive manufacturing
- ❑ Silver coating
- ❑ 3x Inlet coolant of 2°C below ambient temperature in open loop control
- ❑ Coolant Velocity 15 m/s



Credits: CiTD

HEAT REJECTER PRELIMINARY DESIGN



TENDER 5

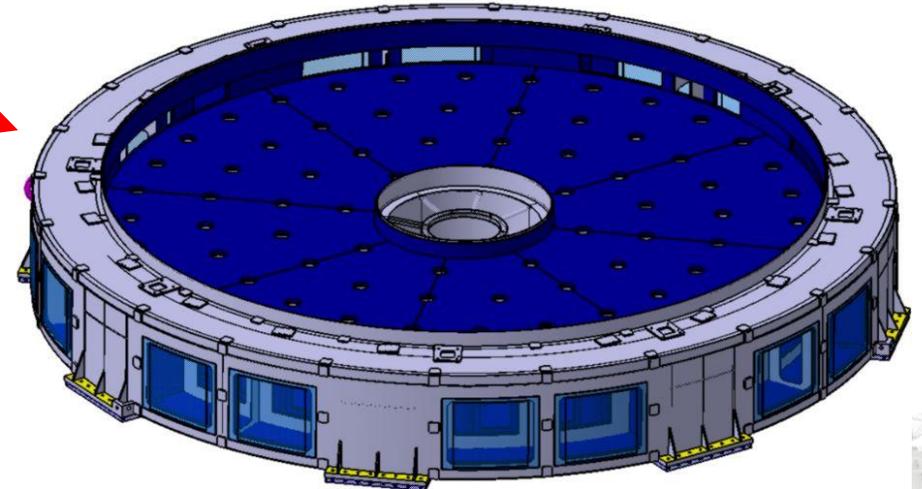
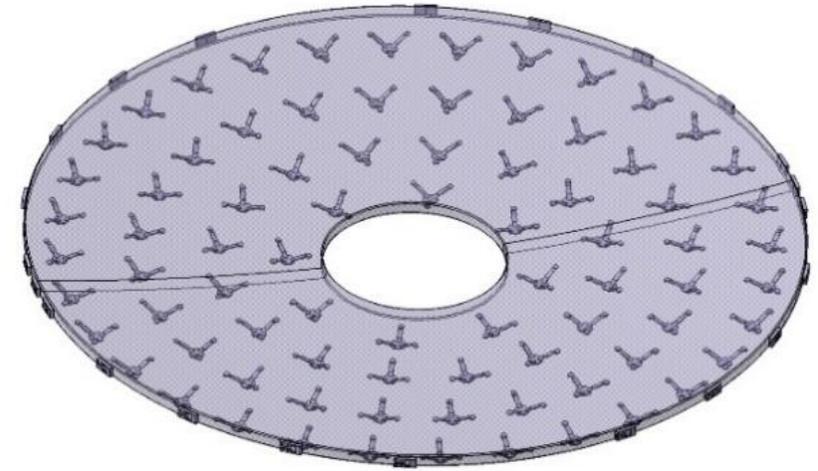
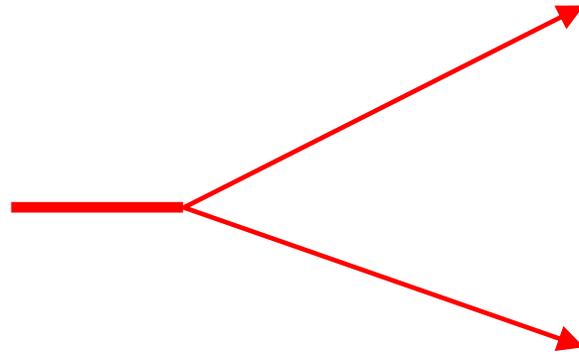
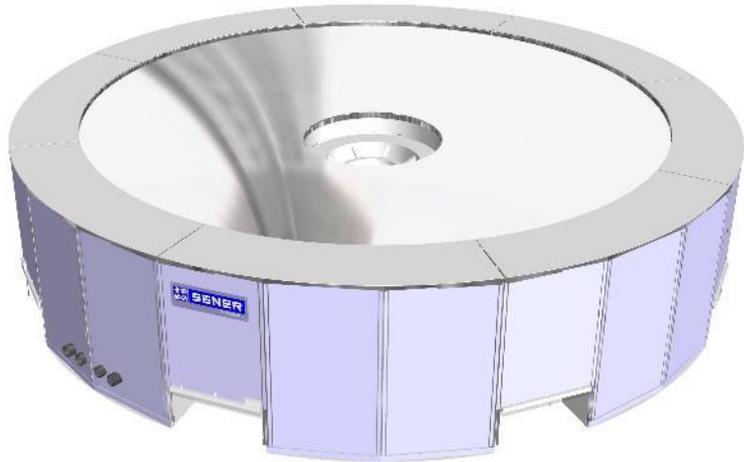
PRIMARY MIRROR (M1)



M1 CELL SCOPE AND BUDGET



- M1:
 - Blank, M1 Cell, auxiliary equipment, polishing

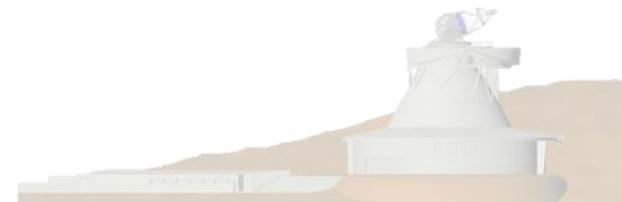


M1 CELL

SCOPE AND BUDGET



- Scope:
 - Design
 - M1 Cell detailed design & analysis
 - Prototypes
 - Local control Unit
 - Manufacturing, Assembly, Integration, test, acceptance and delivery
 - Specialties:
 - Mechanical, Thermal, motion control**, systems engineering, project management
-
- Estimated Budget:
 - 12.8 Million Euros**



M1 CELL DRIVING REQUIREMENTS



Requirement	Value
Clear Optical Aperture Diameter	4200mm
Radius of curvature	12604.71 mm
Conic constant	-0.9954 (parabolic)
Static Optical Surface error	< 60 nm RMS
Dynamic Optical Surface error	< 150 nm RMS
Positioning Range	< +/-2mm in Piston < +/-1mrad in tip-tilt rotation
Positioning Stability	< 0.75 μ rad in tip-tilt rotation (for static pert.) < 0.015 μ rad in tip-tilt rotation (for dynamic pert.)
Mirror Optical surface temperature	< +0.5/-2°C wrt. Ambient Temp.
Cell surface temperature	< +1.5°C/-2°C wrt. Ambient Temp.
M1 Assembly Mass	< 10.500 kg

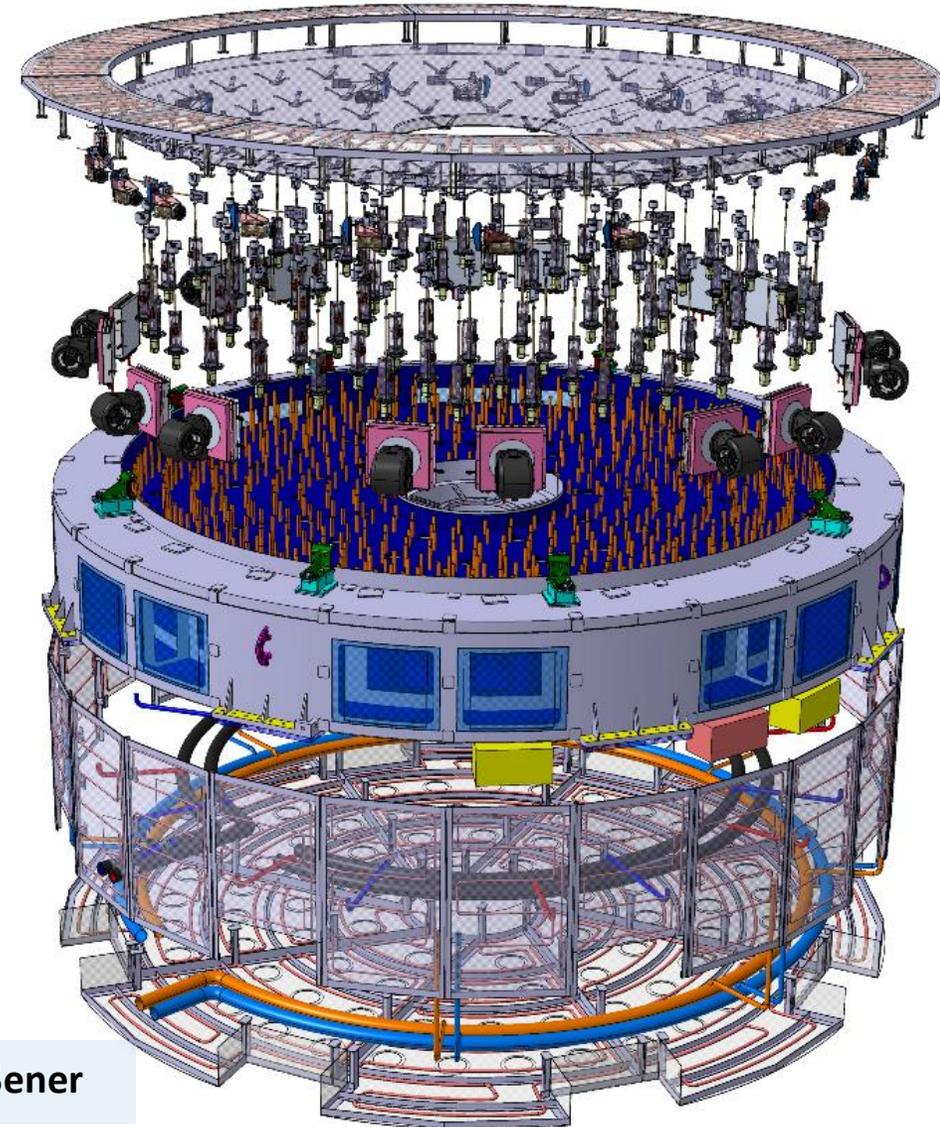


M1 CELL PRELIMINARY DESIGN



The M1 Cell main components:

- Cell Structure
- Mirror Axial Support
- Mirror Lateral Support
- Mirror Thermal Control
- External Cell
- M1 Local Control Unit



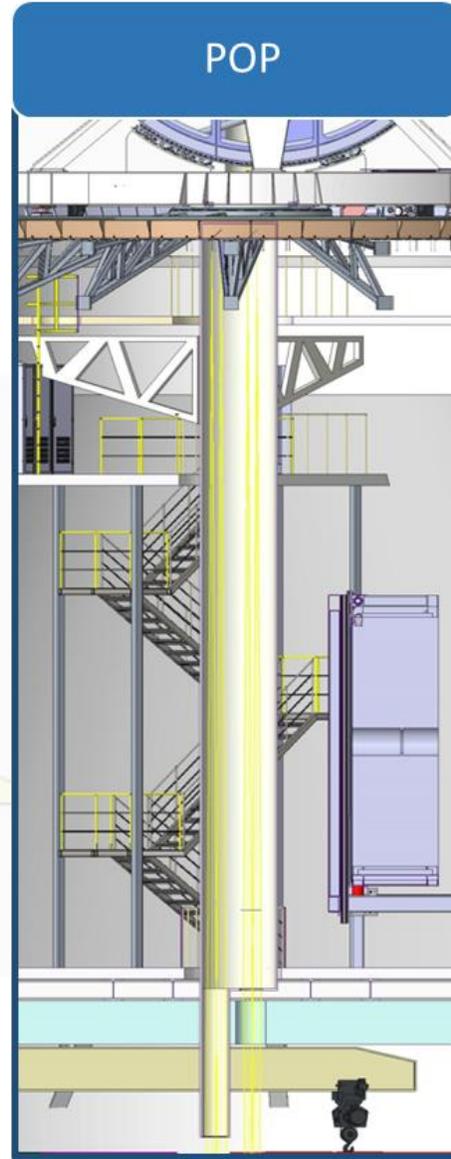
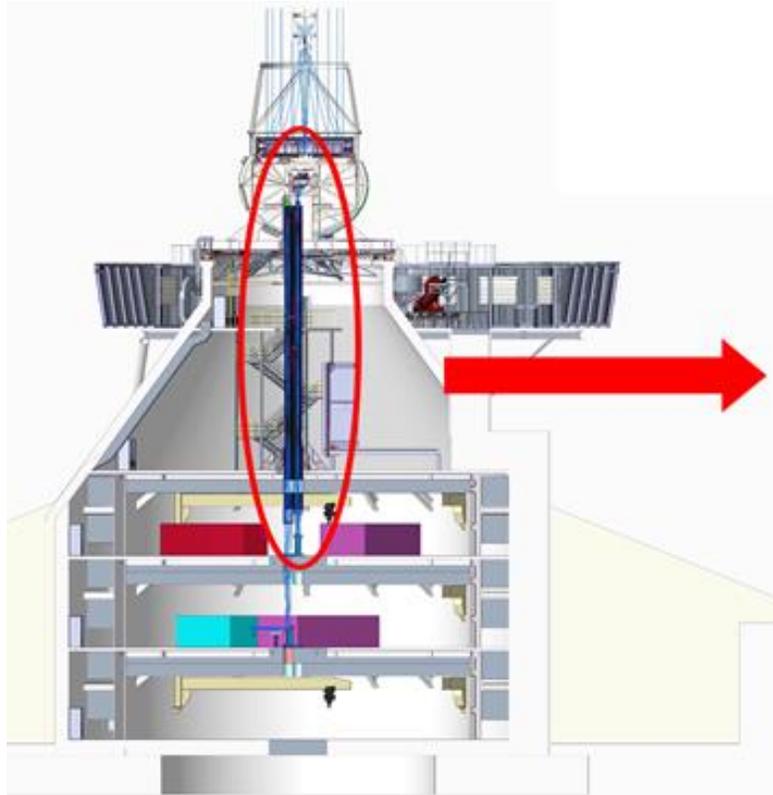
Credits: Sener

TENDER 6

PIER OPTICAL PATH (POP)



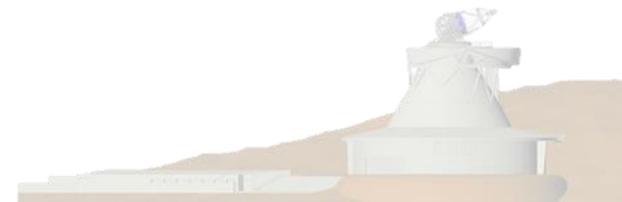
PROCUREMENT SCOPE AND BUDGET



- ❑ Scope:
 - Detailed Design & Manufacturing
 - Site Integration in ORM
 - Optics EXCLUDED

- ❑ Parts:
 - Vacuum Vessel (blind covers)
 - Internal Structure
 - Thermal Links
 - Vacuum pump system
 - Local Control Unit

- ❑ Estimated Budget:
 - **1.3 Million Euros**



POP DRIVING REQUIREMENTS & PRELIMINARY DESIGN

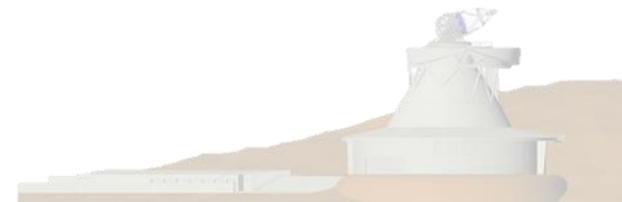


DRIVING REQUIREMENTS:

- Vacuum level: 0,1-1 mbar.
- Admissible leakage rate: The vacuum vessel shall maintain a pressure below 1 mbar at least 7 days and recover in less than 5 hours pumping
- Lifetime: 50 years

PRELIMINARY DESIGN HIGHLIGHTS:

- Steel vacuum vessel of **21 meter in length** and approximately 1.2 meters in diameter.
- The POP Local Control Unit provides an autonomous control of vacuum level, the LCU only works in night time.
- The vacuum vessel can be transported and installed in the telescope in multiple sections to simplify its integration inside the Pier.
- The internal surface of the POP shall be coated with a highly absorbent paint

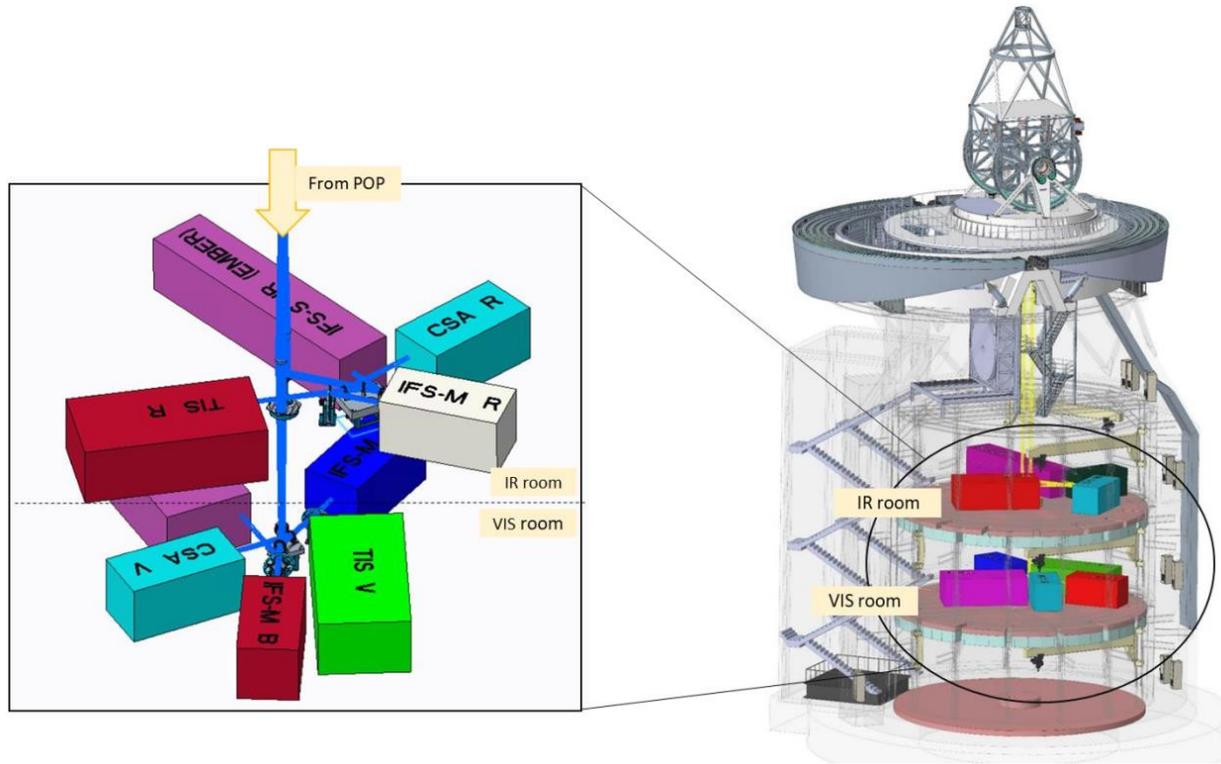


TENDER 7

Coudé Light Distribution (CLD)



PROCUREMENT SCOPE AND BUDGET



☐ Scope:

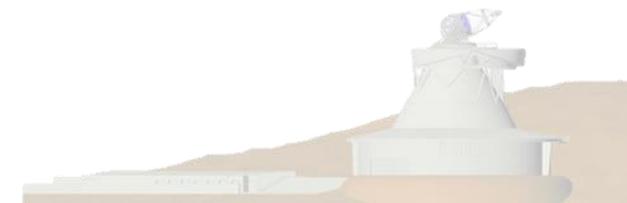
- Detailed Design & Manufacturing
- Transport
- Site Integration in the telescope

☐ Parts:

- Folding mirror focal stations (x3)
- Configurable focal stations (x3) +prototypes.
- Dividers focal station (x4)
- Optical benches (x2)
- Harness
- Sensoring and motors
- Local Control Unit

☐ Estimated Budget:

- **0.8 Million Euros**



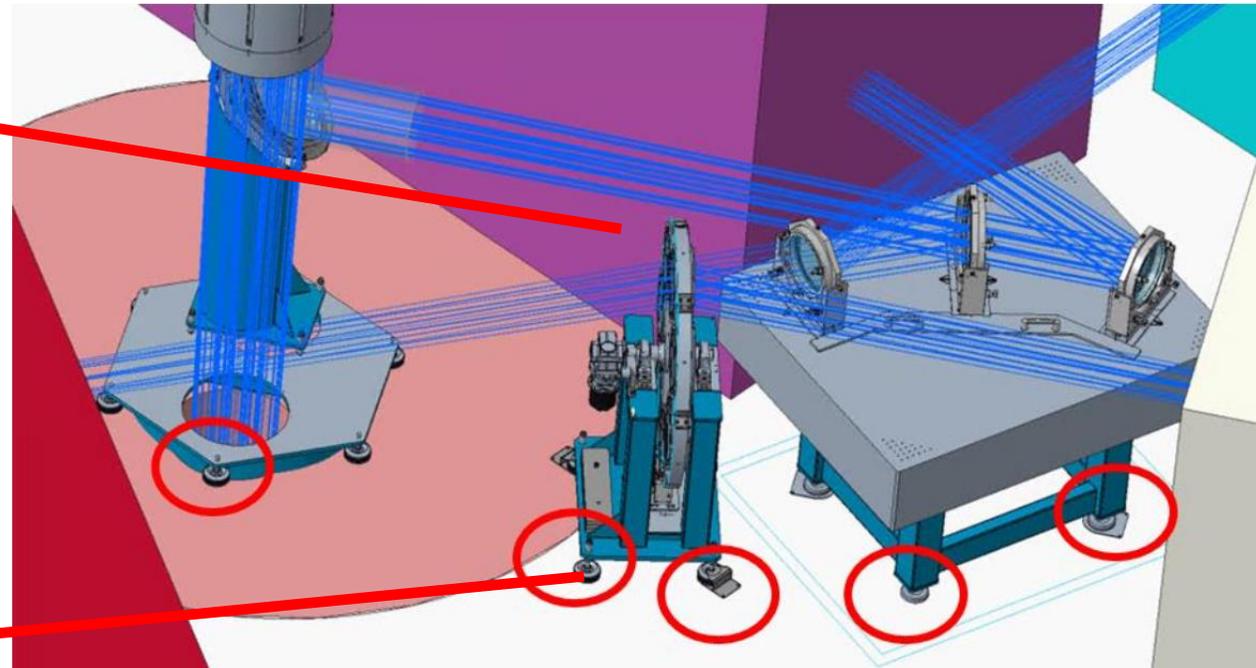
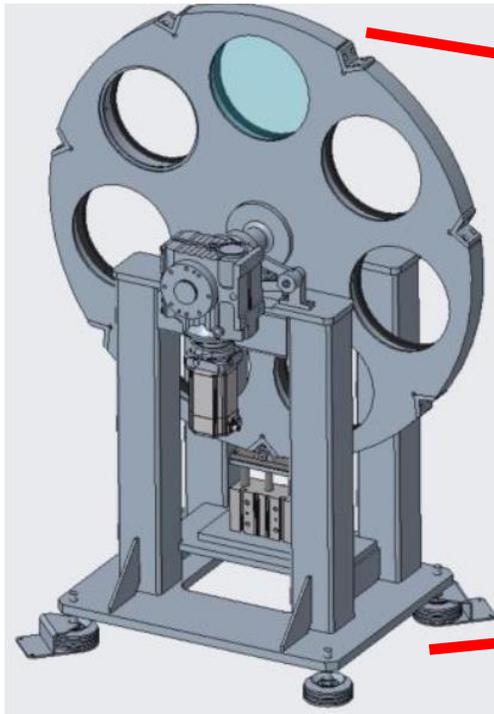
CLD DRIVING REQUIREMENTS & PRELIMINARY DESIGN



DRIVING REQUIREMENTS:

- ❑ $\pm 0.025^\circ$ resolution in rotation fine adjustment
- ❑ ± 0.05 mm linear translation resolution
- ❑ Opto-mechanical mounts with WaveFront Error < 10 nm

PRELIMINARY DESIGN:



CONTRIBUTIONS PROVIDED



Funding Agencies



European Union
European Regional
Development Fund



European
Commission



Gobierno de Canarias
Agencia Canaria
de Investigación, Innovación
y Sociedad de la Información



Canarias
avanza
con Europa



Infraestructuras
Científicas y Técnicas
Singulares



Financiado por
la Unión Europea
NextGenerationEU

EST Foundation



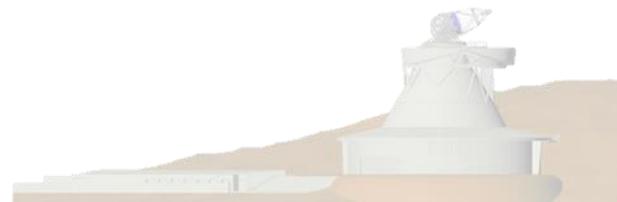


www.est-east.eu

est@est-east.eu

Instituto de Astrofísica de Canarias
C/ Vía Láctea S/N 38200 La Laguna
Tenerife, Islas Canarias, España





TENDER 8

BUILDINGS & FACILITIES



PROCUREMENT SCOPE AND BUDGET

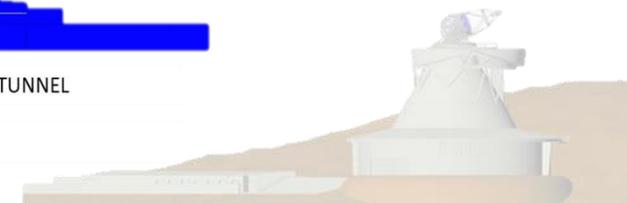
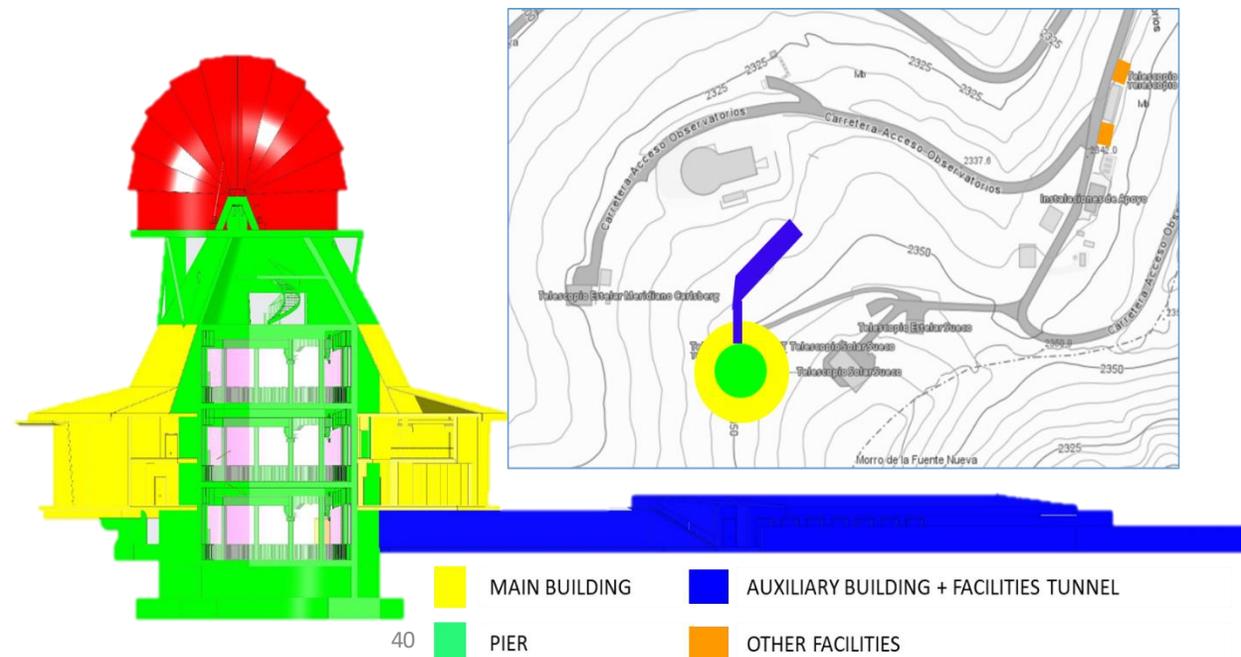


☐ Scope:

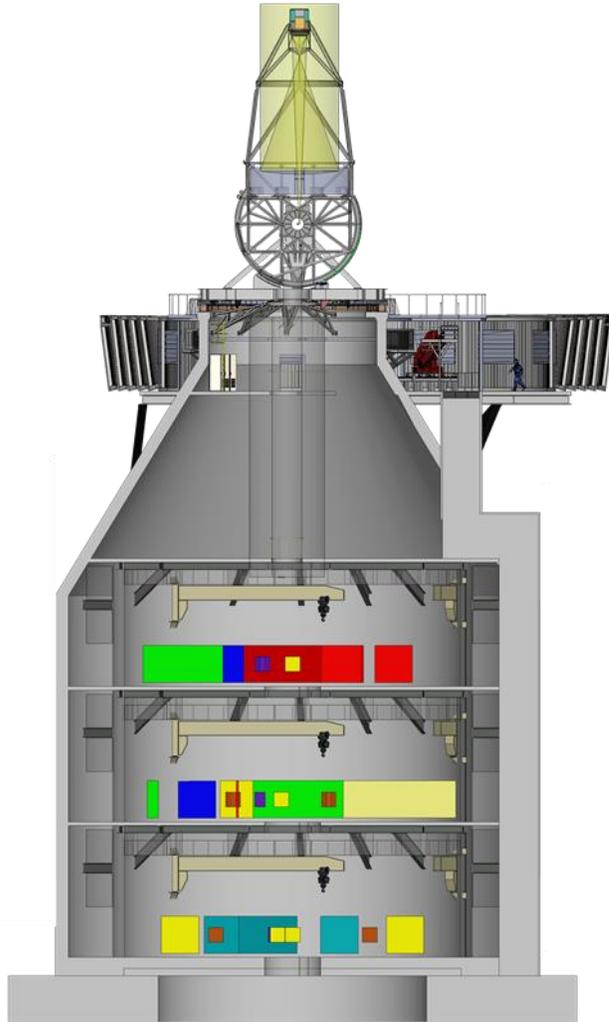
- Construction on site:
 - Site Conditioning
 - Urbanization
 - Main and Auxiliary Building
 - Facilities Tunnel
 - Pier
- Facilities integrated: Electrical, Thermal, air conditioning, big chillers, pneumatic, hydraulic

☐ Estimated Budget:

- **23.9 Million Euros.**



PIER PRELIMINARY DESIGN



- ❑ The telescope pier isolates the telescope from wind turbulence and heat emitted by the terrain.
- ❑ Pier height of 30,5m and diameter of 24m.
- ❑ It accommodates the POP (vacuum vessel), three Coudé rooms and handling equipment
- ❑ A single frame tower solution, characterized by 0,7m thick concrete walls, to support telescope and enclosure loads
 - no movement enclosure during operation
 - wind effect on enclosure and pier provides negligible contribution to telescope image motion
 - thermal contribution to image motion is compensated using some inclinometers on the azimuth track
- ❑ The pier eigenfrequencies are $>8\text{Hz}$
- ❑ Decoupled from main building to avoid transmission vibrations.

Credits: IDOM



Main numbers:

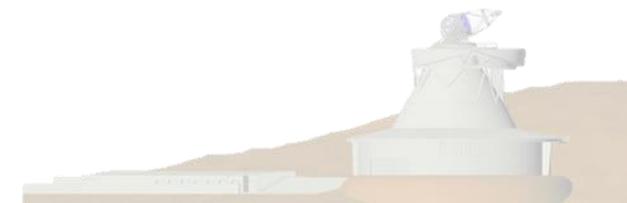
- 2 MW electric power
- 3 clean rooms ISO7 (ISO 14644-1) air renovation of 90 000 m³/h each one
- Cold water: 280 l/min 7 °C
- Hydraulic oil system: 5,4 l/min at 60 bar and 252 l/min at 200 bar
- 3 big chillers (100 kW each one)
- 2 engine-generators with 1500 kVA each
- UPS (500 kW) TBC



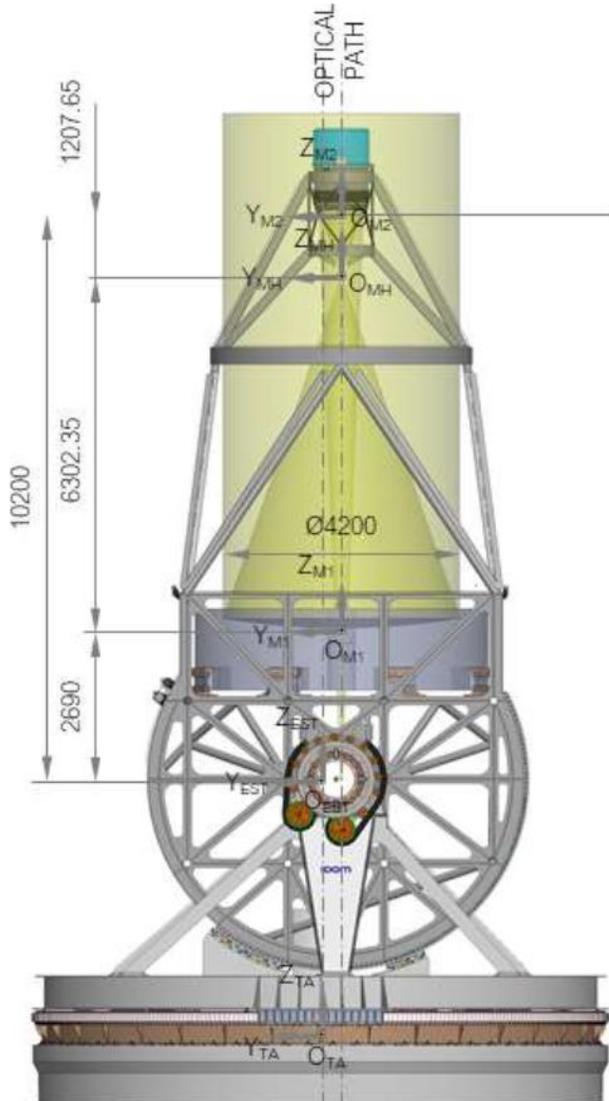
PIER, MAIN AND AUXILIARY BUILDING DRIVING REQUIREMENTS



- The M1 shall be located 35 meters above the ground.
- The Pier and Main Building eigenfrequencies shall be around 8Hz
- Main Manoeuvres: The buildings shall allow the loads maneuvers for the telescope operation.
- Vibration Isolation: The Main Building and the Pier shall provide different foundations and provide solutions for mitigate vibrations.
- Comply with Spanish and local construction normative and environmental impact regulations.
- Lifetime: 50 years



TELESCOPE STRUCTURE DRIVING REQUIREMENTS



- ❑ The pointing error at F3 is 2,3 arcsec and 0,8 arcsec tracking.
- ❑ +/- 1°C surface thermal control.
- ❑ Lifetime: 50 years

