ESO and the ELT

Roberto Tamai

ESO’s ELT Programme Manager

- Intergovernmental Organisation
- International Convention (1962), between 5 countries
- Now 16 Member States
- Annual Budget: ~ 200 million €

The ESO Mission

- Mission (Convention):
  - Build and operate world-class ground-based astronomical facilities
  - Foster collaboration in Astronomy
- ESO enables:
  - Scientific discoveries & understanding of the Universe
  - Other: Development of new technologies, impact in economy, international cooperation
- Complementing other ground & space facilities
- In collaboration with scientists, institutes and industry

Astronomy

- Study of all that is "beyond" the earth
- Objects that are far away, therefore small and weak
  - With limited information about their nature
  - Need for large instruments: resolution and sensitivity
- The combination of different types of observations is crucial
  - Images / spectra / time-series

- The field of visible, infrared and radio waves is accessible from land-based telescopes

Orion Nebula

ESO HQ

Garching b. Muenchen
Germany

Paranal Observatory

ALMA - Chajnantor

La Silla Observatory

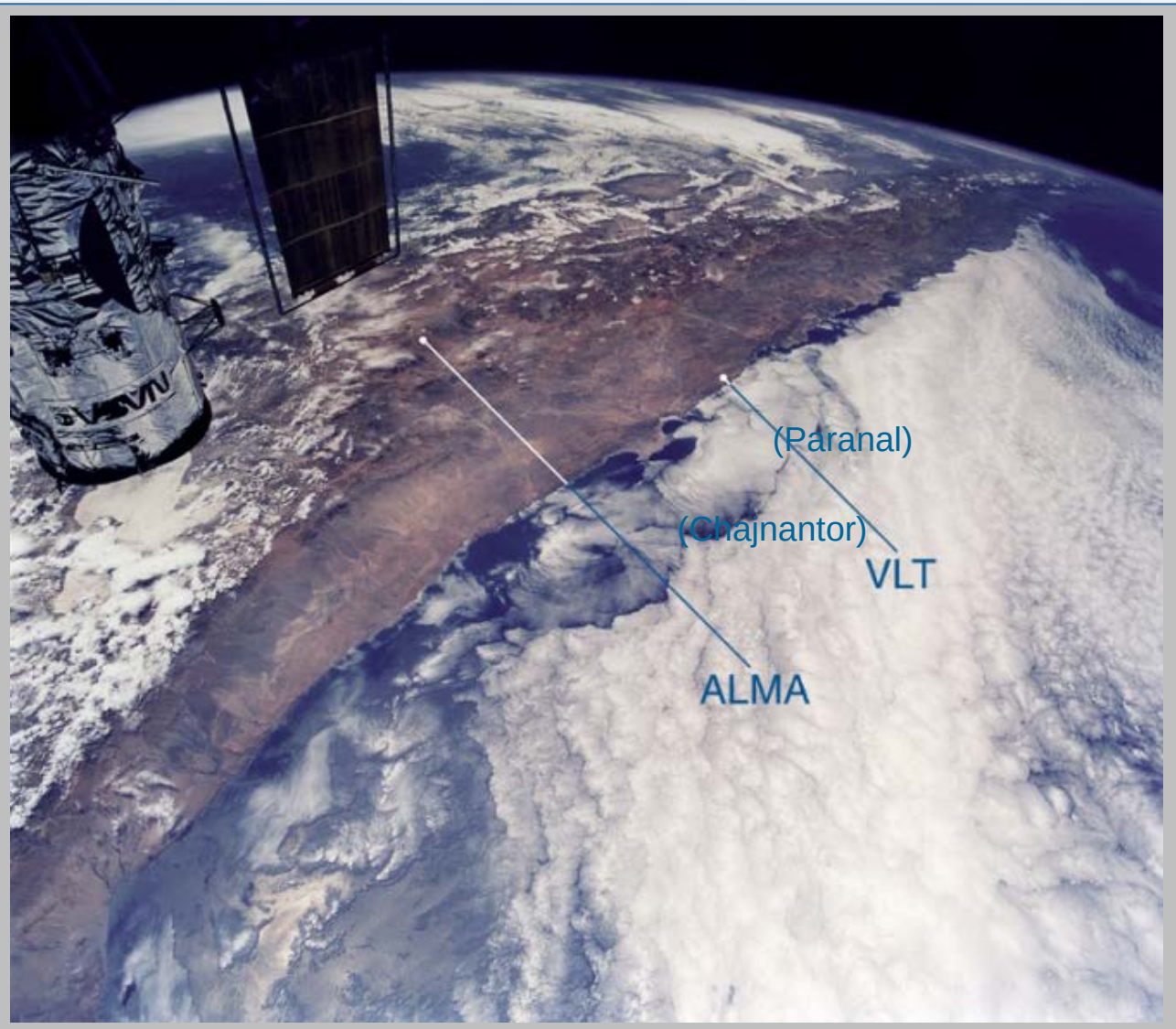
Santiago

Why the ESO Observatories are in Chile?

- Excellent conditions in the Atacama Desert
  - Extremely dry
  - 90% clean sky
  - Low turbulence
  - Very limited light pollution
- Excellent vision to the Southern Hemisphere

Poor site

Chile



ESO in Chile

ALMA Observatory *(2013)*

Paranal Observatory *(1998)*
+ … Armazones (ELT) *(…2025)*

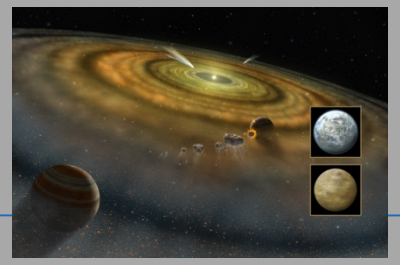
La Silla Observatory *(1960's)*

Administration, Science & ALMA Offices and Guest House

The ESO's Extremely Large Telescope (ELT)

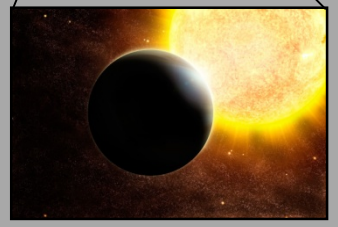
- Largest optical/infrared telescope in the world
  - 39m diameter, primary mirror, 798 high precision segments
  - Science: exo-earths, deep universe, resolved populations, open window to the unknowns
  - System Design complete – Construction on going on Cerro Armazones
    - As integral part of the Paranal Observatory ('one more telescope')
  - Timeline 2014-2025
  - ESO cost:
    - Capital cost: ~1175 MEUR incl. manpower, instruments and contingency
    - Operation cost: ~50 MEUR / year

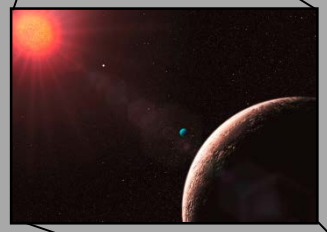
One top goal of the E-ELT is to find and to characterise exo-planets...

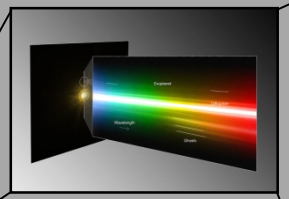


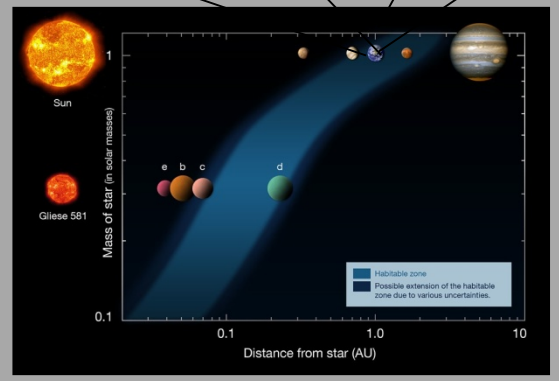
... it is the first telescope ever ***that can explore Earth-twins...***

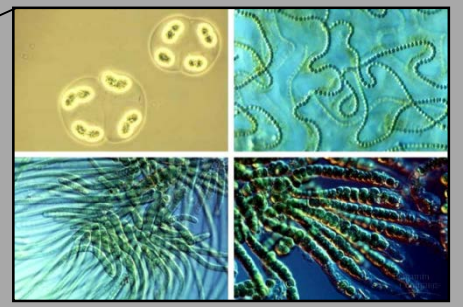
... with ultimately the chance to find ***life beyond the Solar system.***



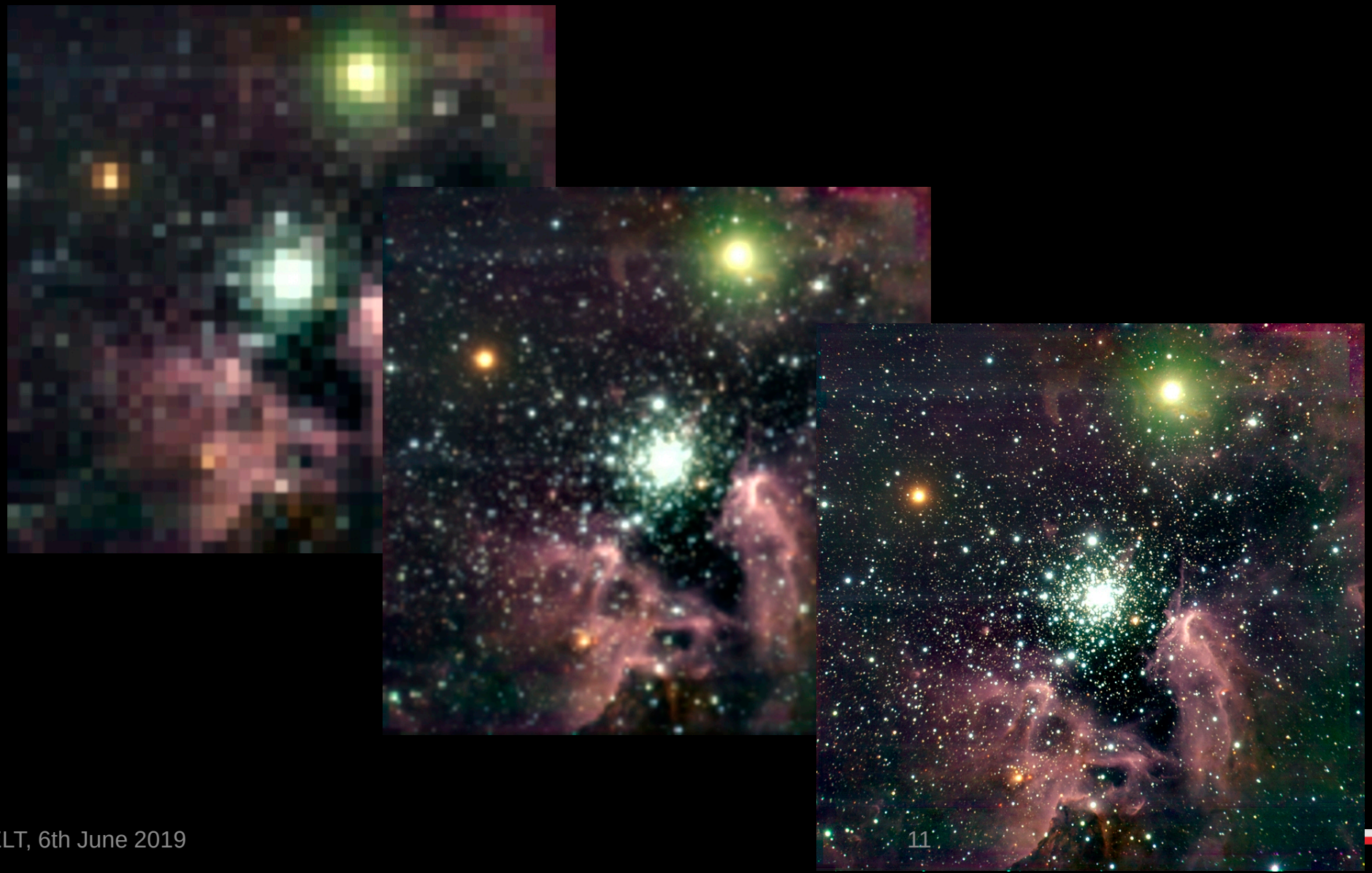




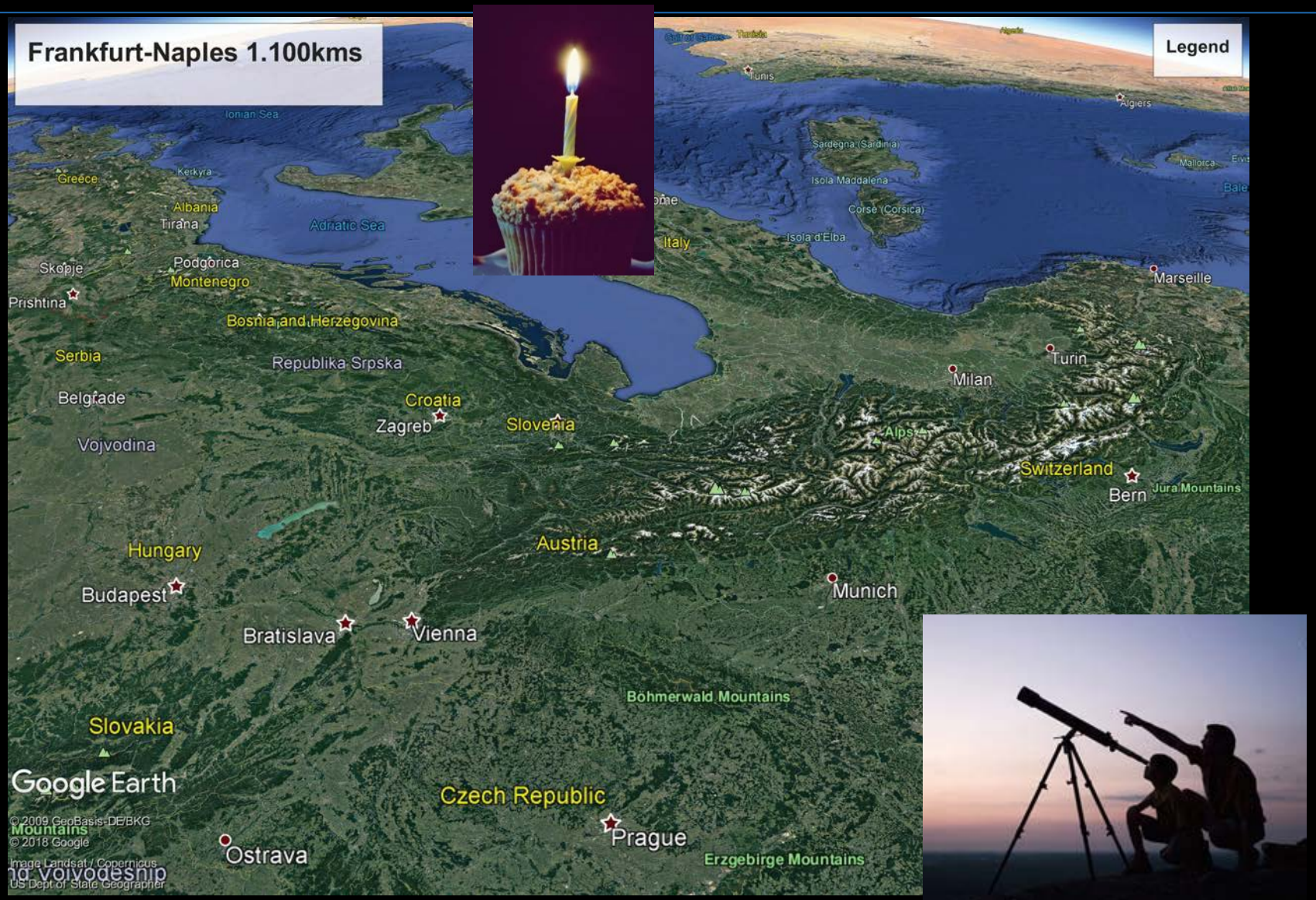




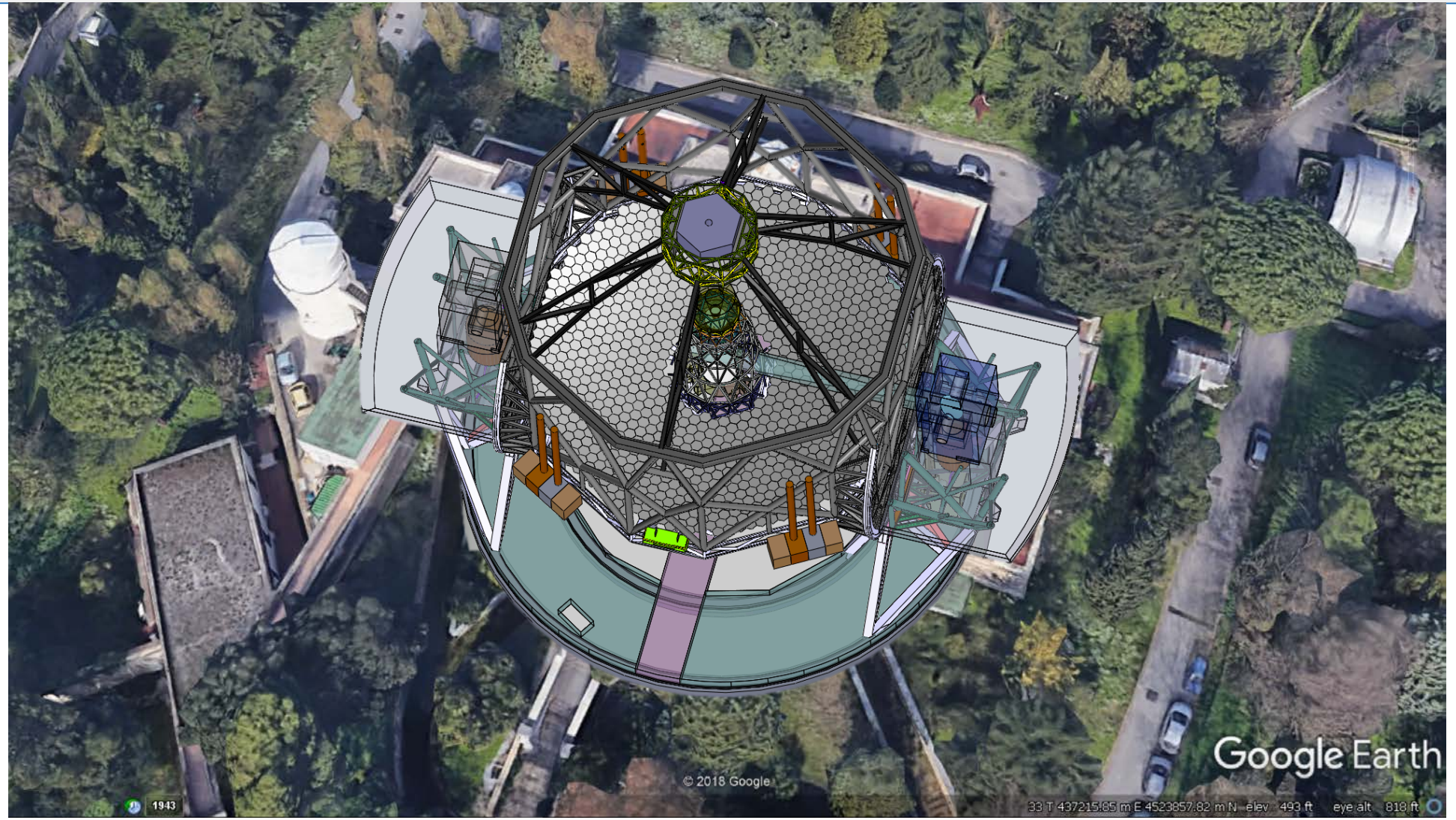
Spectacular Resolution



Required sensitivity

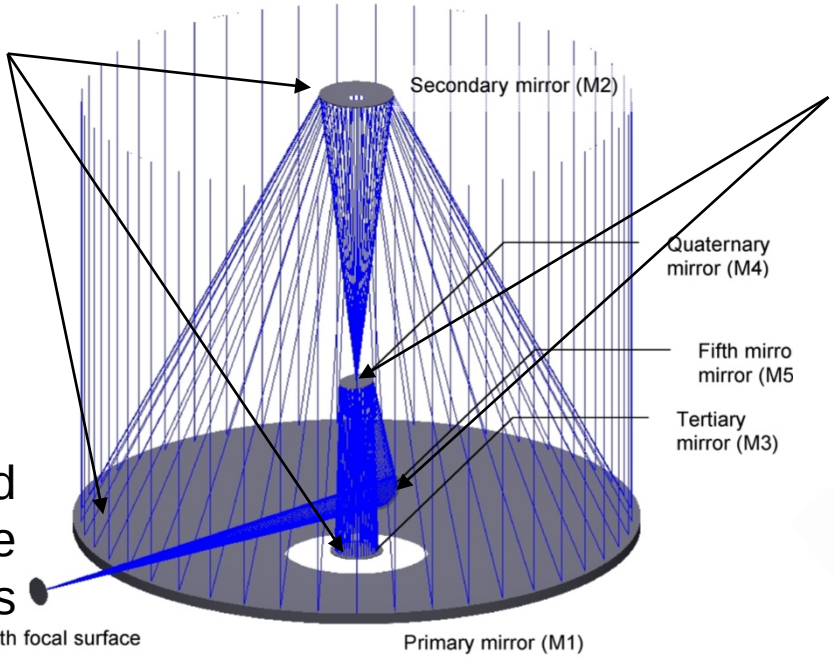


To put it in perspective…



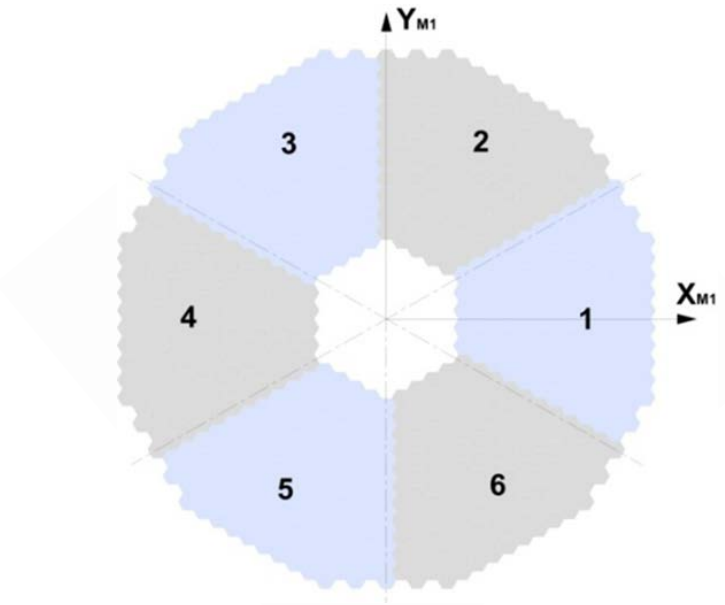
How does it optically work ?

Powered mirrors collect and focus the light



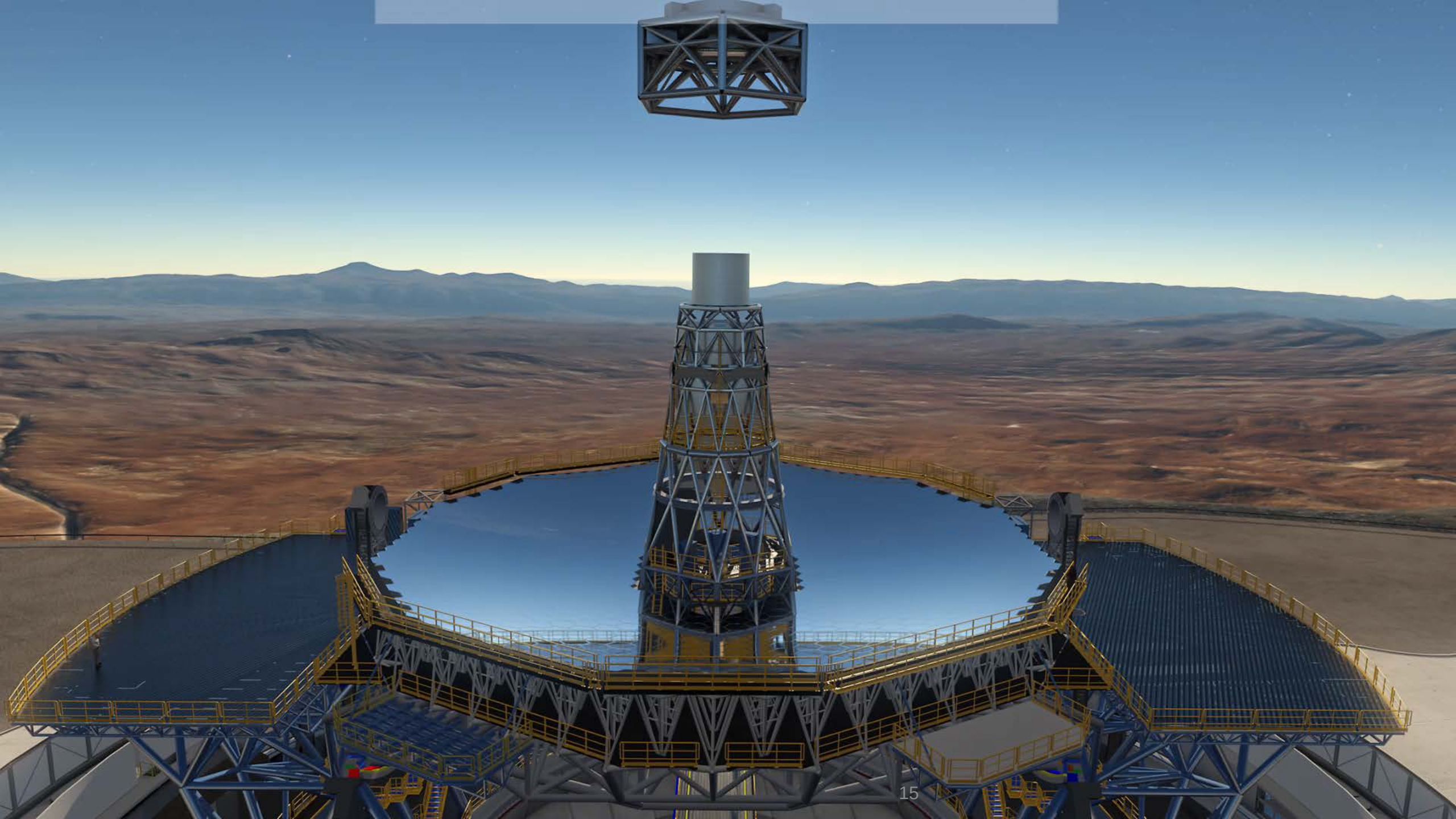
Flat mirrors redirect the light towards the focal plane

Focal plane is fed to science instruments

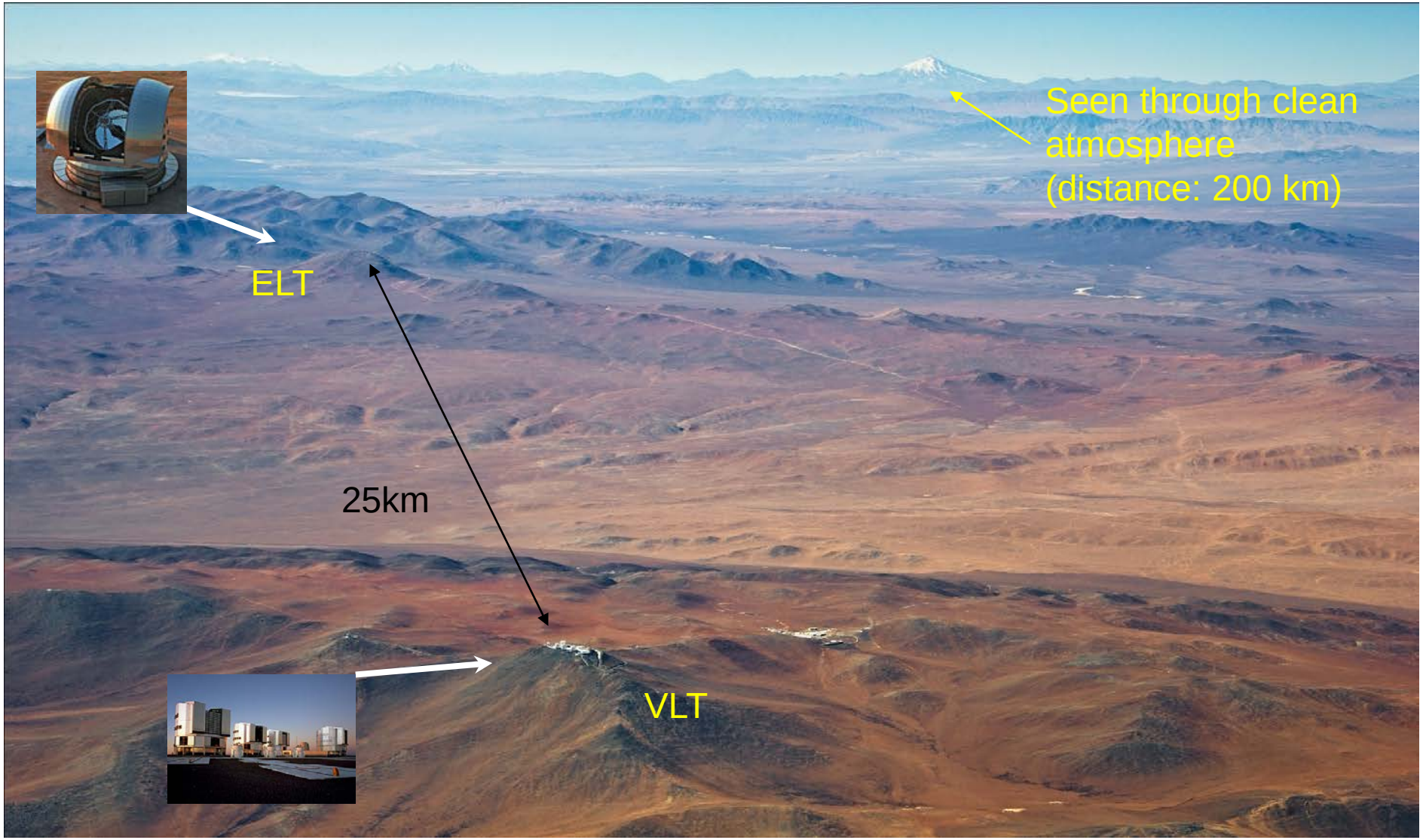


Primary Mirror (M1)
39-m diameter, 798 near-hexagonal segments
re-aligned to ~ 0.0001 mm in real-time

Light is precious – light waves must be preserved to a small fraction of their wavelength (0.0005 mm) and their direction preserved to a small fraction of one arc second



Armazones and Paranal

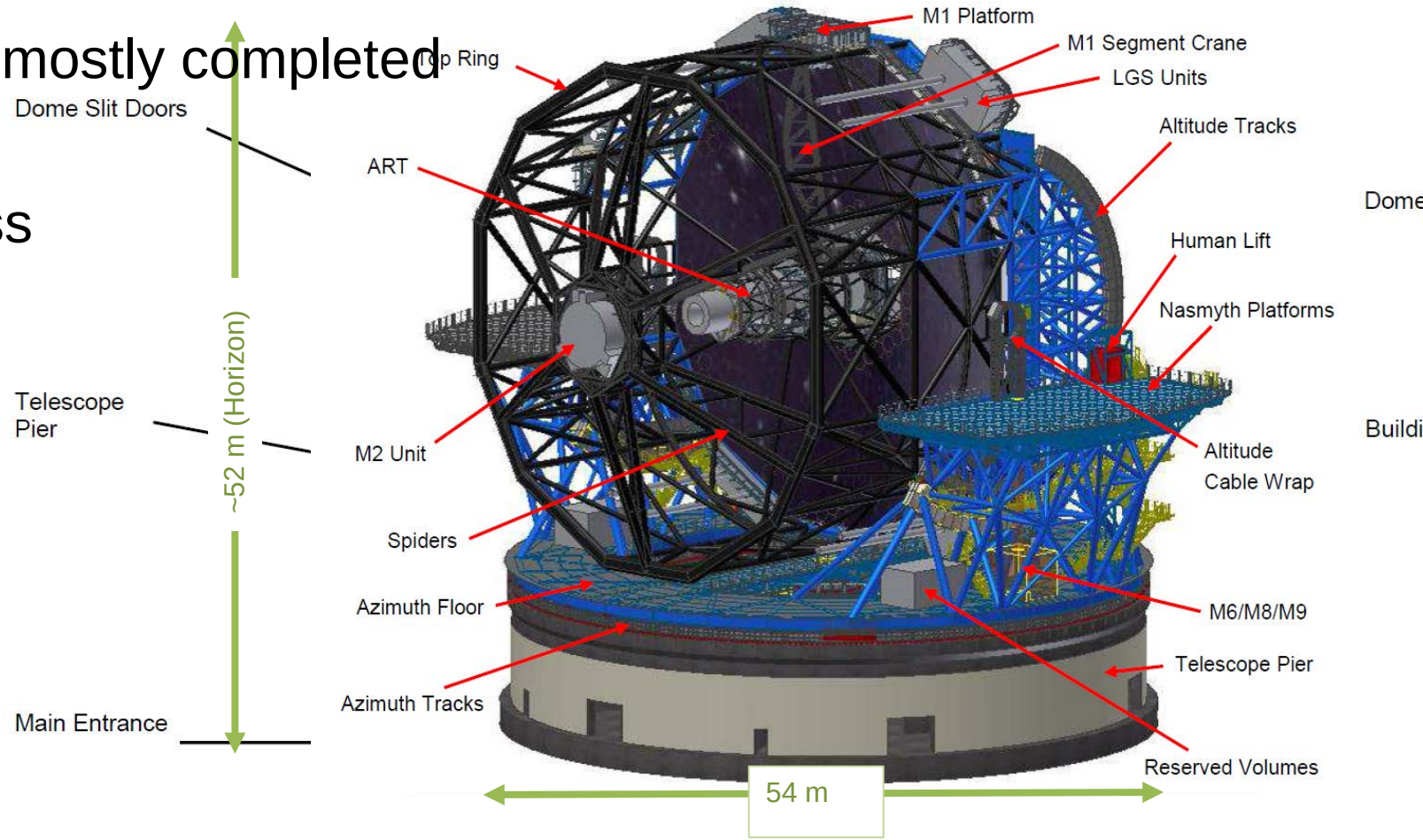


How are we organised to build it

- **ESO** as “Prime” or “**System Architect**”
  - Defines the top-level scientific and technical requirements
  - Develops the system (observatory) concept and subsystem requirements
  - Subcontracts to (ESO Member States) industry for the construction
  - Assembles the subsystems together on-site (AIV)
- **ESO Member States Industry**
  - Detailed design and manufacturing of the subsystems based on requirements following competitive Call-for-Tenders
- Consortia of **Scientific Institutes**
  - Detailed design and manufacturing of the scientific instruments based on (collaborative) agreements

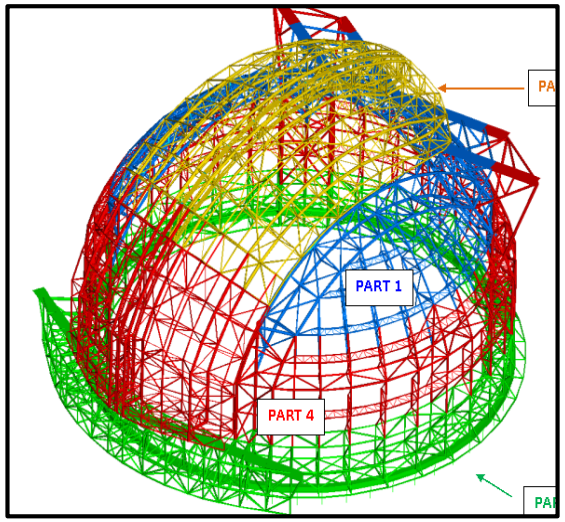
ELT Dome & Main Structure (DMS)

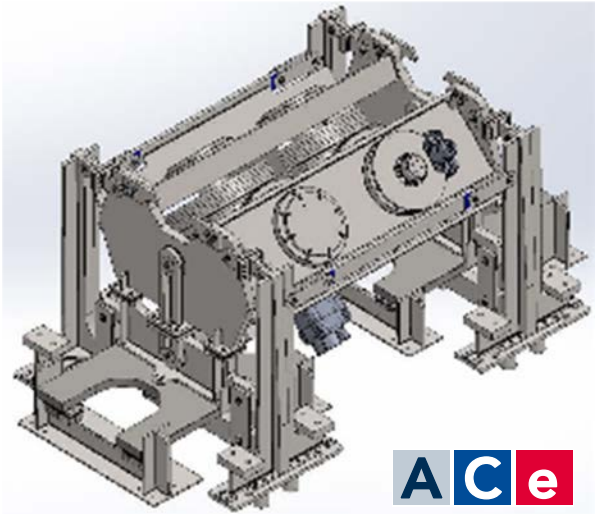
- **Contract placed with ACe, Consortium of Cimolai and Astaldi**
  - PDR of the Dome done
  - PDR of the Main Structure mostly completed
  - Manufacturing started
  - On site activities in progress



DMS manufacturing activities in Europe 1/3

- Dome & Main Structure Manufacturing phase has started for:
  - Enclosure structure
    - Part 3 (first ring in green in the picture here below) is manufactured, pending sand blasting and painting
    - Steel purchased and inspected by ESO, manufacturing on going (part 4)
  - Seismic Isolators of Dome and Aux. Building
    - First units manufactured and tested. Waiting for Contractor confirmation
    - Interface plates for embedding in foundation shipped to site
  - Enclosure rotating mechanism design completed
    - production of first unit started





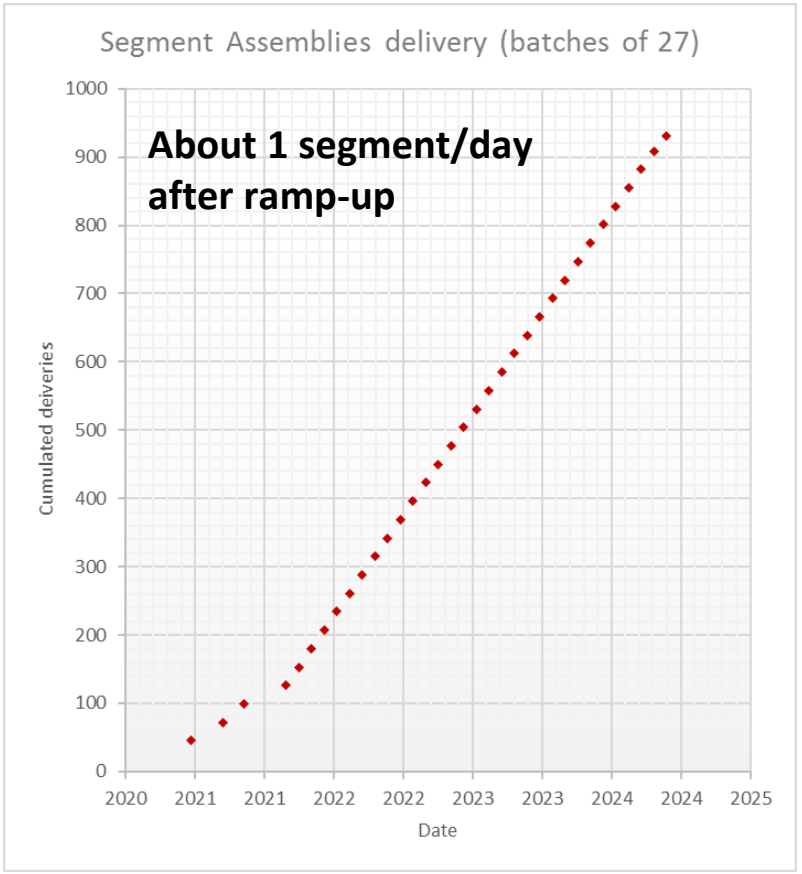
DMS manufacturing activities in Europe 2/3

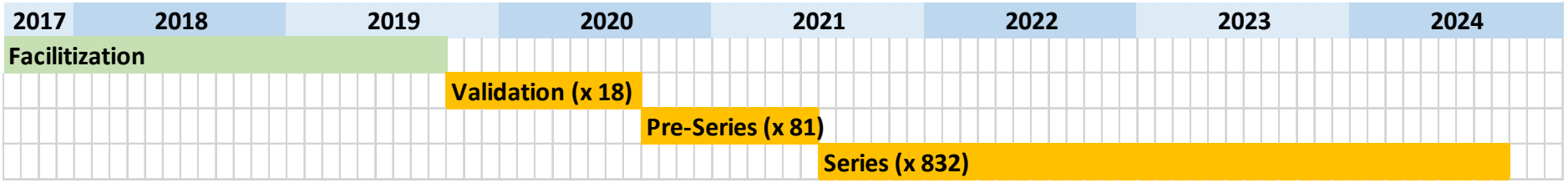
DMS manufacturing activities in Europe 3/3

Mirror Blanks

- M1 Segment Blanks
  - First M1 Segment Blank (tests) completed by SCHOTT end of August.
  - Ready for delivery to REOSC as part of the first delivery set.
- M2 Blank
  - Technically accepted in Dec'18
  - Delivered to Safran/Reosc Jan'19
- M3 Blank
  - Casted
  - Checking the ceramization

M1 Segments Polishing

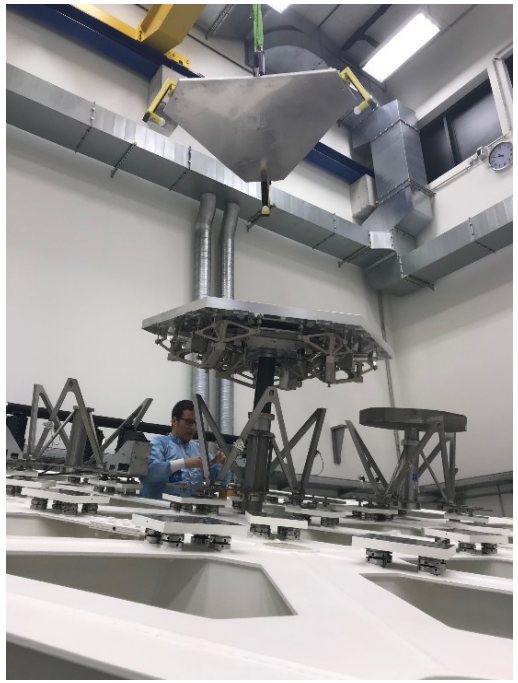


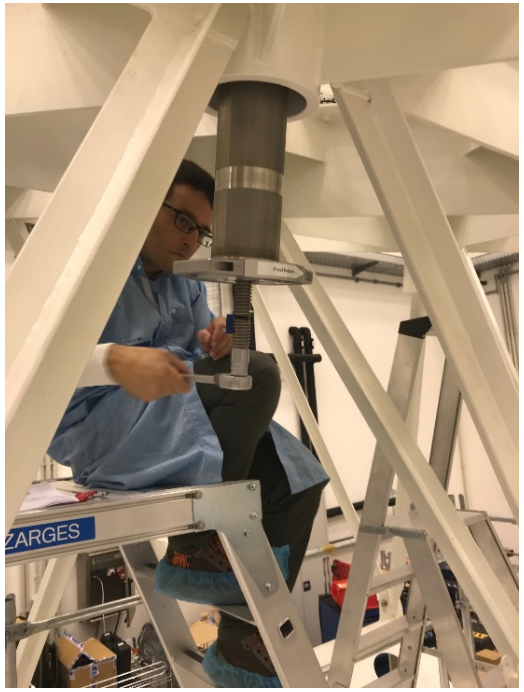


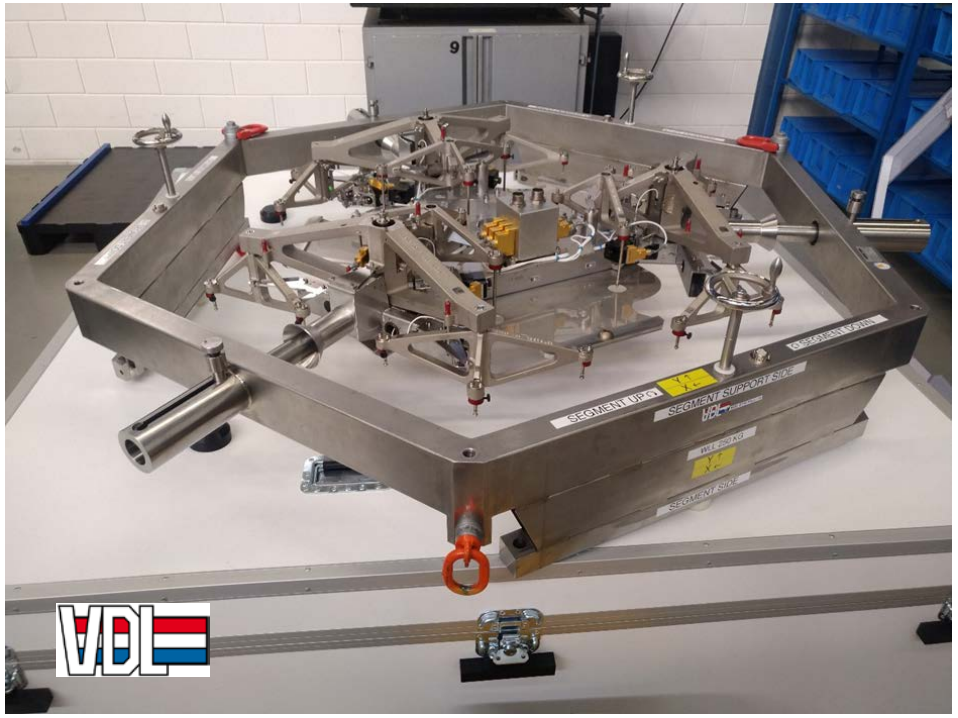
M2 blank from SCHOTT to ESO to SAFRAN-Reosc

M1 Segment Support

- M1 Segment Support (M1SS) Series production
  - Since Kick-Off with VDL (May'18), nominal progress (until April'19)
  - Held Manufacturing Readiness Review (MRR) for Pre-series (18 Supports)
  - Design contract deliverables (5 QM segment support + handling tools) for Reosc are ready for shipment.

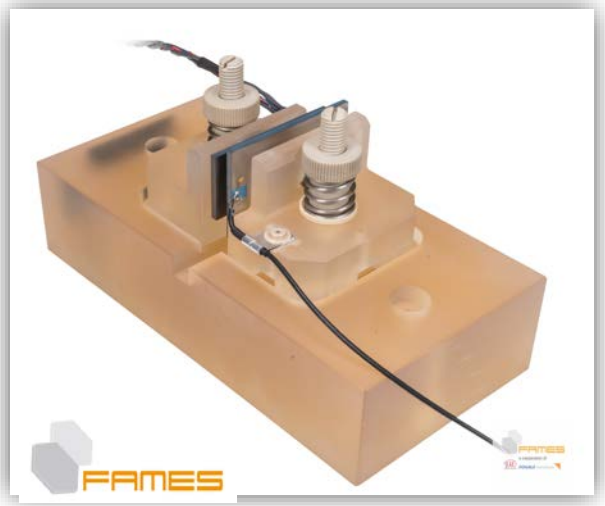






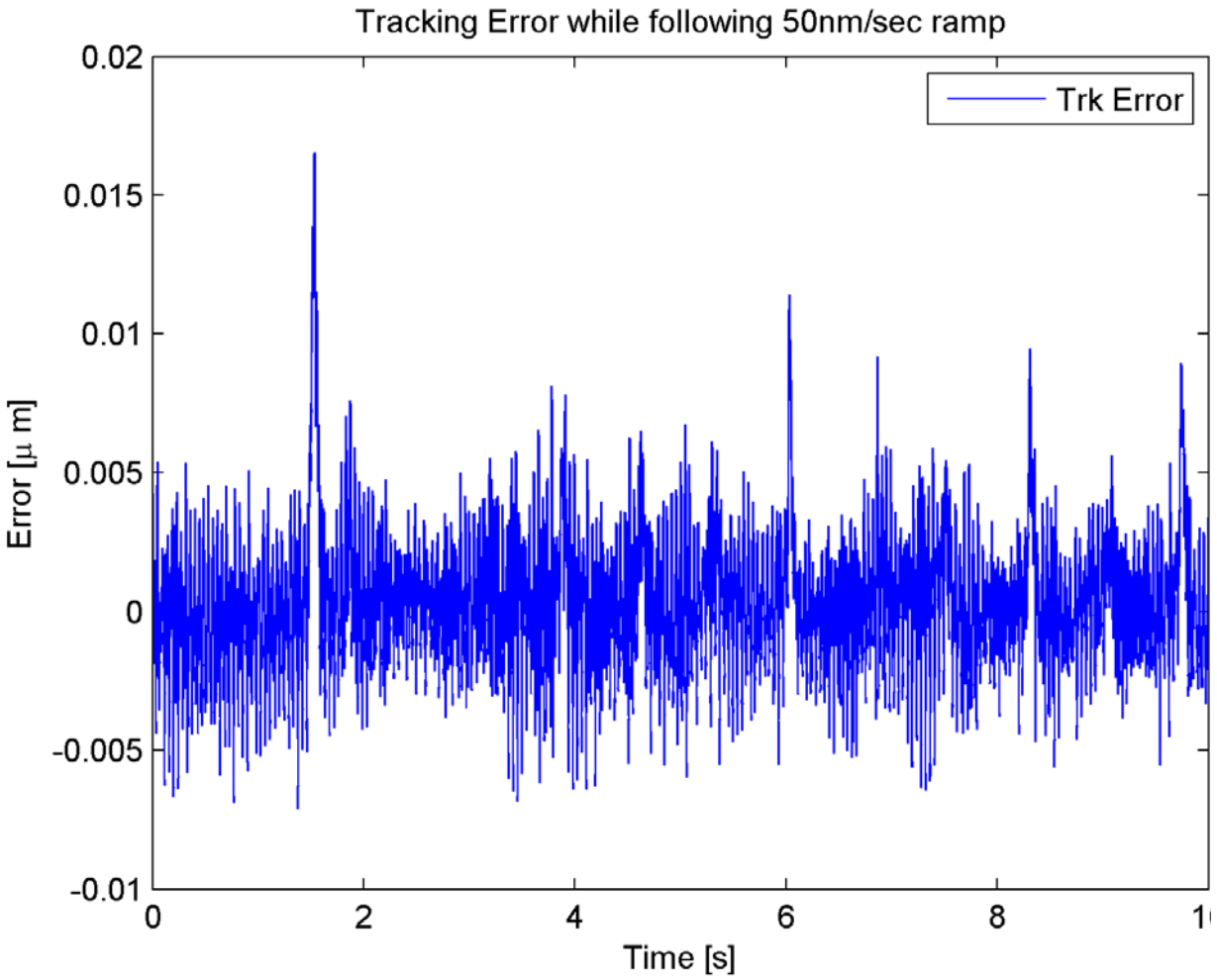
M1 Edge Sensors and Position Actuators

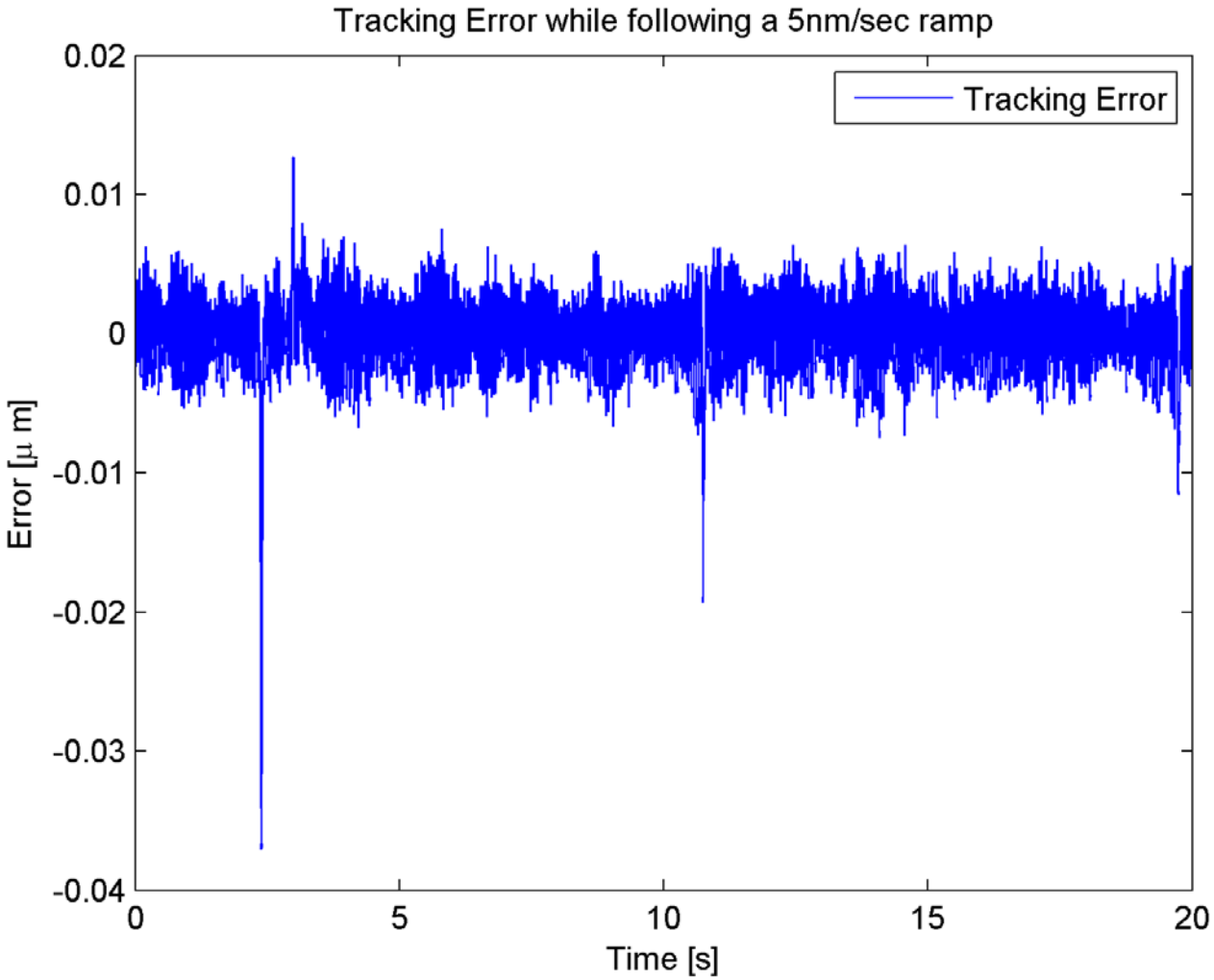
- M1 Edge Sensors (Contract with FAMES, FR-DE)
  - Design and performance are now under control
  - Preliminary Design Review in Jan’19 was succesful
  - 42 Qualification Models (QMs) produced
  - Total to be produced: 4566 pcs.



- M1 Position Actuators (Contract with PI, DE)
  - Qualification Test Review held (Jan’19),
  - Preliminary Design Review in Mar’19
  - 5 QM’s manufactured
  - Total to be produced: 2418 pcs.

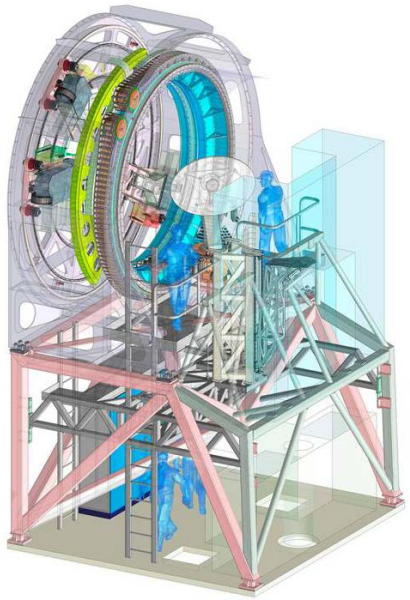
M1 Position Actuators



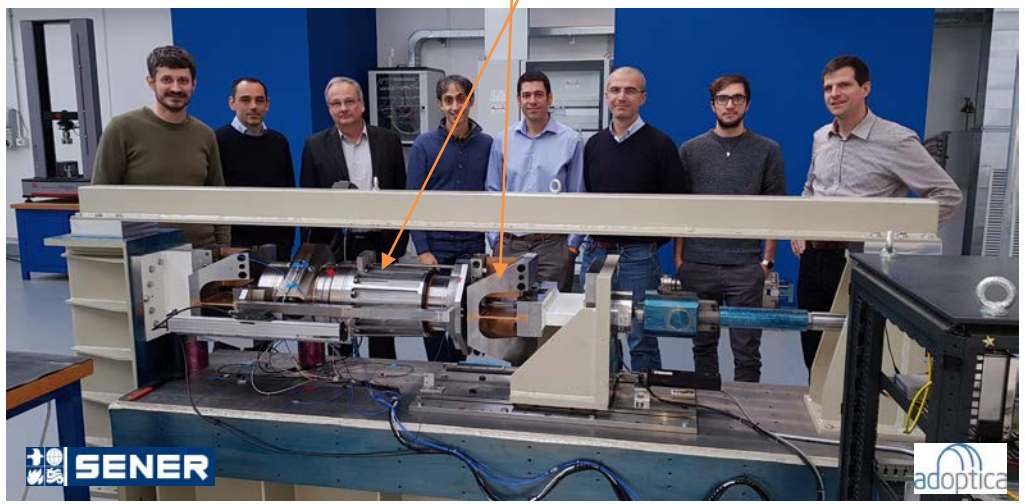


M2 Cell and PFS

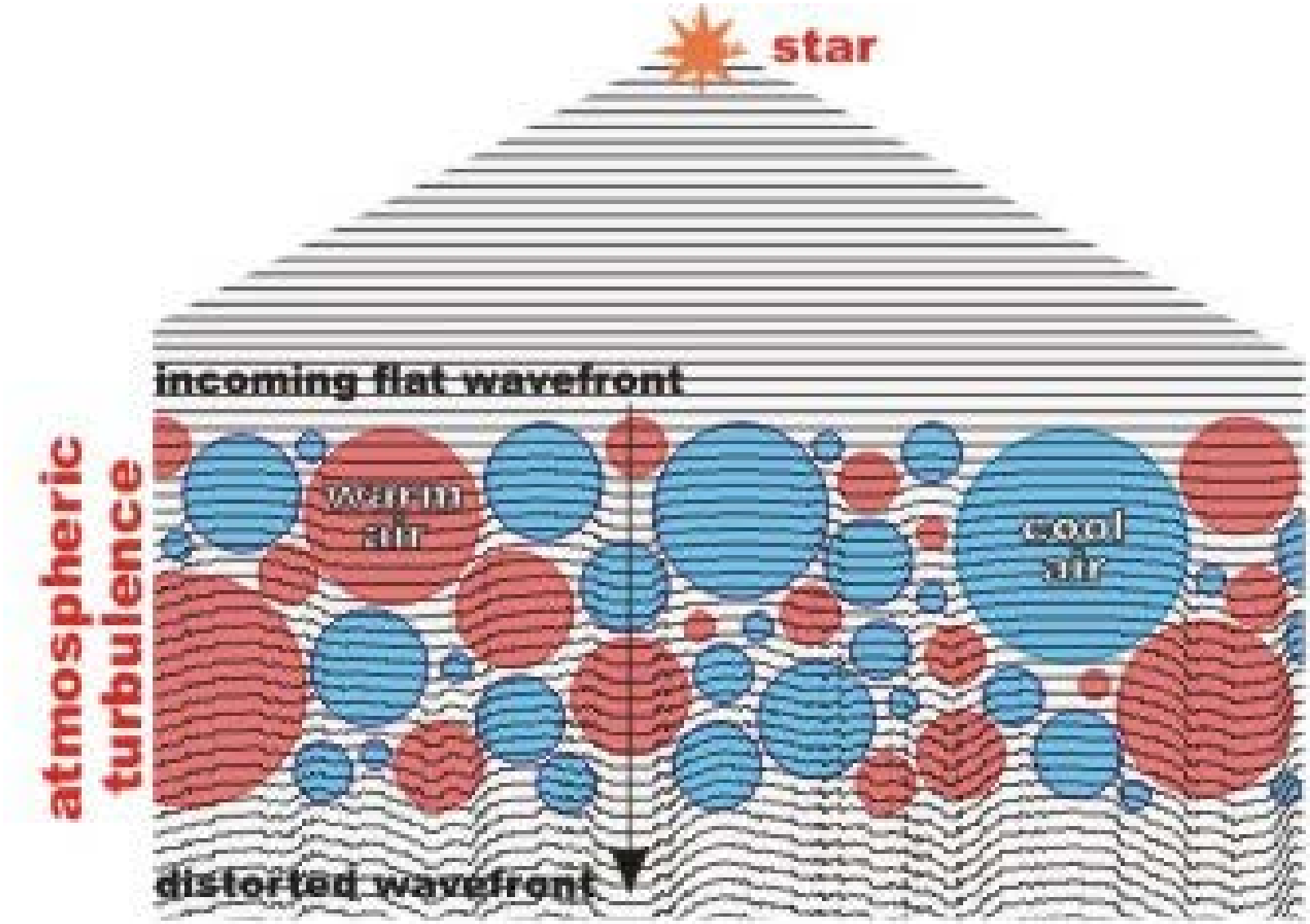
- M2/M3 Cell (SENER, ES)
  - Preliminary Design Review held in 2018
  - Qualification of Hexapod on-going
- Prefocal Station (IDOM, ES)
  - Design on-going, PDR held in Apr ’19



IDOM



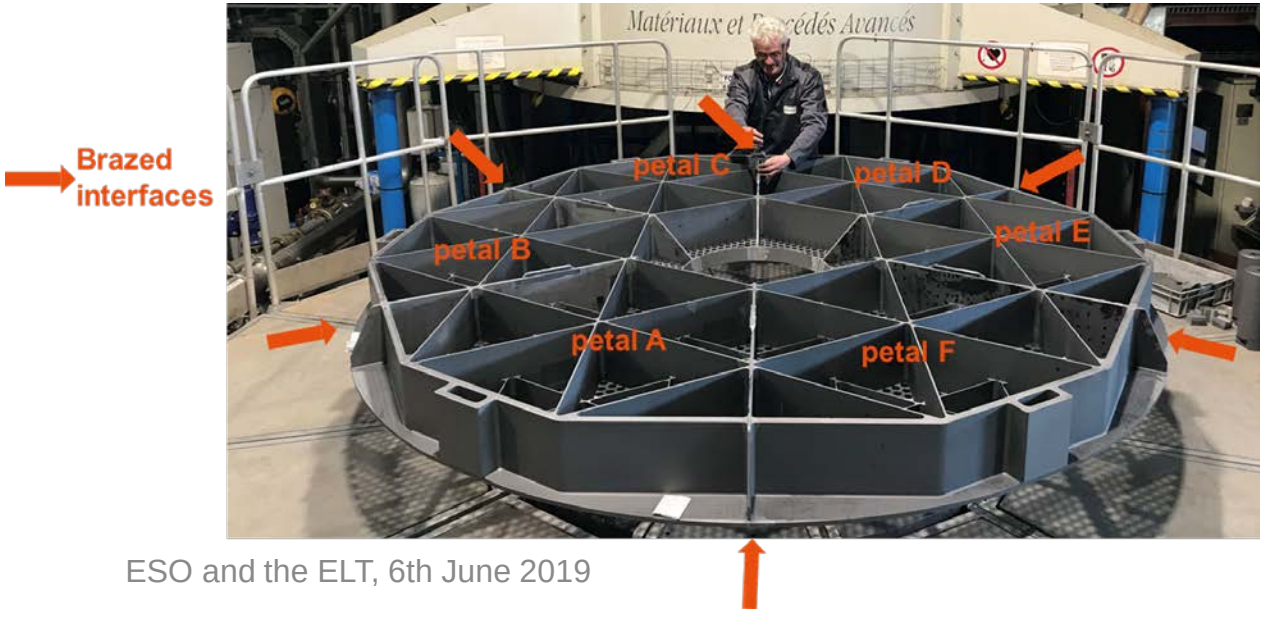
Adaptive Optics

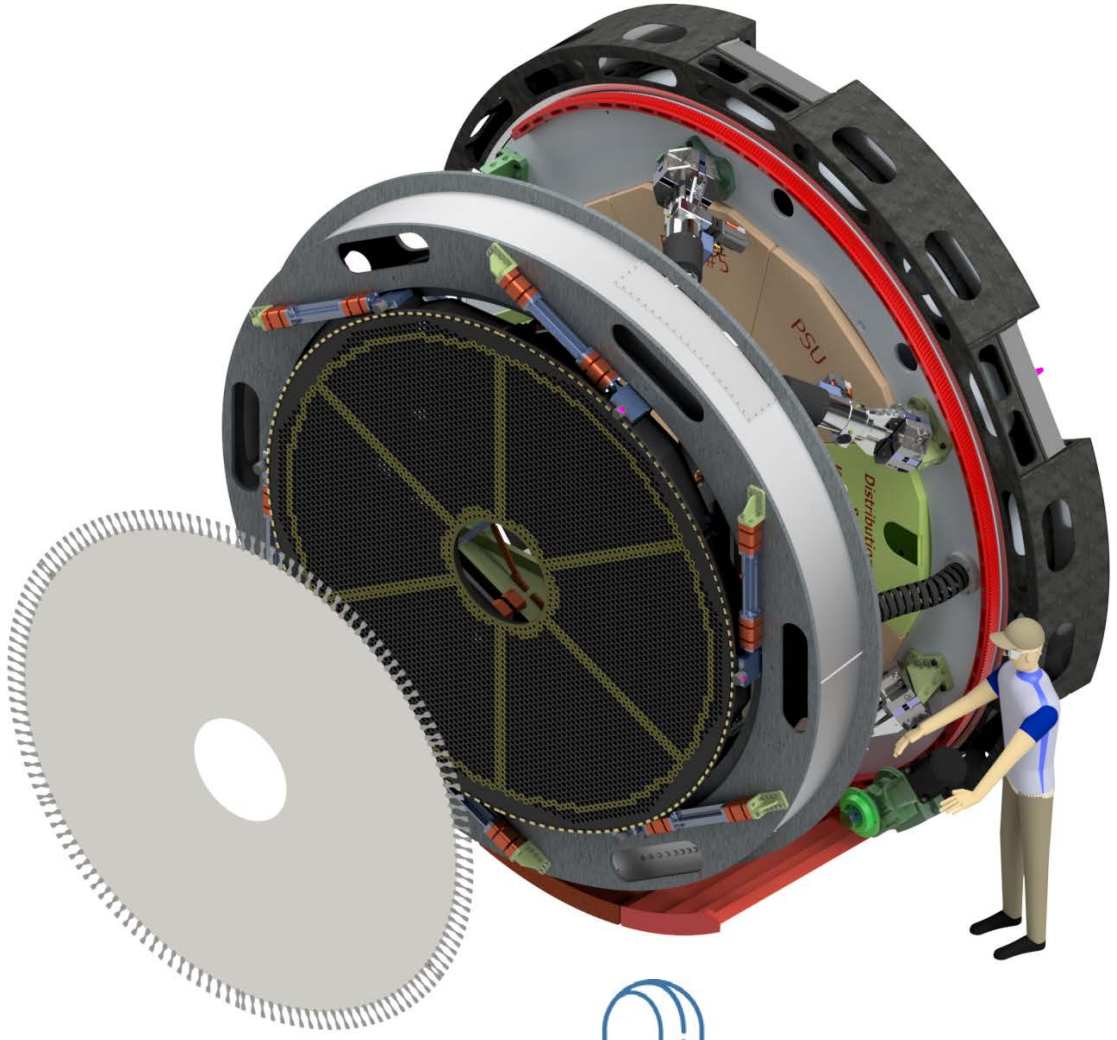


Credit: NASA

M4 Unit

- Contract placed with Consortium AdOptica ADS and Microgate, IT
- FDR passed
- In advanced manufacturing stage
- ESO is delivering the mirror shells

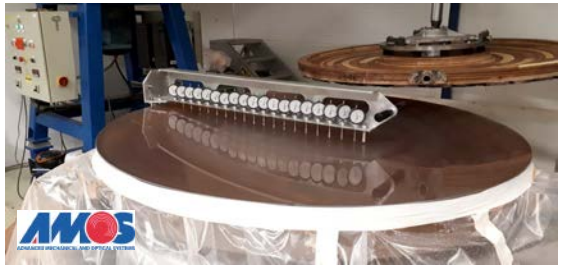




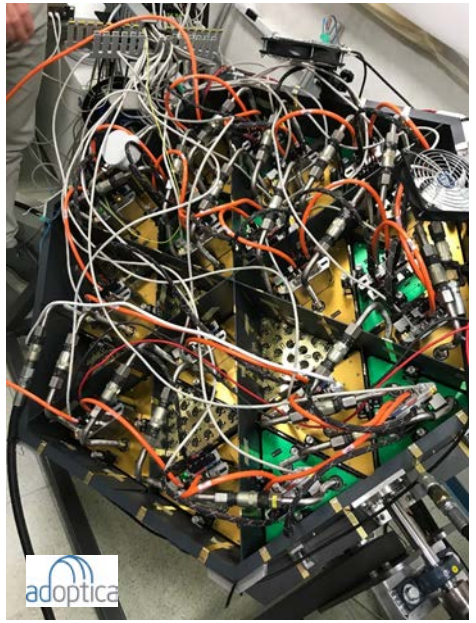
adoptica

M4 Unit

- M4 Shells
  - Four (out of twelve) thin Shells accepted, two delivered to Adoptica for integration into M4 Unit
  - 3rd and 4th shells being delivered to ADS 12th June



- M4 Adaptive Unit
  - Final Design passed
  - Manufacturing in progress
    - Most components for the adaptive mirror actuators (more than 5300 actuators!) ordered and many received (~ 50%)
    - All 6 SiC petals for reference body completed and brazed
    - M4 Test Tower, manufacturing in progress



Telescope Control System

- Telescope Control System
  - **Instrument Control System Framework SW** alpha release delivered to Consortia.
  - **Time Reference System** technologies, verification and failure modes being studied.
  - **Core Integration Infrastructure** software first release imminent (testing on-going).
  - **M1 Electronics Cabinets** (final prototype) integrated and ready for thermal testing.
  - First software release for **M1 Local Control System (LCS);** on-track and comfortably exceeding performance requirements for baseline Edge Sensor control loop.
  - **Central Control System (CCS)** requirements specification released.
  - **M1 Warping Harness (WH) Controller** entered serial production
  - **RTC Toolkit**: WP commencing mid-2019 to provide SW for MIMO controller applications in the telescope (M1, TREx) and INS AO applications.

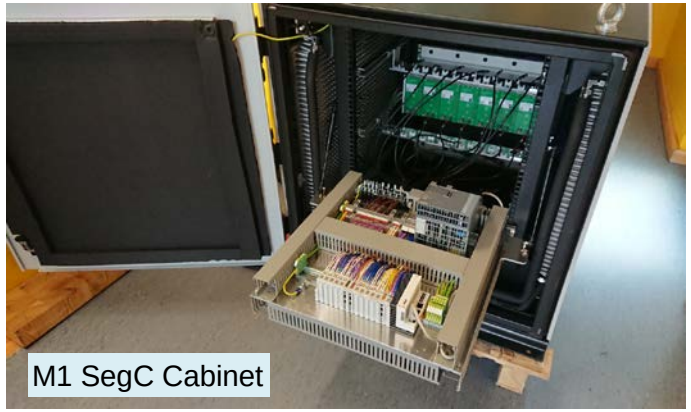
M1 LCS Status – Development

green = 1st version completed, yellow = in progress, red = to be done

Subsystem	Libraries and Applications
RuntimeDB	LPC (dbif) HPC (hpcif)
Data Framework	FEAdapter FECmdMgr FEMeasMon (FEEsMon, FEPactMon) FERefMgr FEInfoMon FESim (ref. impl.) FEConfig
Sync	PtpAdapter SyncAdapter SyncMgr SyncMon
Net	NetAdapter NetMon NetConfig
PDC	PdcAdapter PdcMgr PdcMon PLCCode PLCSim PDCConfig
FDIR	FDIRMgr FDIREsMeasMgr
Data Recorder	DataRecorder
Scripts	Tests Deployment LSV-LCS
GUIs	FE (pymudpigui) RuntimeDB (DBBrowser) Status (m1StatusGui) PLC M1 FDIR
Common	mudpiif msgif cfgif
Tools/Config	sink figloop genconf repoloader msgsend msgpub msgsub mudpireceive mudpisend templates NewTrafficGenerator

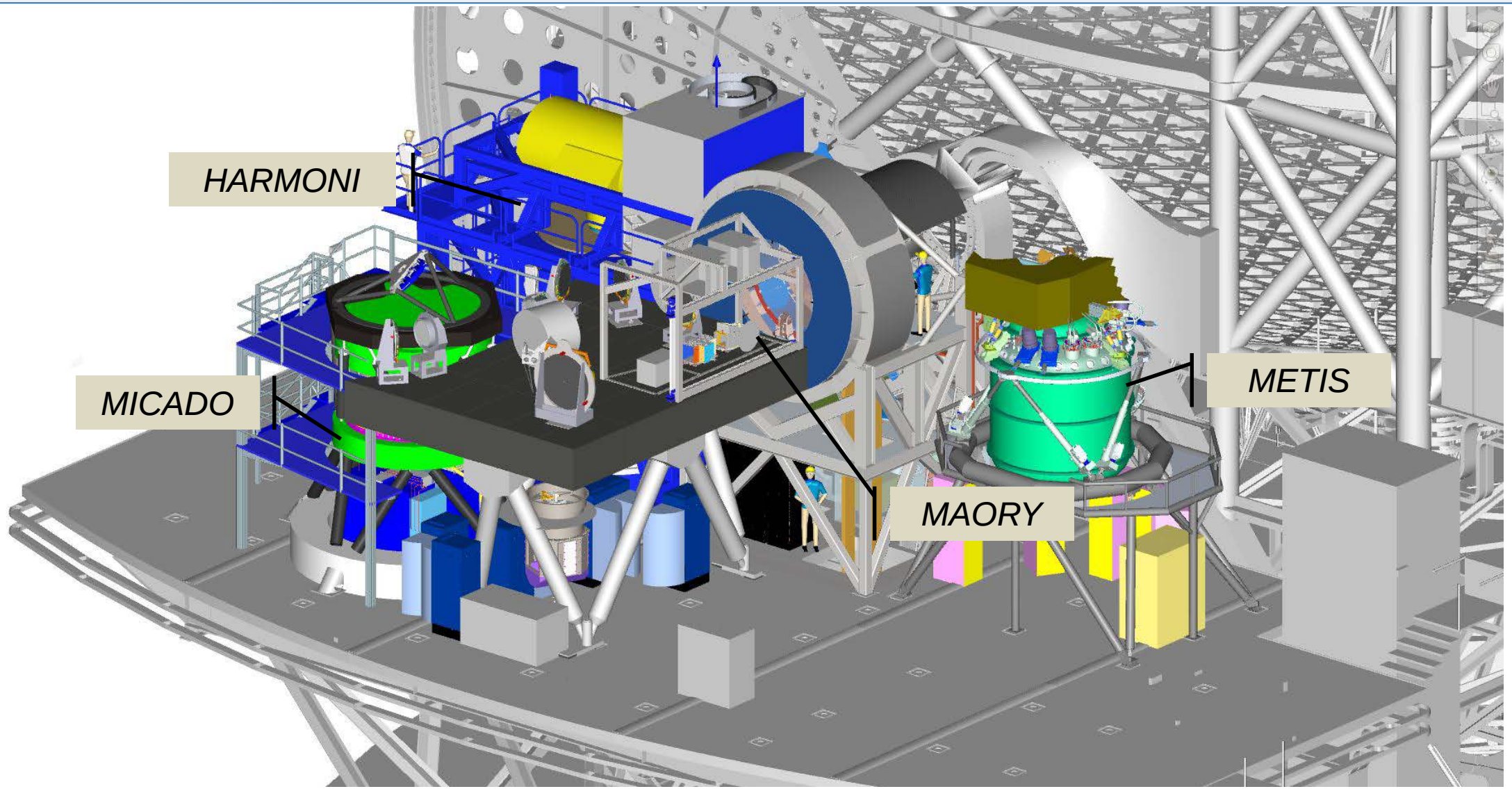
M1LCS SW - Status Report, 26 Feb 2019, ESO Internal Use 5


M1 Warping Harness Controllers in Chassis

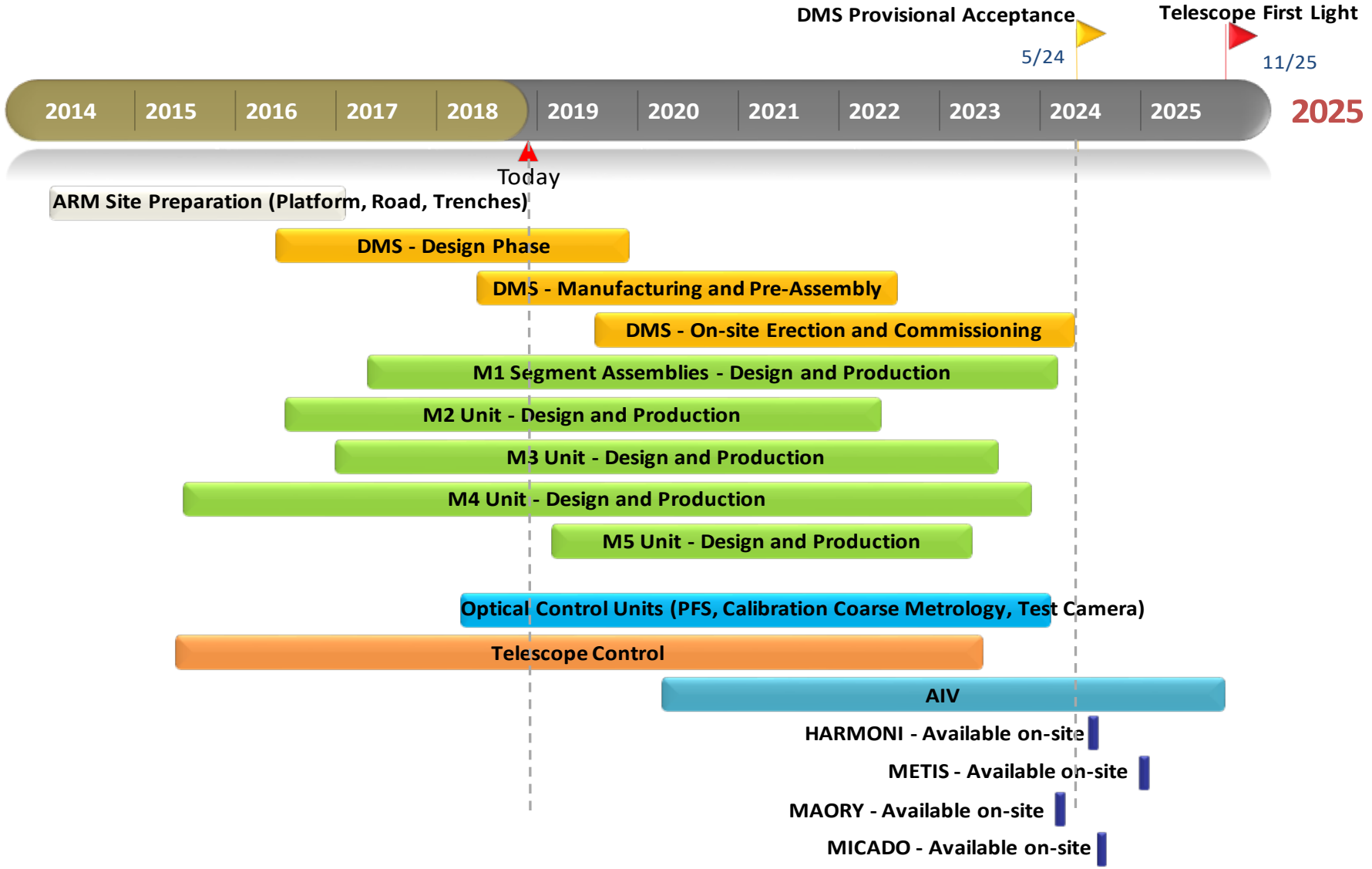

M1 SegC Cabinet


M1 SecD Cabinet

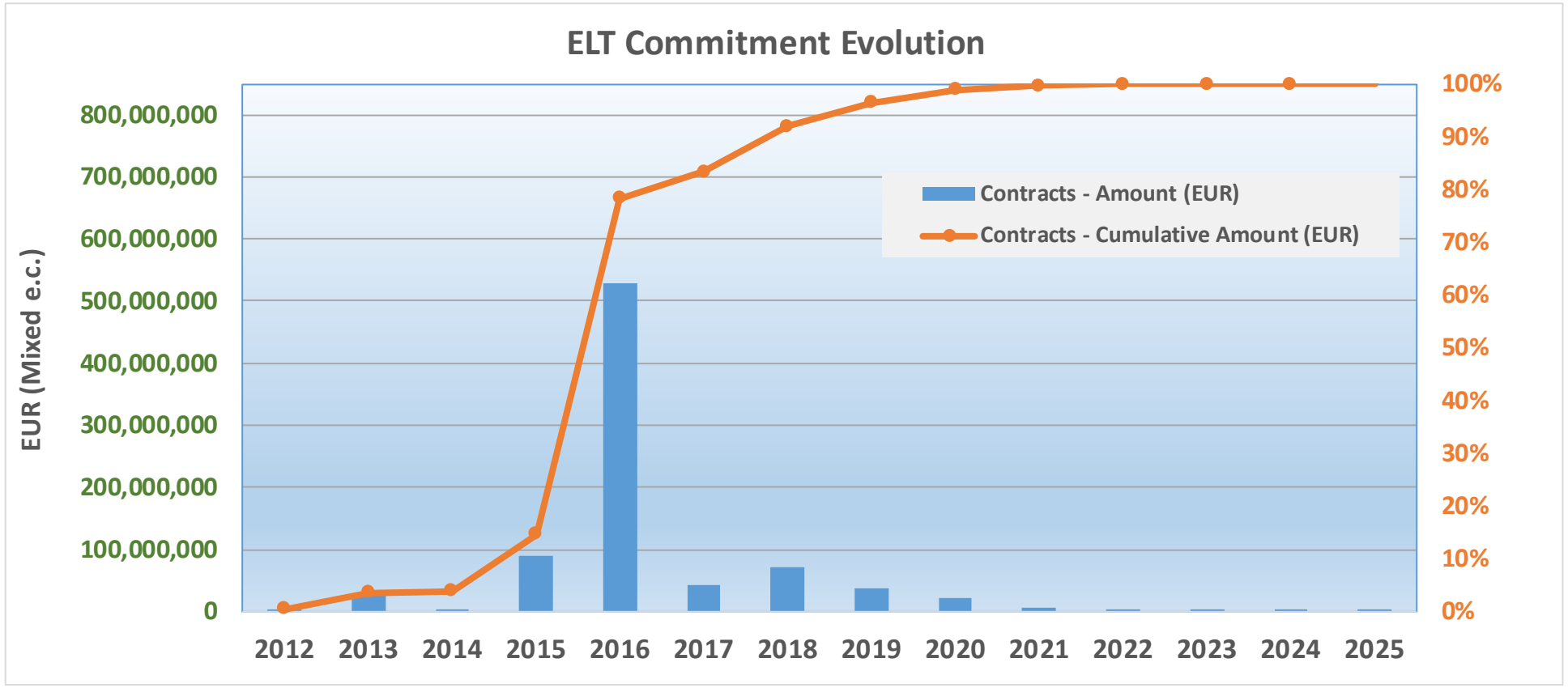
ELT First set of Instruments



ELT Top Level Schedule

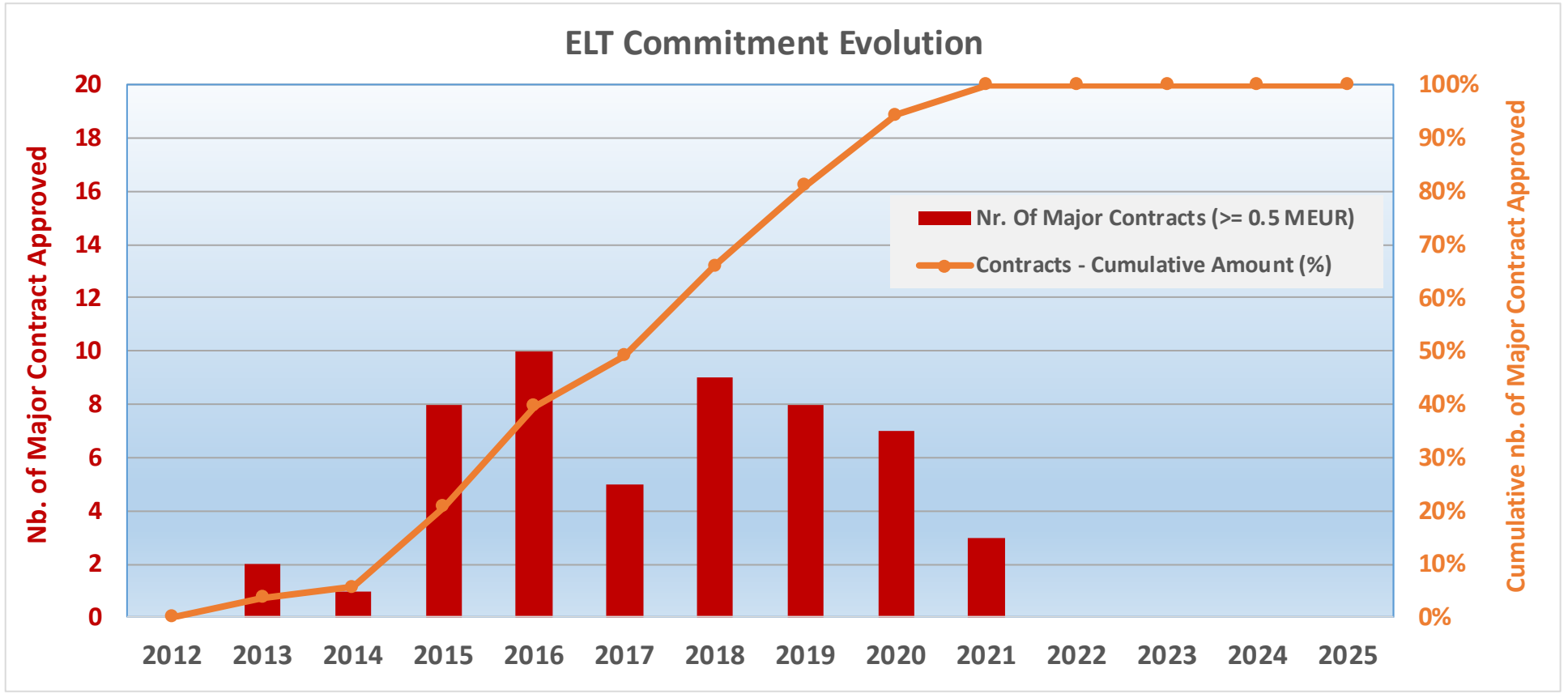


ELT Programme – Commitment Evolution



ELT Programme – Commitment Evolution

Nr. of Contracts



ELT – On-Going Contracts

Concluded/Ongoing Contracts	Description of Work	Contract Signature Date	Contractor	Contract Responsible	Forecast Completion Date (w/o Options)	Status
PJ42.01 Project Office	**PA Consultancy Services**	Jan-16	ISQ	**H. Kurlandczyk**	Dec-18	On-going
	ISVV Consultancy Services	Jan-16	Critical Software	**H. Kurlandczyk**	Dec-18	On-going
	Construction All Risks Insurance	Mar-18	SCOR	**B. Koehler**	Mar-26	On-going
PJ42.02 DMS	**Consultancy Support**	Jun-13	Ramboll	**R. Tamai**	May-18	On-going
	DM&S Design and Construction Contract	May-16	ACe Consortium	**S. Stanghellini**	May-23	On-going
PJ42.03 Optomechanics	**M4 Phase 1 Preliminary Design**	May-12	AdOptica	**N/A**	Jan-15	Closed
	M4 Unit Final Design and Manufacturing	Jun-15	AdOptica	**E. Vernet**	Jan-23	On-going
	M1 Segment Supports - Qual. Units	Jan-15	VDL	**O. Sqalli**	Jul-17	On-going
	M1 Segment supports - Qual. Units	Feb-15	CESA	**F. Derie**	Oct-17	Closed
	M4 Mirror Shells Supply	Jul-15	Safran Reosc	**E. Vernet**	Nov-23	On-going
	M2 Mirror and Auxiliary Equipment Supply	Jul-16	Safran Reosc	**C. Haupt**	Feb-24	On-going
	M2 Blank Supply	Jan-17	Schott	**O. Sqalli**	Jan-19	On-going
	M3 Blank Supply	Jan-17	Schott	**O. Sqalli**	Jul-19	On-going
	M3 Mirror and Auxiliary Equipment Supply	Feb-17	Safran Reosc	**C. Haupt**	Sep-23	On-going
	M2 and M3 Cell Design and Manufacturing	Jan-17	Sener	**M. Mueller**	Jul-22	On-going
	M1 Edge Sensors Design and Manufacturing	Jan-17	FAMES	**C. Lucuix**	May-22	On-going
	M1 Mirrors Polishing	May-17	Safran Reosc	**A. Foerster**	Jun-23	On-going
	M1 Blanks Supply	May-17	Schott	**O. Sqalli**	Sep-22	On-going
	M1 Position Actuators	Jun-17	PI	**L. Pettazzi**	Sep-22	On-going
	M1 Segment supports - Production	Apr-18	VDL	**O. Sqalli**	May-22	On-going
	M5 Blank Supply + Polishing	Mar-19	Safran Reosc	**E. Vernet**	Sep-24	On-going
PJ42.04 Control	**Core Integration Infrastructure**	Jul-17	Cosylab AB	**N. Kornweibel**	Jun-20	On-going
PJ42.05 Civil Infrastructure	**Road and Platform**	Dec-13	ICAFAL	**C. Cabrera**	Feb-17	Closed
	Paranal ELT Technical Facility Design and Construction	Mar-18	Abengoa	**C. Cabrera**	Jul-19	On-going
PJ42.06 Support Infrastructure	**Supply, and installation of ABC Power Substations (23kV + 0.4 kV)**	Oct-16	SIEMENS	**D. Kalaitzoglou**	Jul-17	On-going
	M1 Coating Plants Supply	Jun-18	AGC	**P. Sansgasset /V. Heinz**	Nov-21	On-going
PJ42.09 Science Data Ops	**Dataflow Software Components for ELT**	Nov-18	Etamax	**M. Sterzik**	Nov-22	On-going
PJ18.10 Instrumentation	**MICADO Construction**	Oct-15	MPE	**F. Kerber**	Mar-25	On-going
	HARMONI Construction	Oct-15	STFC	**S. Egner**	Apr-26	On-going
	METIS Construction	Oct-15	NOVA	**C. Haupt**	Mar-26	On-going
	MAORY Construction	Feb-16	INAF	**F. Kerber**	Aug-25	On-going
	IR Detectors for HARMONI, MICADO, METIS	Jul-18	Teledyne	**D. Ives**	Jan-23	On-going
	C-RED Cameras for MAORY	Jul-18	FLI	**E. Marchetti**	Sep-20	On-going
	CCD-220 Detect. for MAORY, MICADO, HARMONI, PFS-A	Apr-19	Teledyne	**P. Amico**	Jun-20	On-going
	MUSE type detectors for HARMONI	June-19 TBC	Teledyne	**E. George**	Mar-21	On-going
PJ42.11 Optical Control	**PFS-A Main system Design and Manufacture**	Apr-18	IDOM	**S. Lewis**	Feb-24	On-going
	Laser Sources	Dec-17	Toptica	**S. Lewis**	Dec-22	On-going

Conclusion

- The Programme is in full construction!
  - 33 large contracts plus agreements
  - >90% of material cost committed
  - On-site progress (e.g. Dome foundations at Armazones, Technical building at Paranal)
- A fantastic endeavor with many technical challenges
  - but all currently “under control”
- Very tight Timeline
  - All contracts signed for First Light 2024 (delays appearing at contractors level), new baseline foresee First Light in 2025.

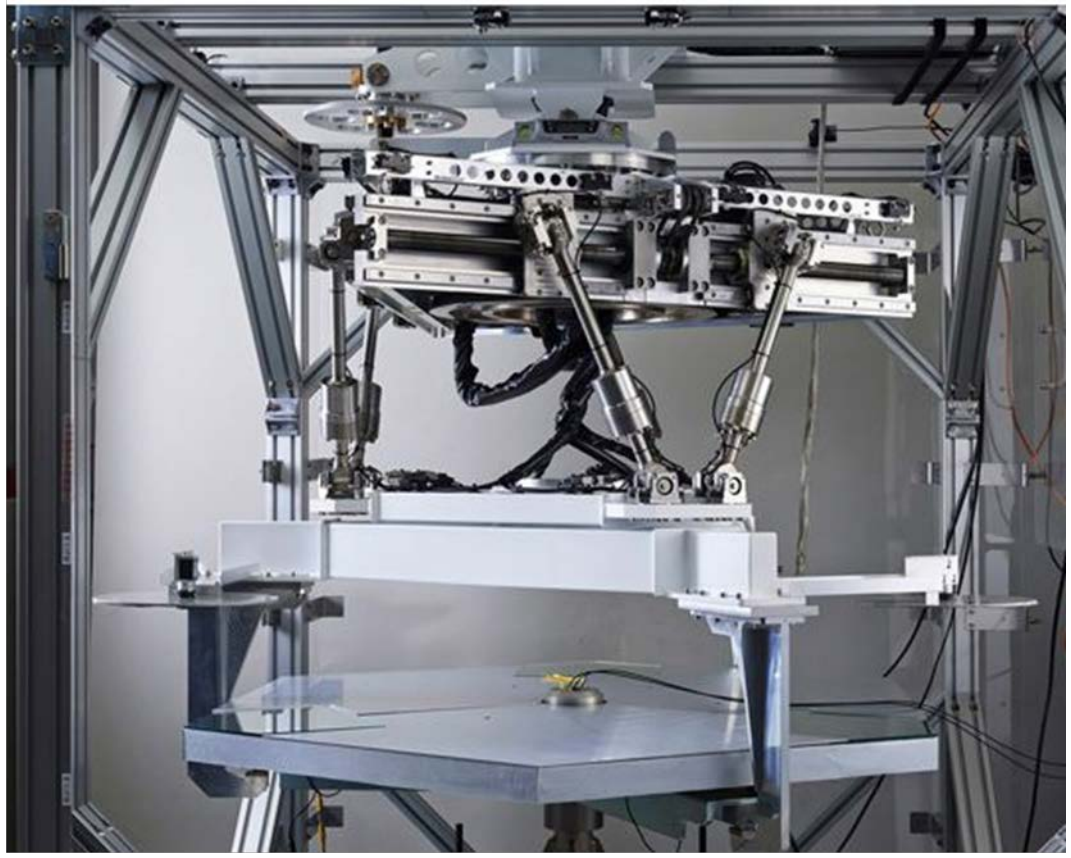
Go to Details for next procurements

Go to movie

On-going Procurement

Next Procurements

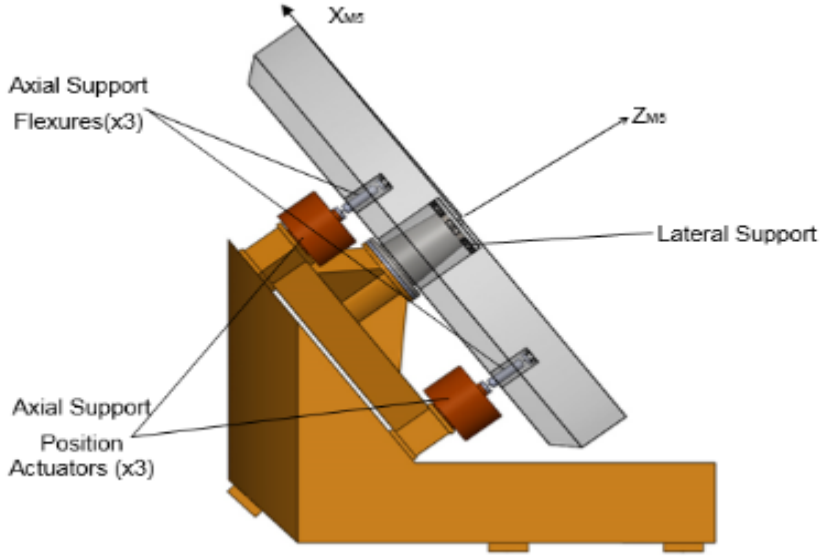
1. M1 Manipulator

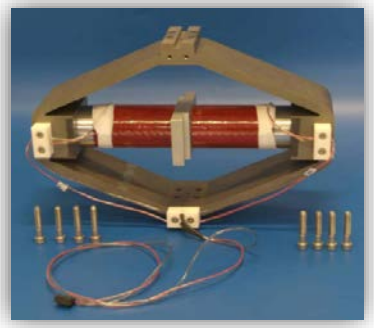


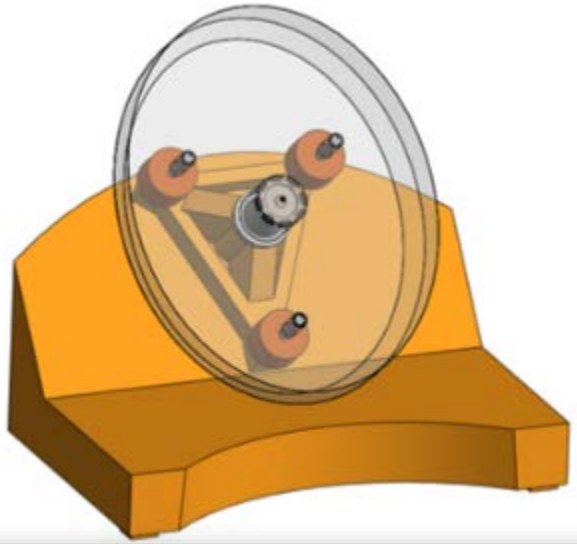
By Mitsubishi for TMT

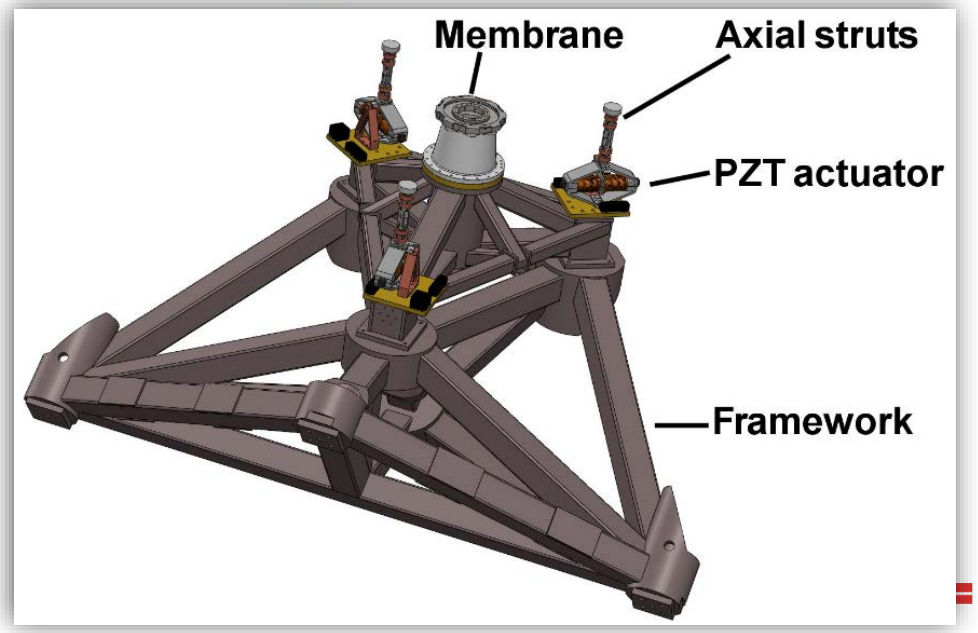
Next Procurements

1. M1 Manipulator
2. M5 Cell



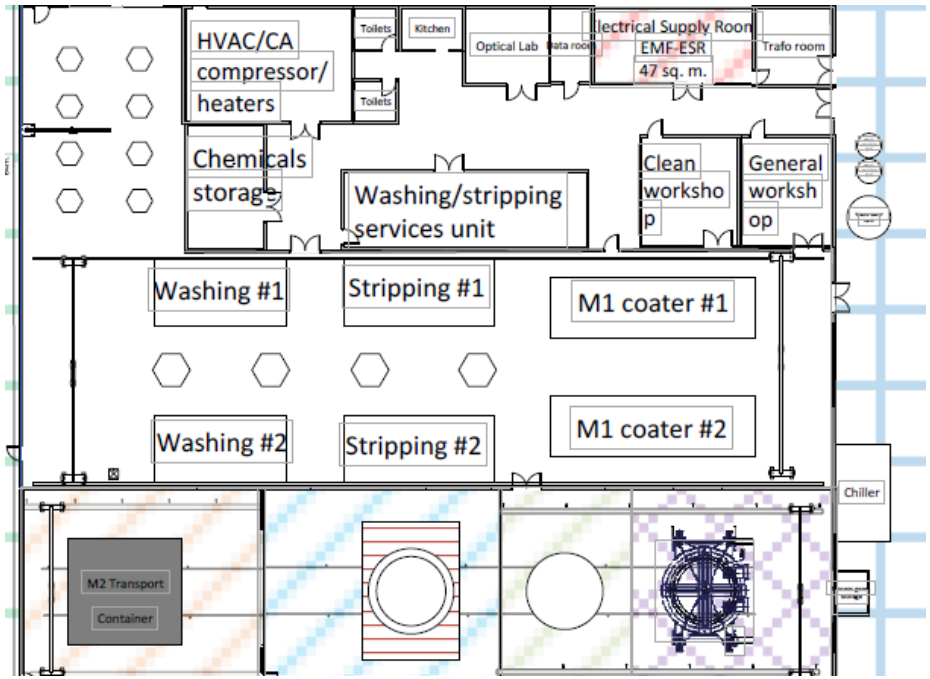


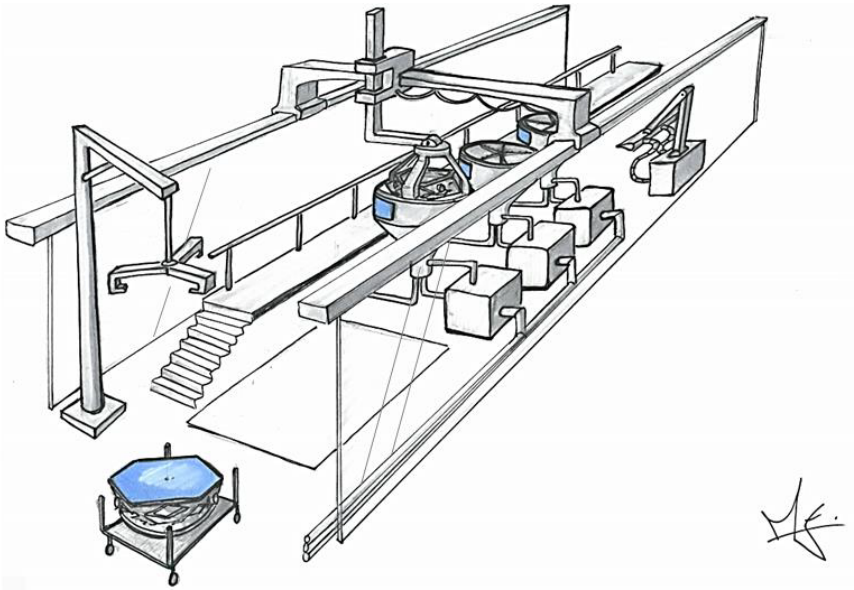




Next Procurements

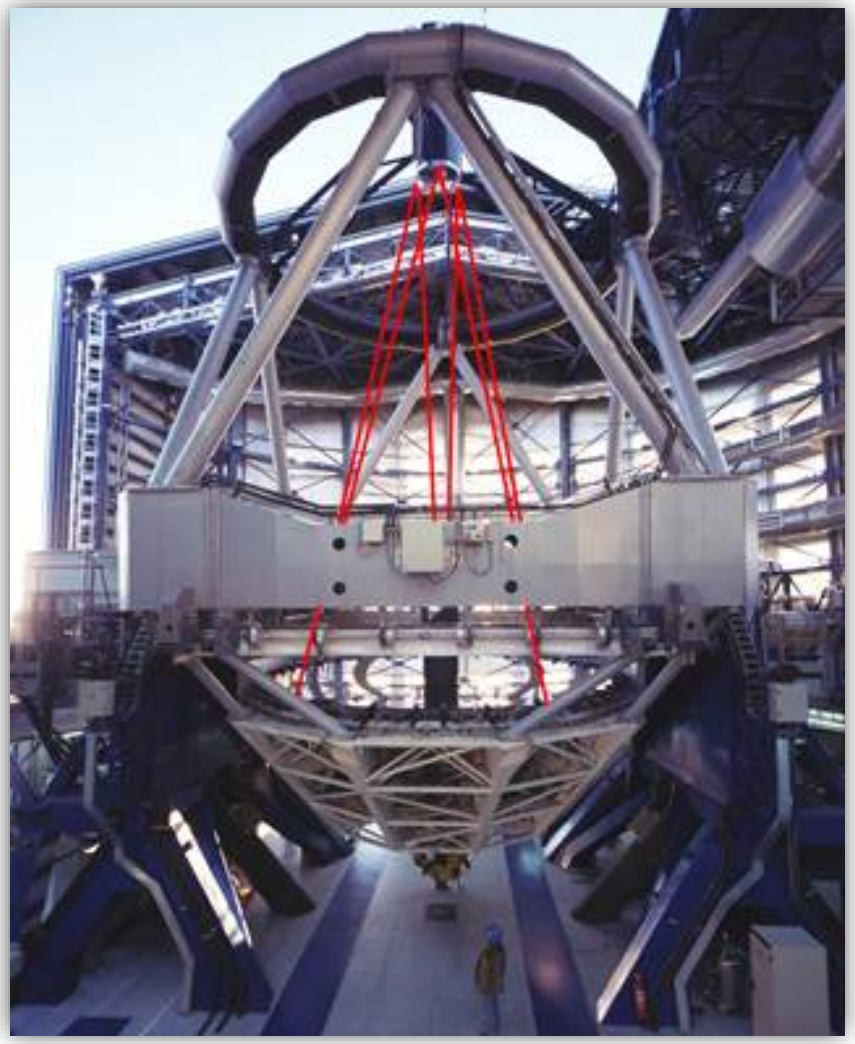
1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping





Next Procurements

1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping
4. Coarse Metrology and alignment tools

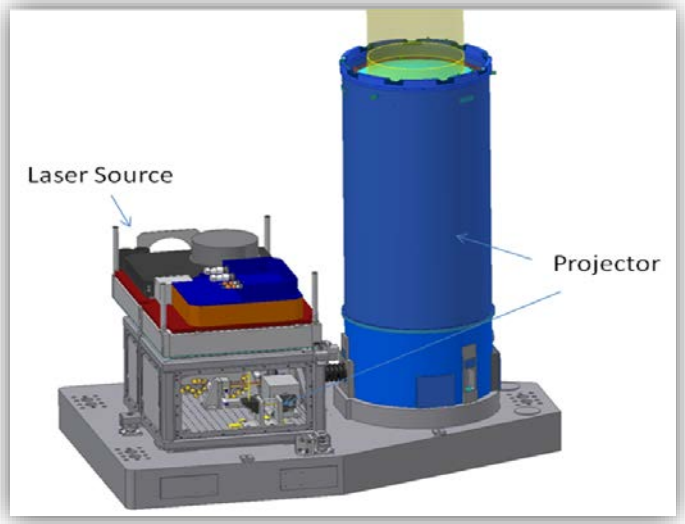


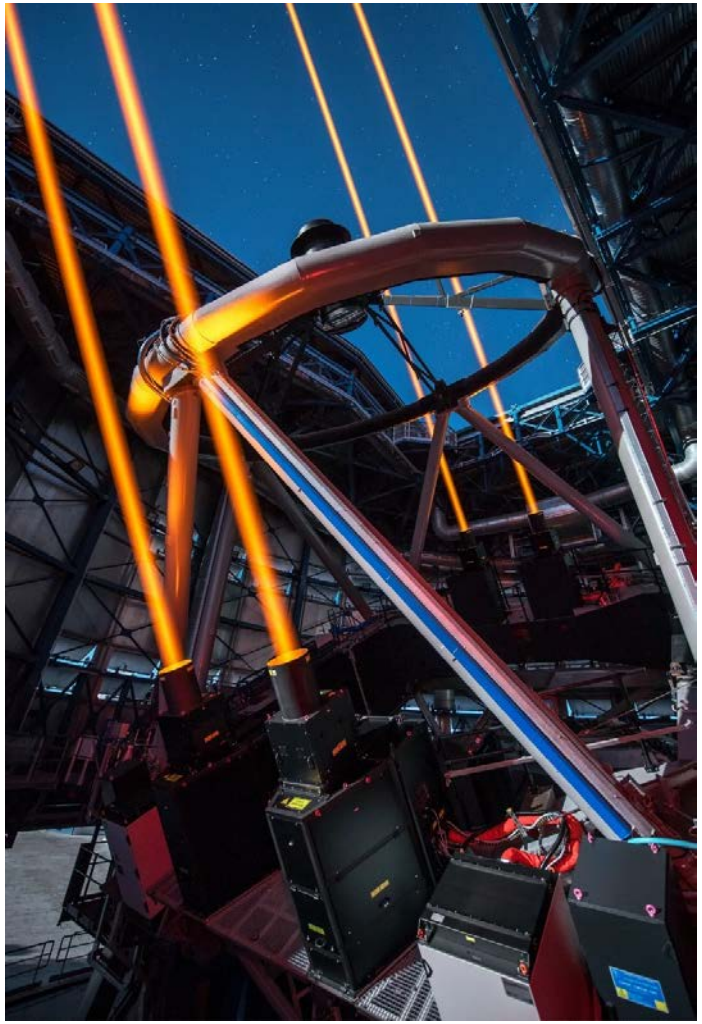
Next Procurements

1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping
4. Coarse Metrology and alignment tools
5. Cameras for detectors

Next Procurements

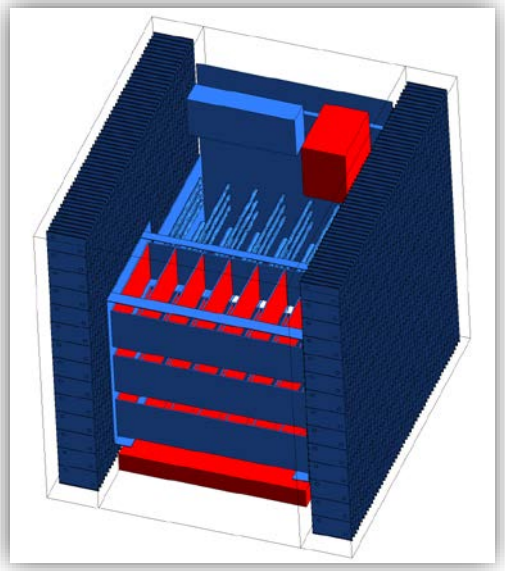
1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping
4. Coarse Metrology and alignment tools
5. Cameras for detectors
6. Laser Beam Projection subunits

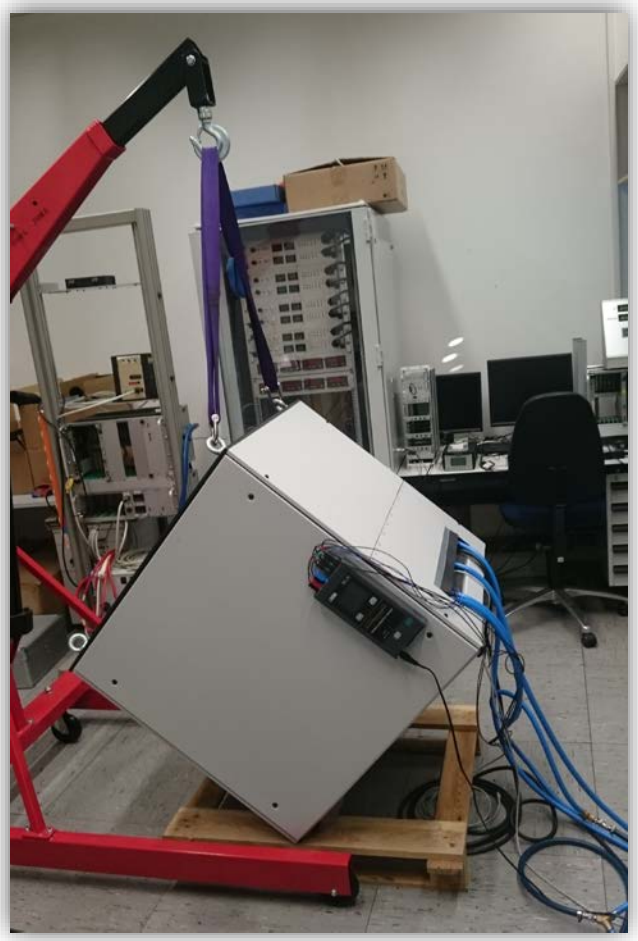




Next Procurements

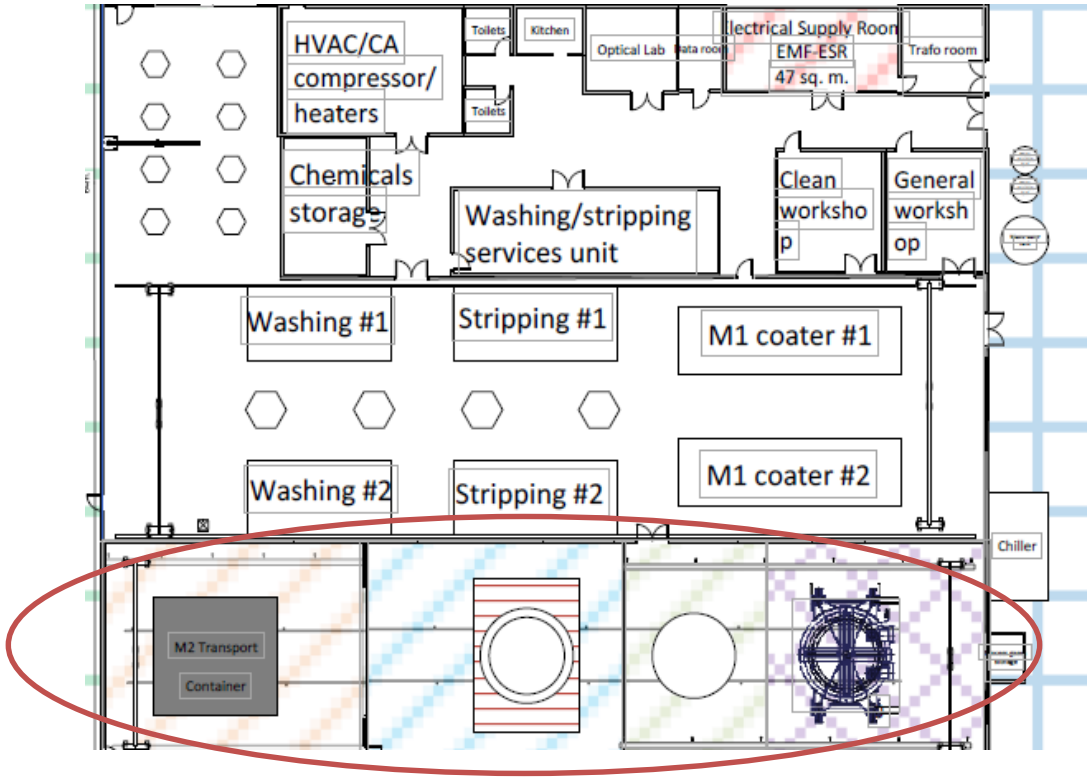
1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping
4. Coarse Metrology and alignment tools
5. Cameras for detectors
6. Laser Beam Projection subunits
7. M1 LCS Cabinets





Next Procurements

1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping
4. Coarse Metrology and alignment tools
5. Cameras for detectors
6. Laser Beam Projection subunits
7. M1 LCS Cabinets
8. 5m Coating unit



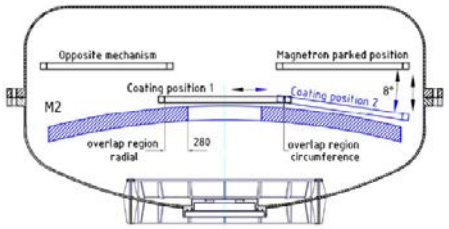


Figure 2. M2 coating/cleaning positions

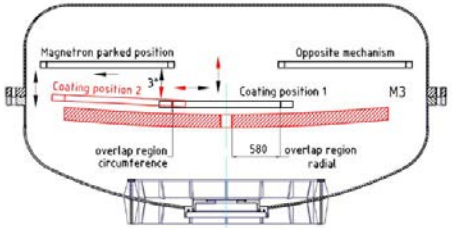


Figure 3. M3 coating/cleaning positions

Next Procurements

1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping
4. Coarse Metrology and alignment tools
5. Cameras for detectors
6. Laser Beam Projection subunits
7. M1 LCS Cabinets
8. 5m Coating unit
9. Network Infrastructure

Next Procurements

1. M1 Manipulator
2. M5 Cell
3. M1 Washing and Stripping
4. Coarse Metrology and alignment tools
5. Cameras for detectors
6. Laser Beam Projection subunits
7. M1 LCS Cabinets
8. 5m Coating unit
9. Network Infrastructure
10. RTC (Real Time Computing) Infrastructure

Plan for 2019-2020 (Large Procurements)

Description of Work	Forecast FC Approval Date
M5 Mirror	February-19
MUSE Type CCD for HARMONI	February-19
CCD220 Detectors for MAORY, MICADO, HARMONI, PFS-A	February-19
M5 Cell	September-19 ✓
M1 Manipulator	November-19 (TBC) ✓
Mirror Washing Stripping unit	November-19 (TBC) ✓
Coarse Metrology and Alignment	November-19 (TBC)
Laser Beam Projection SubUnits	Feb-20 (TBC)
Cameras for LVSM, CCD220	May-20
Transportation Service Contract	May-20
M1LCS Cabinets Procurement	May-20
Mirror Coating Unit (5m)	November-20
Telescope Test Unit	November-20 (TBC)
Network Infrastructure*	November-20
M1LCS Network infrastructure Equipment*	November-20

Go to movie

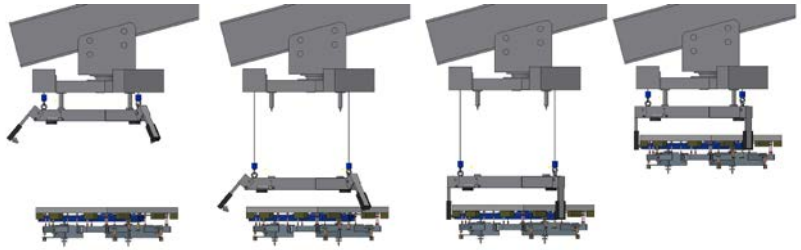
Annual Turn-over Categories

Category	Annual Turn-over
Low	<3 M€
Medium	3 to 15 M€
Large	>15 M€

M1 Segment Assembly - Manipulator

- Scope:
  - Design, construction and testing of high-precision, 4-axis, fail-safe handling tool with gripper to remove the M1 segment assembly from the telescope

- Expected Contract Duration:
  - ~ 1.5 years

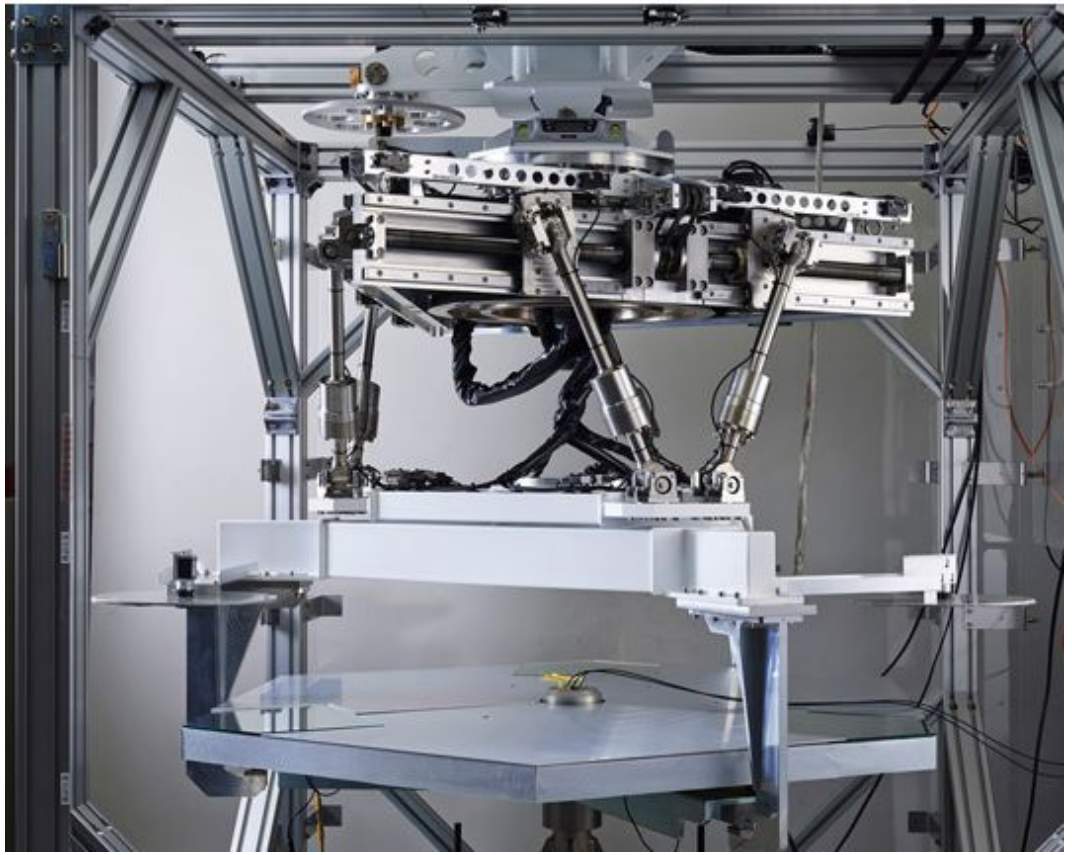


- Turn-over: Low
- Timeline:

✓ Request for Information	Oct 2018
✓ Preliminary Inquiry	Jan 2019
➢ Release Call for Tender	May 2019
➢ Closing date	Sep 2019
➢ FC Approval	Nov 2019 (TBC)

M1 Segment Assembly - Manipulator

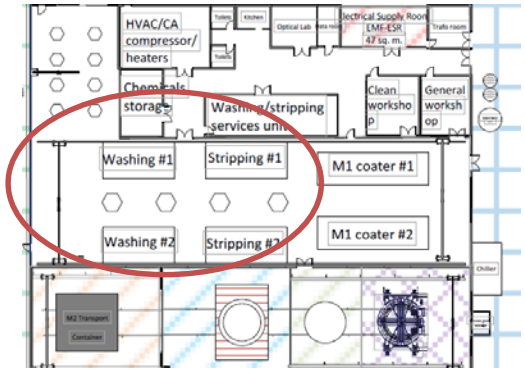
- Specialties for potential (sub)contractors:
  - Design, construction and testing of robotics arm
  - Mechatronics,
  - Automation engineering,
  - Industrial handling

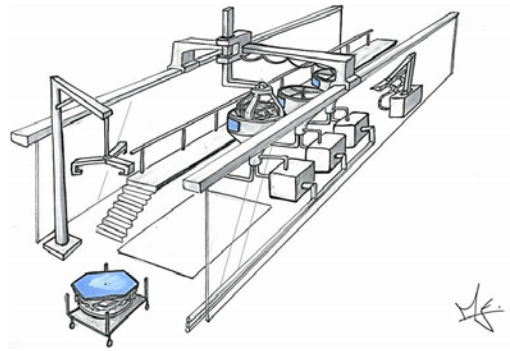


By Mitsubishi for TMT

Washing & Stripping Unit (M1)

- Scope:
  - Design, manufacturing and installation on-site of the washing-stripping units for M1 Segments
- Expected Contract Duration:
  - ~ 2-4 years
- Turn-over: Medium
- Timeline:





✓ RFI	Mar – Apr 2018
➢ PI	Jan 2019
➢ CfT	May 2019
➢ FC Approval	Nov 2019 (TBC)

Washing & Stripping Unit (M1)

- Specialties for potential (sub)contractors:
  - Design, manufacturing and installation on-site of the washing-stripping units for M1 Segments
  - Chemical coating removal
  - Process automation
  - Safety standards

Coarse Metrology and Alignment System

- Scope:
  - Procurement of standard tools and design, fabrication of high-accuracy long-range metrology network to monitor relative positions of telescope mirrors [long-range (tens of m) non-contact, micron-accuracy optical sensing in industrial environment]
- Expected Contract Duration:
  - ~ 3 years
- Turn-over: Low
- Timeline:

Start procurement process	Q4 2019 (TBC)
Closing date	Q2 2020 (TBC)
FC Approval	(TBC)

Cameras for LVSM and CCD220

- Scope:
  - Manufacture, Verification and Delivery of different types of Wavefront Sensing Cameras for Adaptive Optics applications at the ELT
  - The cameras consist of the detector (ESO furnished) and its mount, read-out Front-End board, Main Control board, Power Regulator board, Peltier Controller/Cryostat, main structure and cooling system
- Expected Contract Duration:
  - ~ 2 years
- Turn-over: Low
- Timeline:

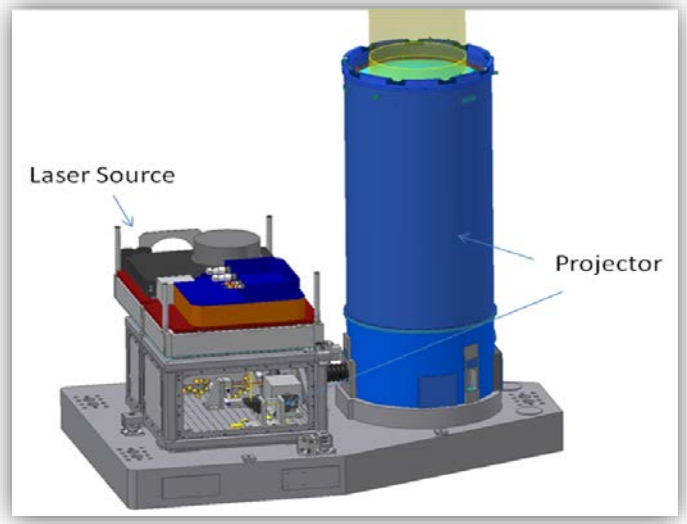
✓ Request For Information	Q4 2018
➢ Release Preliminary Inquiry	Q3 2019
➢ Release Call for Tender	Q4 2019 (TBC)
➢ Closing date	TBD
➢ FC Approval	May 2020 (TBC)

Cameras for LVSM and CCD220

- Specialties for potential (sub)contractor:
  - Manufacturing and testing of small mechanics
  - Manufacturing and testing of low-noise electronics
  - Minimum understanding of optics

Laser Beam Projection Subunits

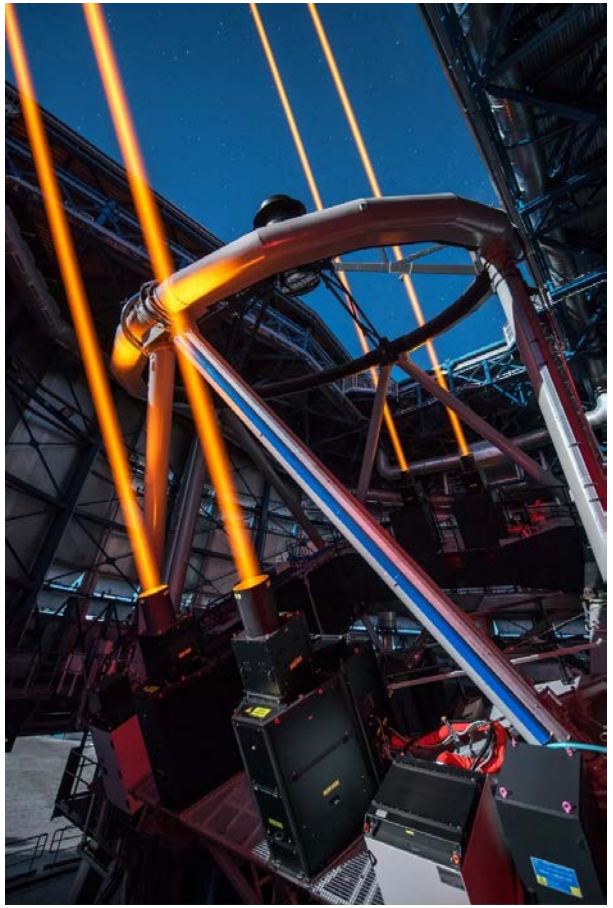
- Scope:
  - Design, fabrication, testing of ~400mm diameter telescope, relay optics, beam steering & focus mechanism
- Expected Contract Duration:
  - ~ 4 years
- Turn-over: Medium
- Timeline:



Request for Information	Q4 2019 (TBC)
Preliminary Inquiry	Q4 2019 (TBC)
Release Call for Tender	Q1 2020 (TBC)
Closing date	Q2 2020 (TBC)
FC Approval	Nov 2020 (TBC)

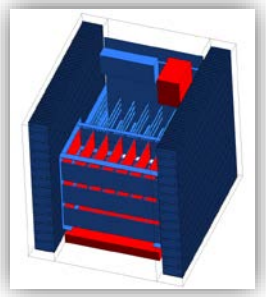
Laser Beam Projection Subunits

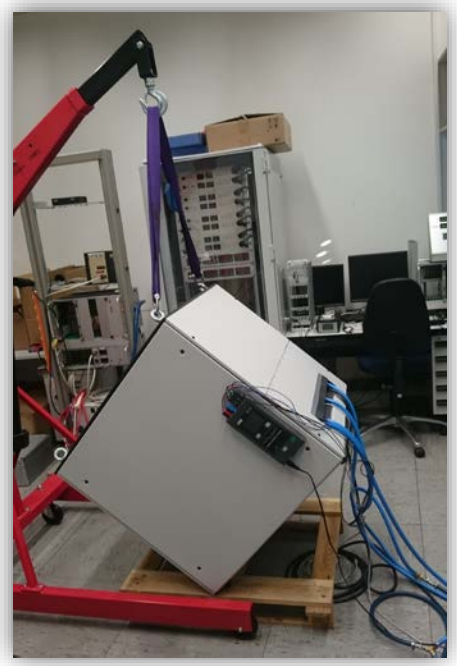
- Specialties for potential (sub)contractors:
  - Large precision optics and mechanisms and athermalisation
  - Polarisation analysis
  - Optical and mechanical alignment
  - Performance verification of large precision opto-mechanical and electro-mechanical systems specified for varying environmental and operational loads (temperature, gravity vector, laser thermal load)



M1 LCS Cabinet Procurement

- Scope:
  - Production of 132 electronic cabinets equipped with cooling heat exchanger, low power supply consumption, front-end electronics for Edge Sensors, PACTS, Warping Harness, COTS components.



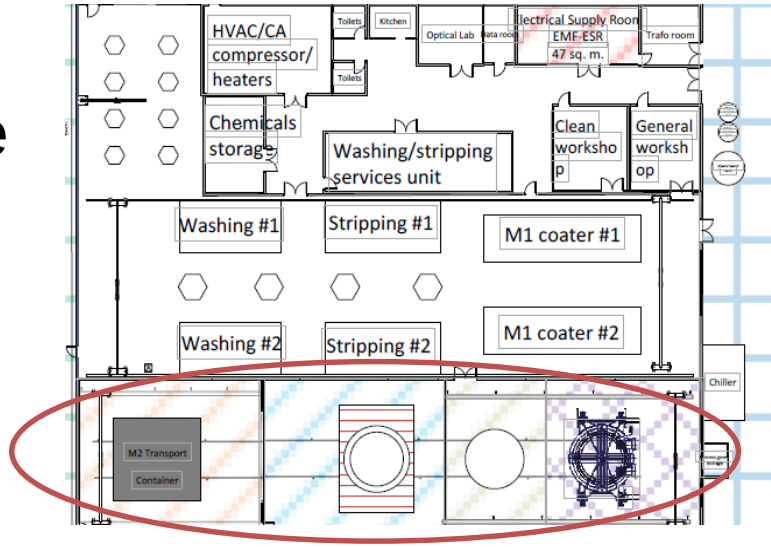


- Expected Contract Duration:
  - ~ 2 years
- Turn-over: Medium
- Timeline:

Release Call for Tender	Q3 2019
Closing date	Q4 2019
FC Approval	May 2020

Coating Unit (5m)

- Scope:
  - Design, manufacturing and installation on-site of the coating unit for the large mirrors (M2, M3, M5, M6)
- Expected Contract Duration:
  - ~ 2 years
- Turn-over: Medium
- Timeline:



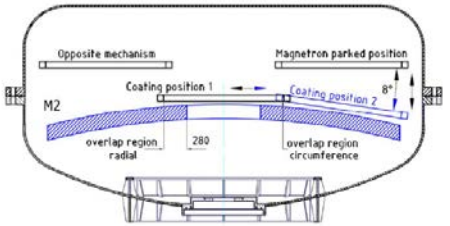


Figure 2. M2 coating/cleaning positions

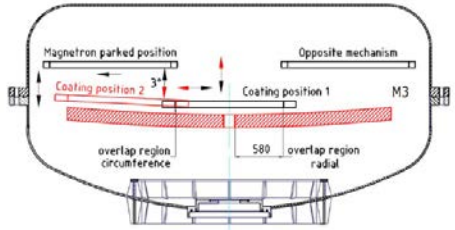


Figure 3. M3 coating/cleaning positions

Release Call for Tender	Q2 2020
Closing date	Q3 2020
FC Approval	Nov 2020

Coating Unit (5m)

- Specialties for potential (sub)contractors:
  - Design, manufacturing and installation on-site of coating units for 4m class mirrors
  - Control systems
  - Thin-film coating technologies
  - vacuum system (pumps)

Network Infrastructure

- Scope:
  - Supply of network devices hosted in Computer room (multilayer data center switches) and in the SCP-B cabinet (ruggedized industrial switches)
- Expected Contract Duration:
  - ~ 3 years (+2 years possible extension)
- Turn-over: Low-Medium
- Timeline:

Release Call for Tender	Q1 2020
Closing date	Q2 2020
FC Approval	Nov 2020

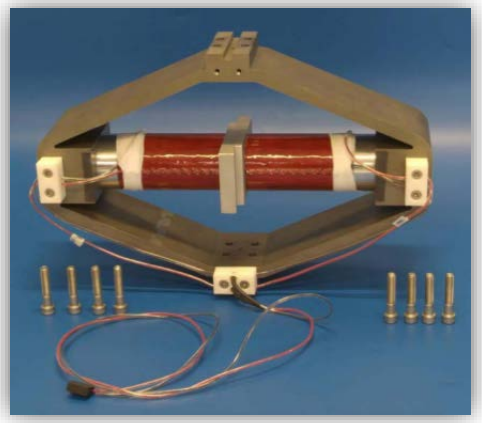
Real Time Control (RTC) Infrastructure

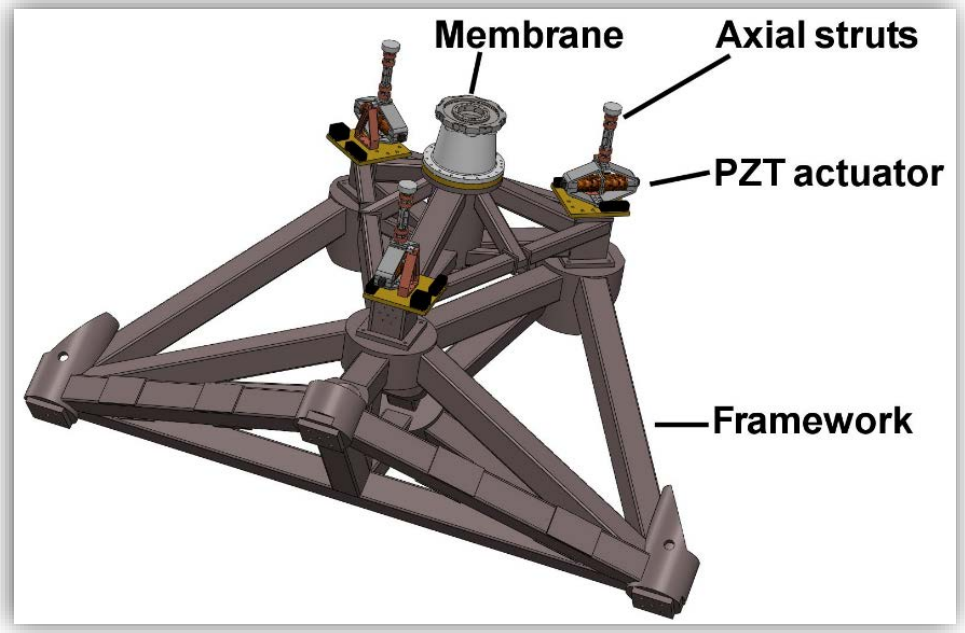
- Scope:
  - Design & development of high performance computing cluster for reliable & deterministic computation of Adaptive Optics corrections to M4 and M5
  - Delivery: High Performance computing cluster
  - HW, SW & network infrastructure
- Expected Contract Duration:
  - ~ 3 years
- Turn-over: Low
- Timeline:

Release Call for Tender	TBD
Closing date	TBD
FC Approval	May ‘21

M5 Cell – CfT closed, but…

- Specialties for potential (sub)contractor:
  - Design, manufacture & testing of fast tip-tilt actuators
  - Fast nanometer-precision frictionless actuators and tip-tilt mechanism (Piezo, Flex pivot, stiff structure)
  - Cutting-edge dynamic control system technology





Plan for 2019-2020 (Large Procurements)

Description of Work	Forecast FC Approval Date
M5 Mirror	February-19
MUSE Type CCD for HARMONI	February-19
CCD220 Detectors for MAORY, MICADO, HARMONI, PFS-A	February-19
M5 Cell	September-19 ✓
M1 Manipulator	November-19 (TBC) ✓
Mirror Washing Stripping unit	November-19 (TBC) ✓
Coarse Metrology and Alignment	November-19 (TBC)
Laser Beam Projection SubUnits	Feb-20 (TBC)
Cameras for LVSM, CCD220	May-20
Transportation Service Contract	May-20
M1LCS Cabinets Procurement	May-20
Mirror Coating Unit (5m)	November-20
Telescope Test Unit	November-20 (TBC)
Network Infrastructure*	November-20
M1LCS Network infrastructure Equipment*	November-20

Plan for 2019-2020 (Small Procurements)

JOB	Activity Desc.
Common Lift., Handl. and Transp. Equipment	40ton truck heavy duty 6x6 with 100mt Palfinger type crane - Supply
	10ton truck - Supply
Instrumentation Infrastructure	Procurement of lab. equipment for Inst lab - 2020
	Procurement of handling equipment for Inst lab - 2019
M1 Unit	M1 Segment Assembly - Stands
Washing and Coating	Mirror Washing/Stripping unit (5m) Procurement
Supporting Equipment	PAR Supporting Equipment - ETF Chiller Manufacturing
Interlock and Safety	Purchase development environment (GAR) - (TCS-ILS)
ELT Laser Guide Star Units	LGS - Cooling System - Procurement
M1 In-Situ Cleaning Development	Segment Assembly - In situ cleaning Studies

Plan for 2020-2021 (Small Procurements)

JOB	Activity Desc.
Common Lift., Handl. and Transp. Equipment	ELT Road transporters - 3ton Van - Supply
	Forklifts - 2 ton (x2) - Supply
	Forklifts - 5 ton - Supply
	Forklifts - 10 ton - Supply
	Forklifts - 1.5 ton (x2) - Supply
M1 Unit	M1 Cell Auxiliary Sensors
WFRTC	Purchase SW Development Environment - AO app SW

Overview of Specialities involved in Main Procurements

Specialities for potential (sub)contractors

Procurement	Planned FC Approval	Specialities
M5 Cell	Sep'19	• Fast nanometer-precision frictionless actuators and tip-tilt mechanism (Piezo, Flex pivot, stiff structure) • Cutting-edge dynamic control system technology
M1 Manipulator	Sep/ Nov'19	• mechatronics, automation engineering, industrial handling
Laser Beam Projection SubUnits	Nov'19	• Precision opto-mechanics and control, • Lens polishing and laser coating
Mirror Washing Stripping unit	Nov'19	• Chemical coating removal • Process automation • Safety standards
Coarse Metrology and Alignment	Nov'19 (TBC)	• Long-range (tens of m) non-contact, micron-accuracy optical sensing in industrial environment

Specialities for potential (sub)contractors

Procurement	Planned FC Approval	Specialities
Cameras for LVSM, CCD220	May'20	• Manufacturing and testing of small mechanics • Manufacturing and testing of low-noise electronics
M1LCS Cabinet Procurement	Nov'20	• Low-power consumption electronics, power supply, cabinet cooling (heat exchanger), COTS components
Mirror Coating Unit (5m)	Nov'20	• Design, manufacturing and installation on-site of coating units for 4m class mirrors • Control systems • Thin-film coating technologies, • vacuum system (pumps),
Telescope Test Unit (TBC)	Nov'20 (TBC)	• Opto-mechanical design and manufacture • Detectors
Network Infrastructure	Nov'20	• Network components (Routers, Switches, Firewall, WLAN Controller, etc.)
M1LCS Network infrastructure Equipment	Nov'20	• network devices including multilayer data center switches • ruggedized industrial switches.


Thanks for you attention!