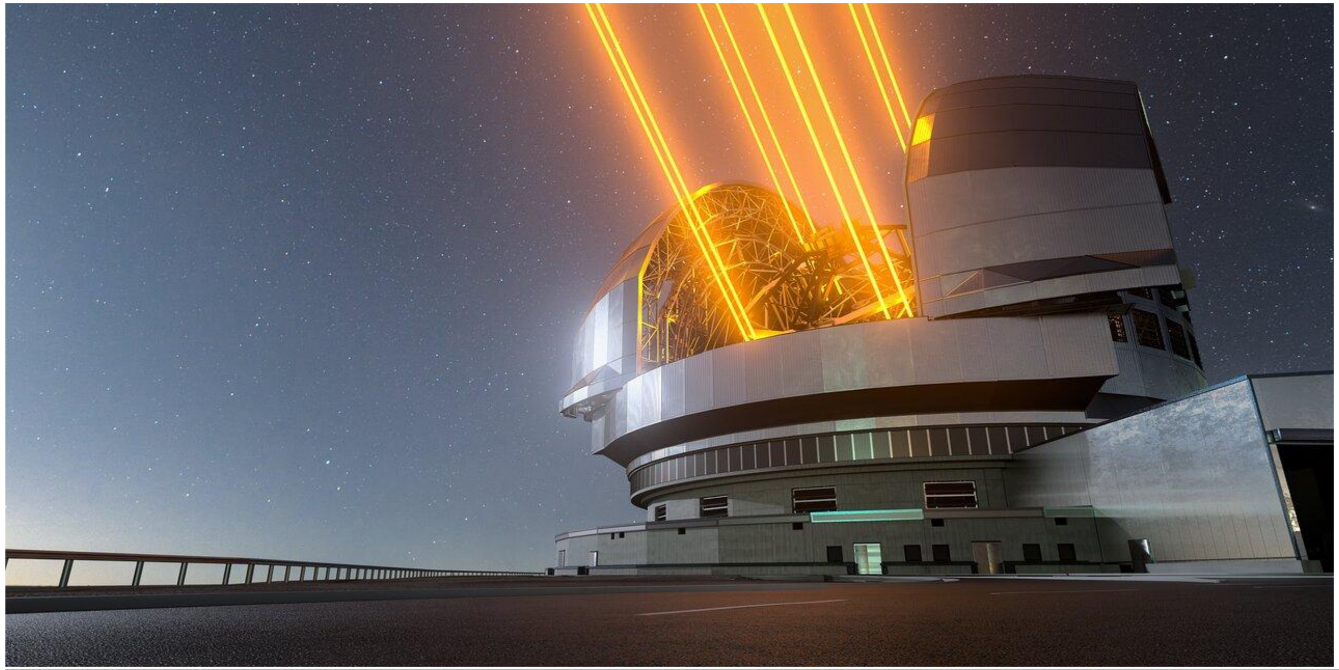
ELT Construction Programme

Fabio Biancat Marchet ELT Programme Engineer

IDEA 2026 workshop

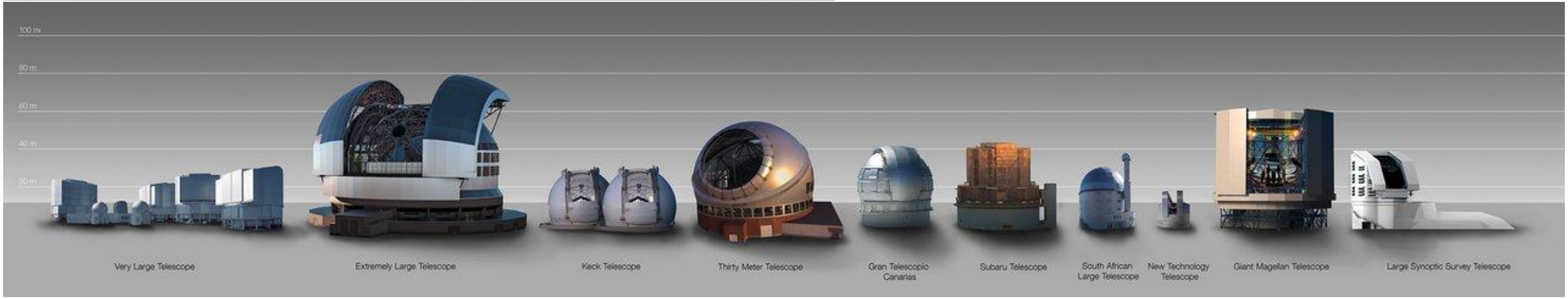
12 August 2025

The ELT



Will be the **largest optical/infrared telescope** ever built or planned

The most powerful telescope of the new generation, the only one with secured funding, and the most advanced in its construction



The ELT

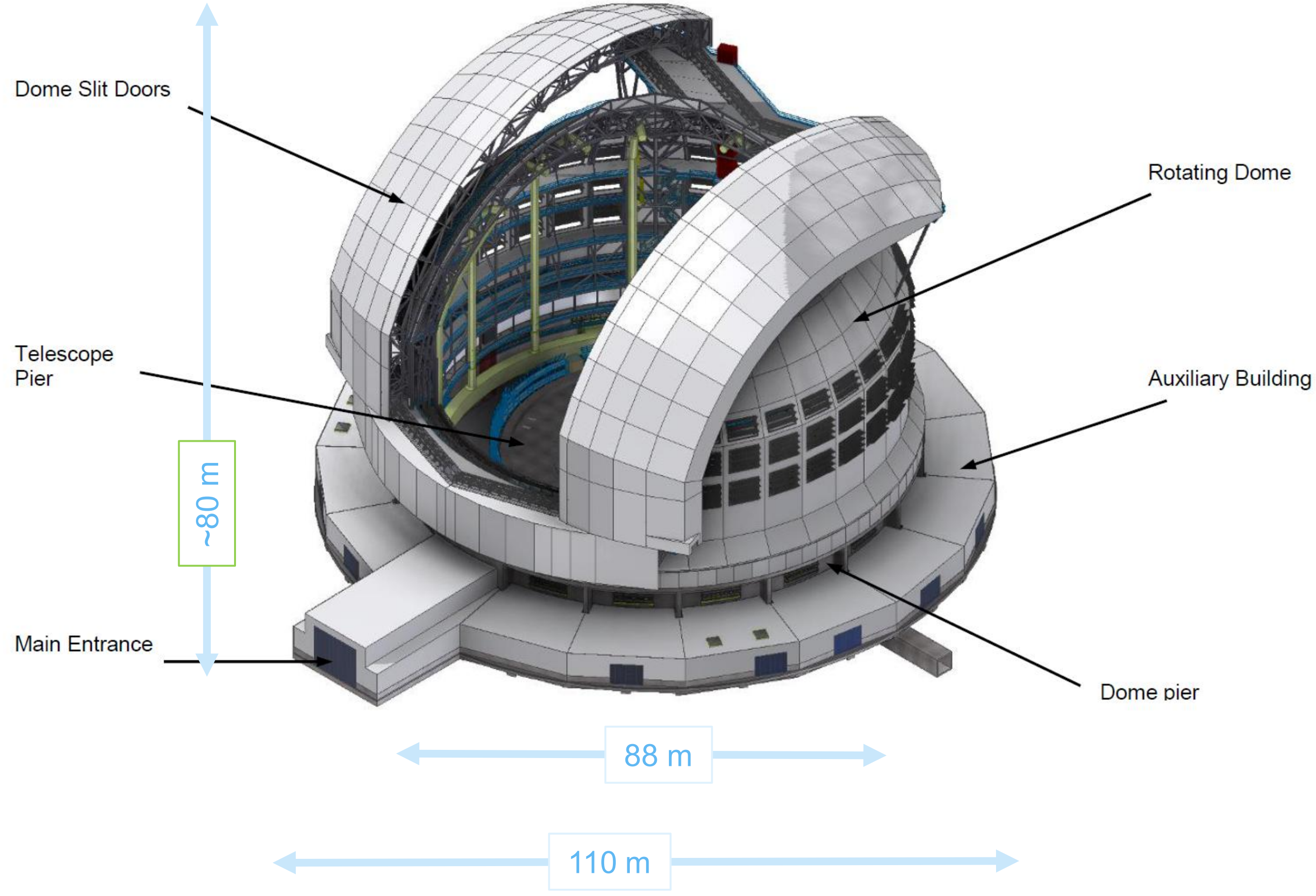
Is being built on Cerro Armazones in the Chilean Atacama Desert, at 3046 metres altitude and just 23 kilometres from the site of ESO's Very Large Telescope (VLT) at Paranal

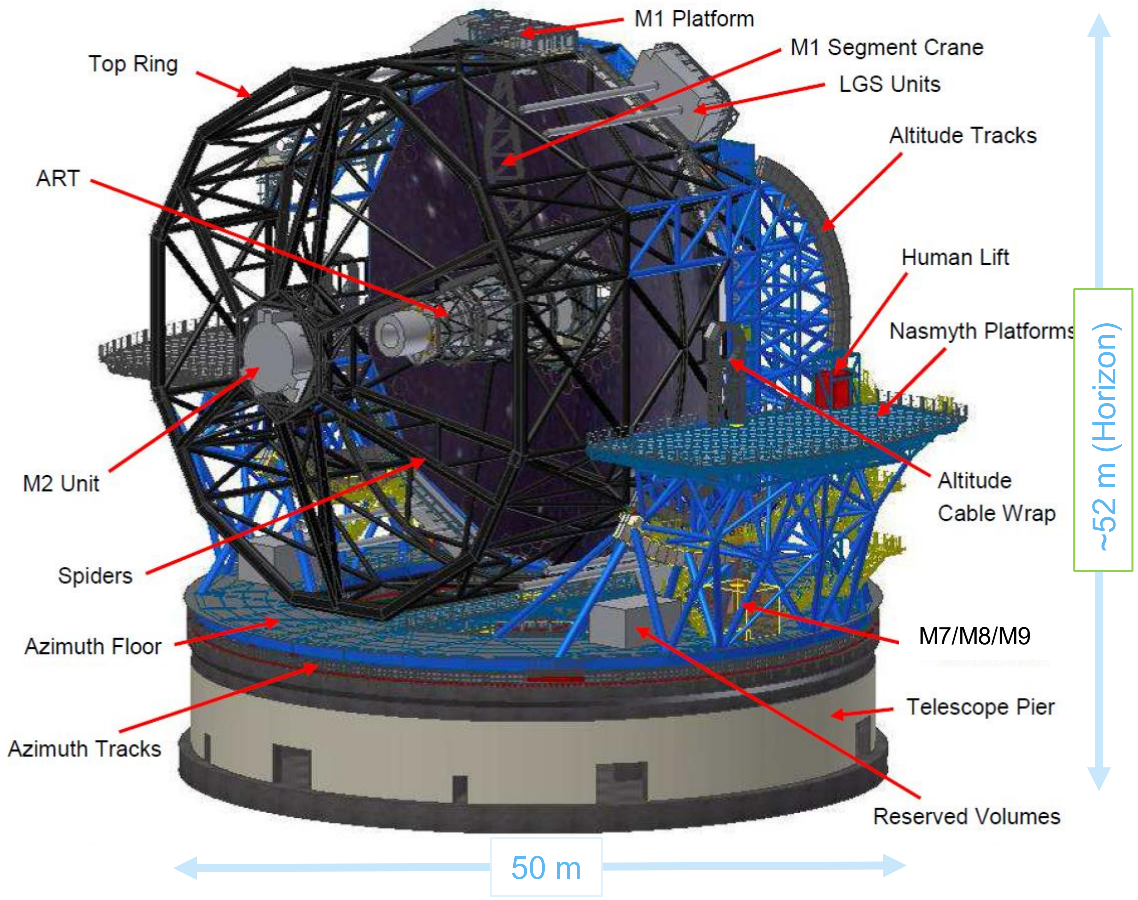
Construction 2014-2030 (**~1500 MEUR)**

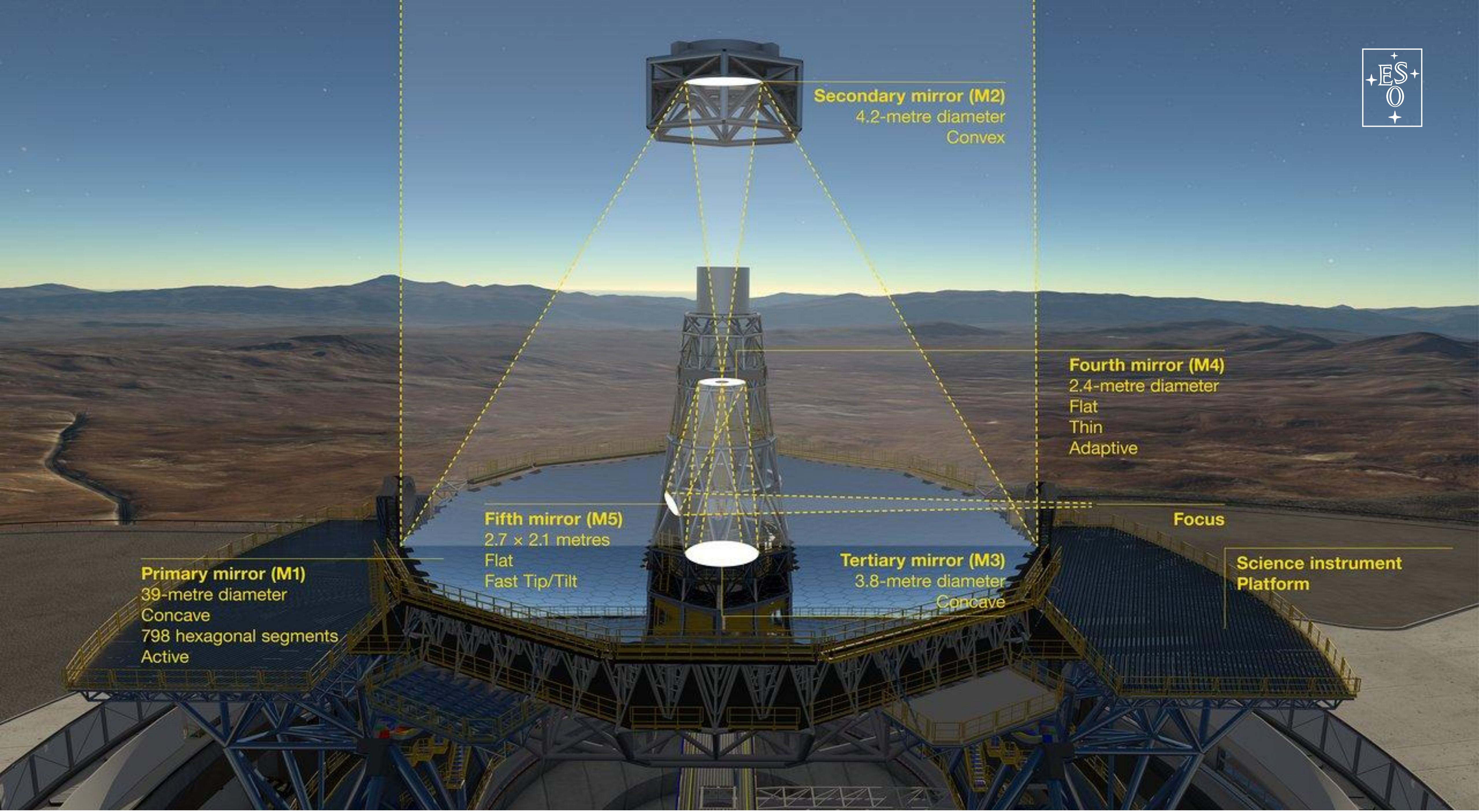
First scientific light by the end of 2030

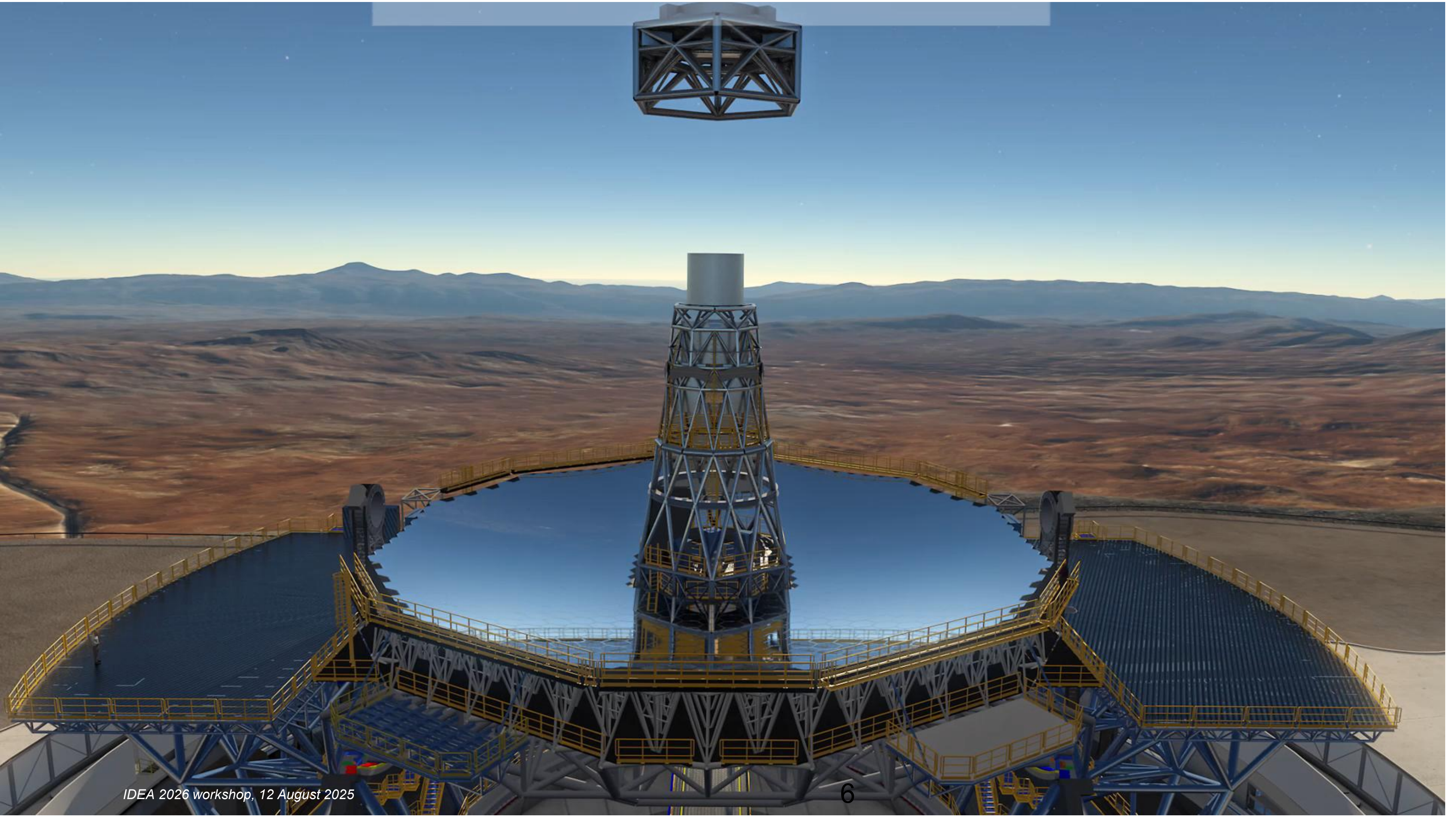
For details and updated status, visit elt.eso.org

Dome & Main Structure (DMS)



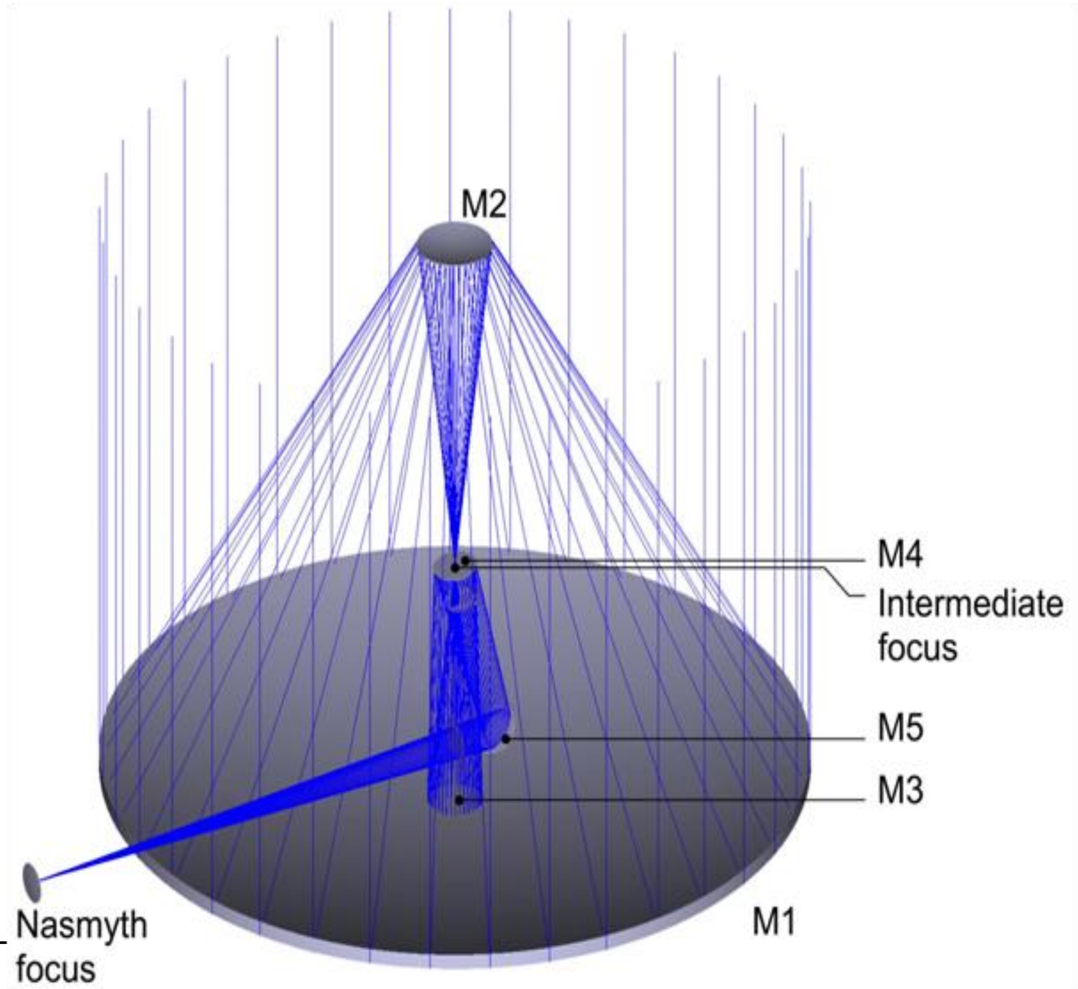



Secondary mirror (M2)
4.2-metre diameter
Convex
Fourth mirror (M4)
2.4-metre diameter
Flat
Thin
Adaptive
Fifth mirror (M5)
2.7 × 2.1 metres
Flat
Fast Tip/Tilt
Focus
Primary mirror (M1)
39-metre diameter
Concave
798 hexagonal segments
Active
Tertiary mirror (M3)
3.8-metre diameter
Concave
Science instrument
Platform



ELT Optomechanics

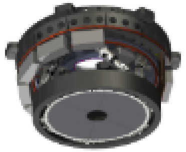
Ultimate purpose: bring the light to the detector with wavefront error << wavelength ~ 100nm (H atom radius ~0.1nm)



M1 mirror (segmented)
39-m
Concave – Aspheric f/0.9
Segmented (798 Segments)
Active + Segment shape Control

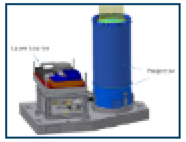
M2 Unit
4-m
Convex Aspheric f/1.1
Passive + Position Control

M3 Unit
4-m – Concave – Aspheric f/2.6
Active + Position Control



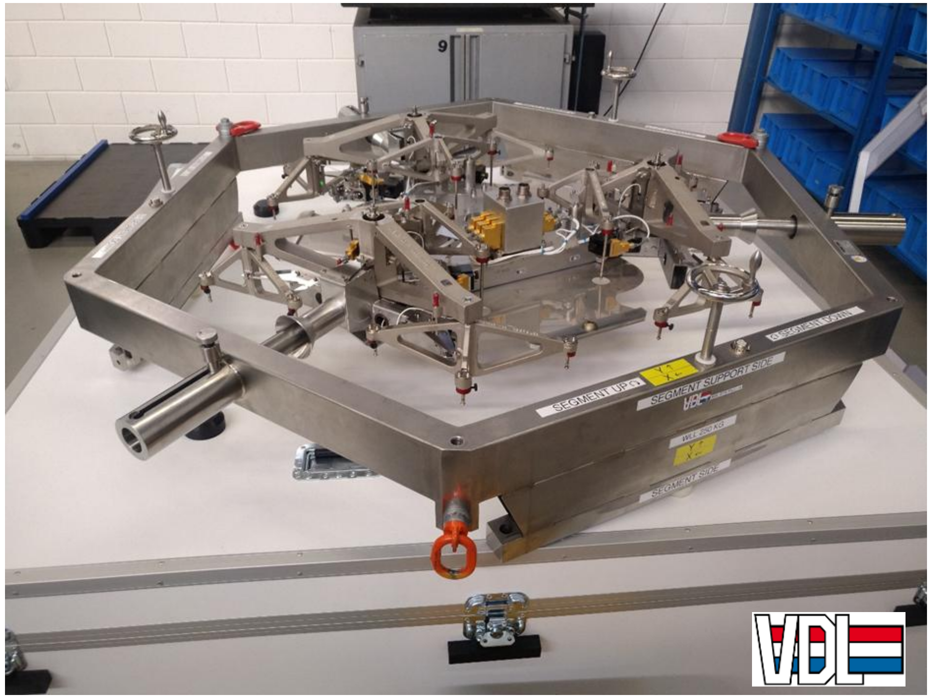
M4 mirror (deformable)
2.4-m
Flat
Segmented (6 petals)
Adaptive + Position Control

M5 mirror (SIC, fast Tip-Tilt)
2.7x2.1-m
Flat
Passive + Fast Tip/Tilt



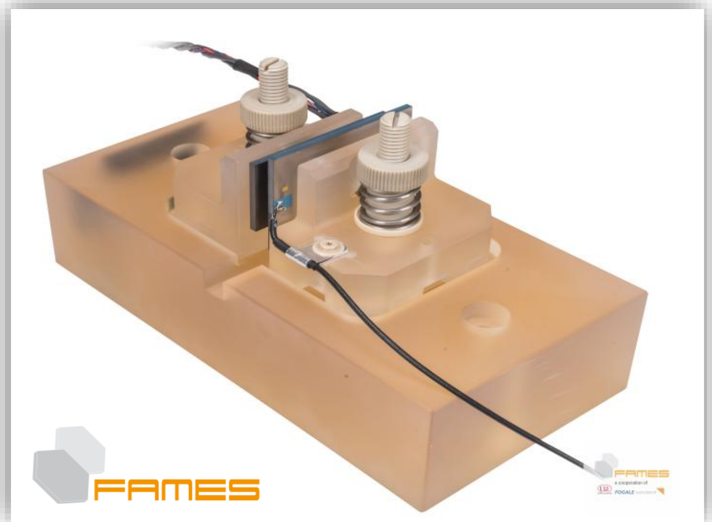
LGSU
(Laser Guide Star Units)
High Energy continuous Laser Sources +
Laser Beacons shaping and emitting

M1 Segment Assembly (~792)
Each segment: 3 actuators and 6 sensors



Segment supports: 792

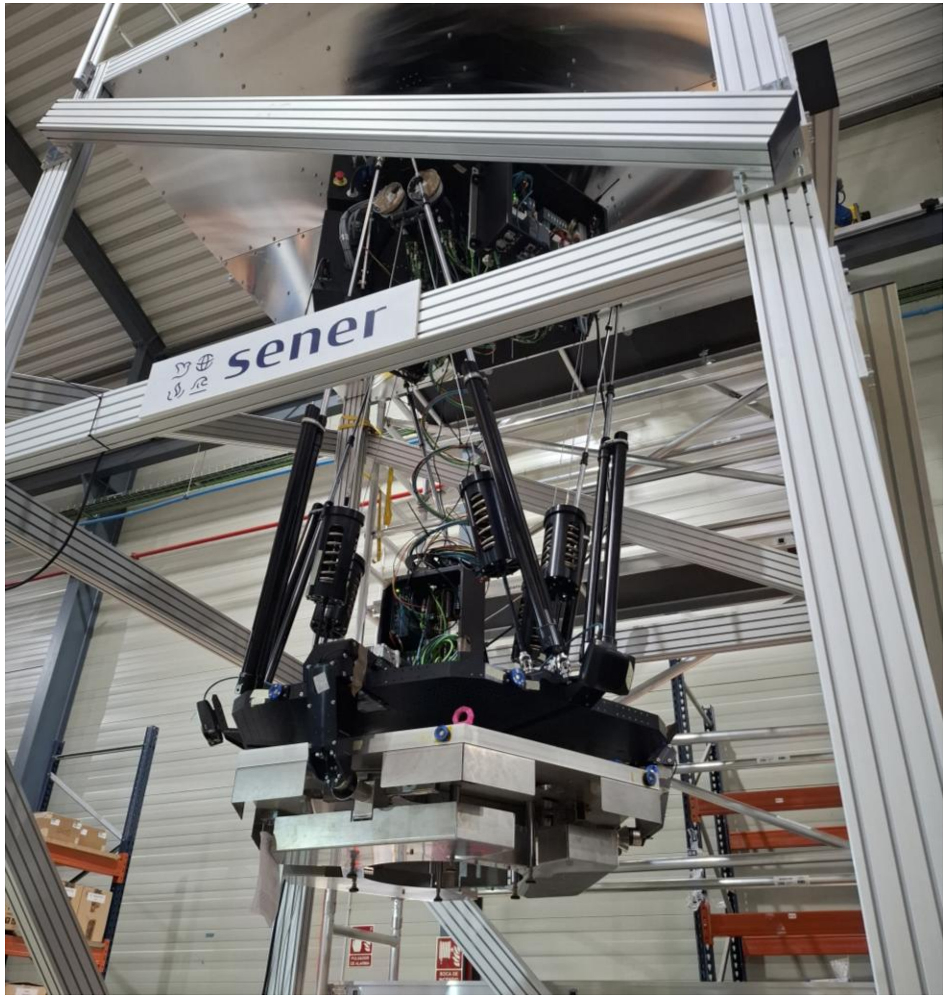
Position acutators: 792x3
Range 10mm, resolution 0.1nm
BDC motor + piezo actuator



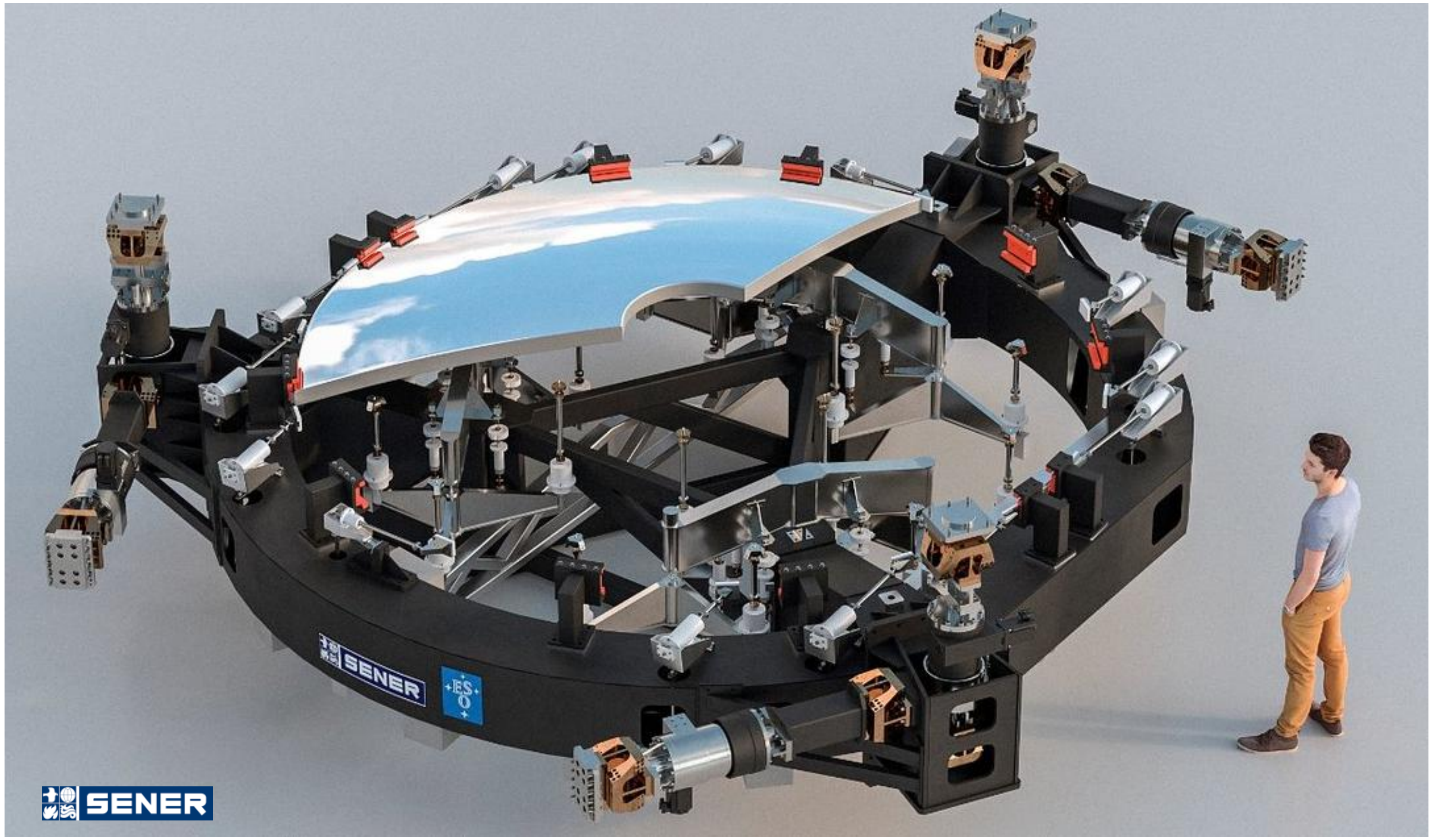
Edge sensors (TX-RX): 792x6
Inductive, narrow-band (~80kHz)
Resolution 0.1nm

M1 Segments Manipulator

No direct human access to the M1 segments
The manipulator will be the only means allowing to replace 2 segments/day (to be re-coated)



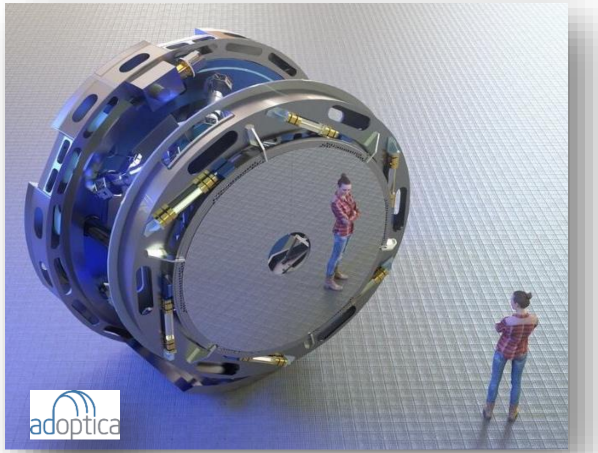
M2 and M3, mounted on steerable cell

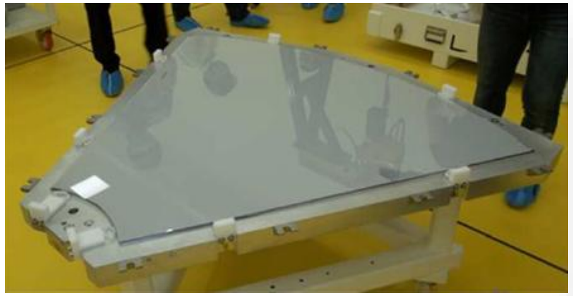


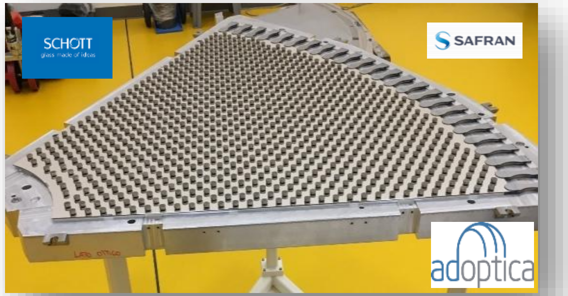
The M4 Adaptive Optics Unit

The world largest Adaptive Optics Mirror

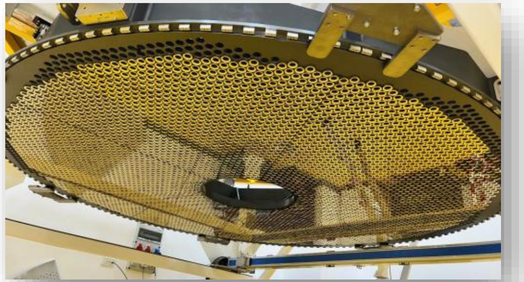
- Thin mirror shell: Φ2.4m diameter (6 sectors),1.95mm thick only!
- >5000 voice coil actuators & capacitive sensors; 1kHz control;
- SiC Reference Body
- FPGA High speed (70kHz) distributed control
- Actively cooled by liquified gas





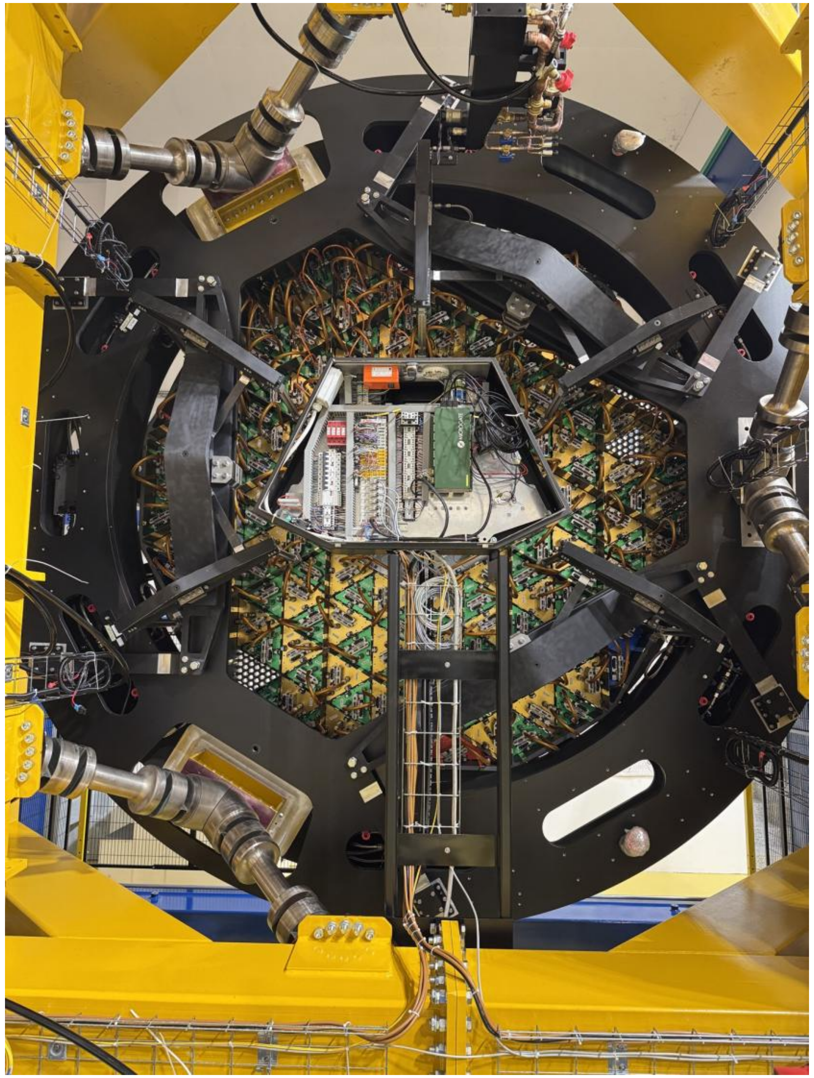


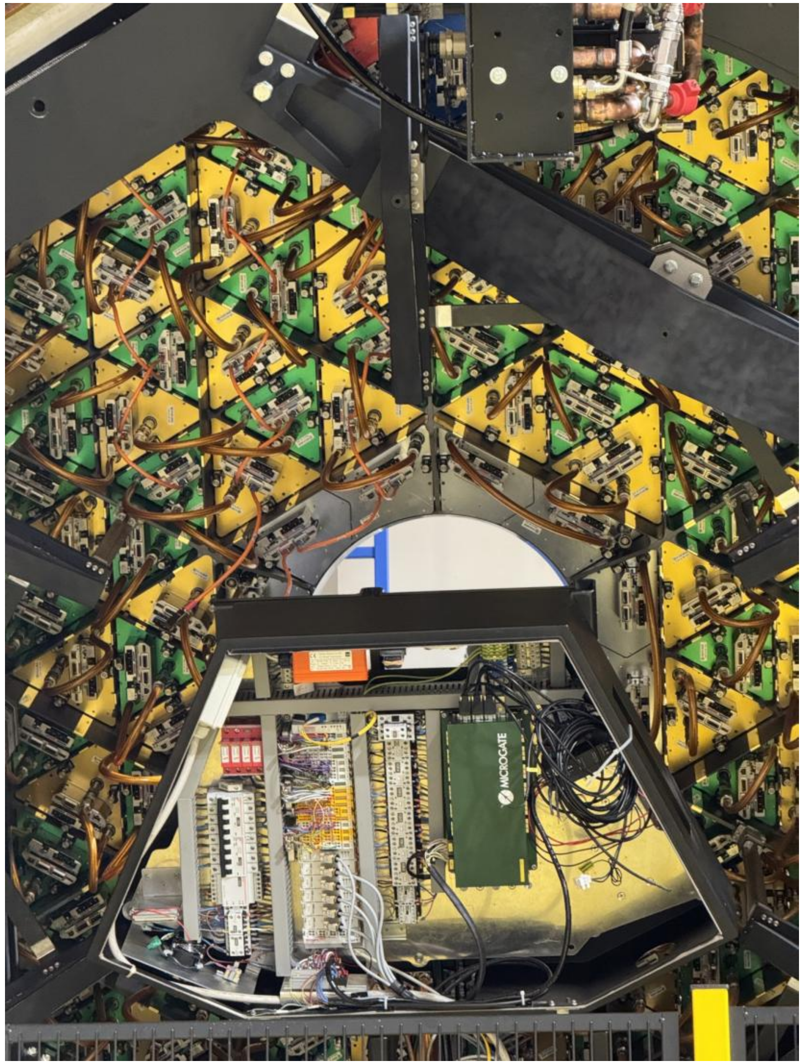
The ELT M4 Actuator Bricks production and testing

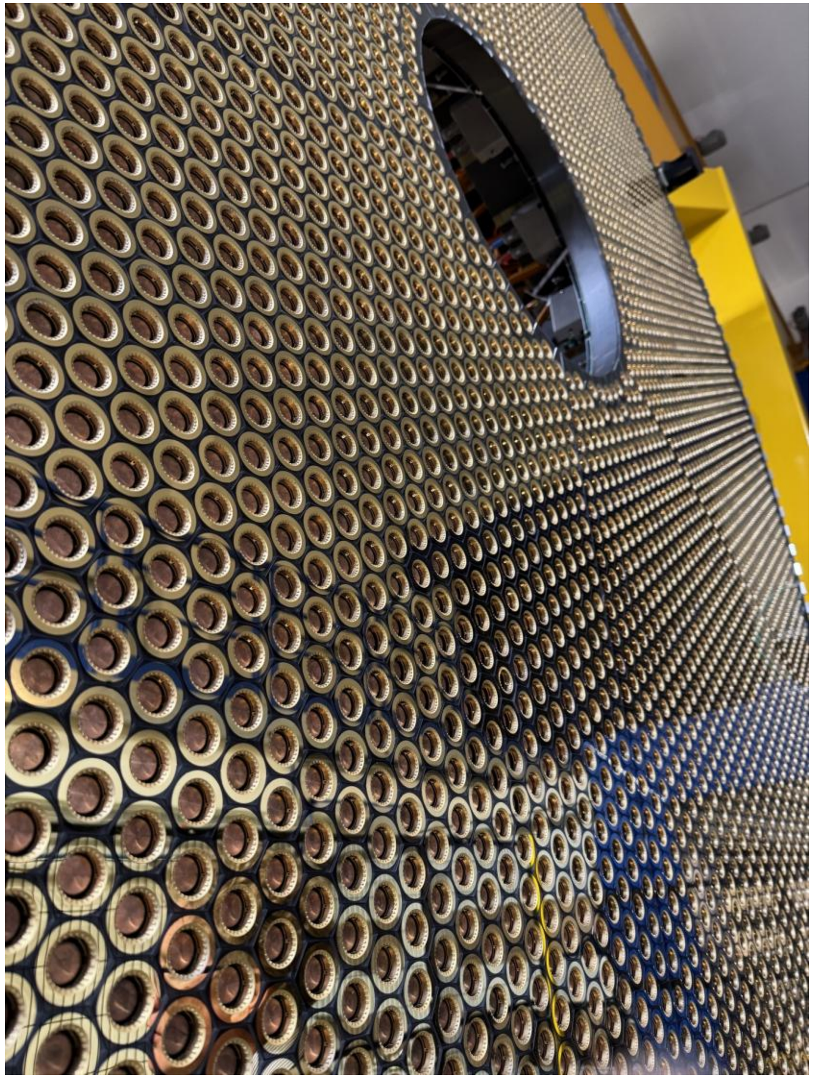


adoptica = MICROGATE + A.D.S. International

M4 Mirror installed in its stand at Microgate



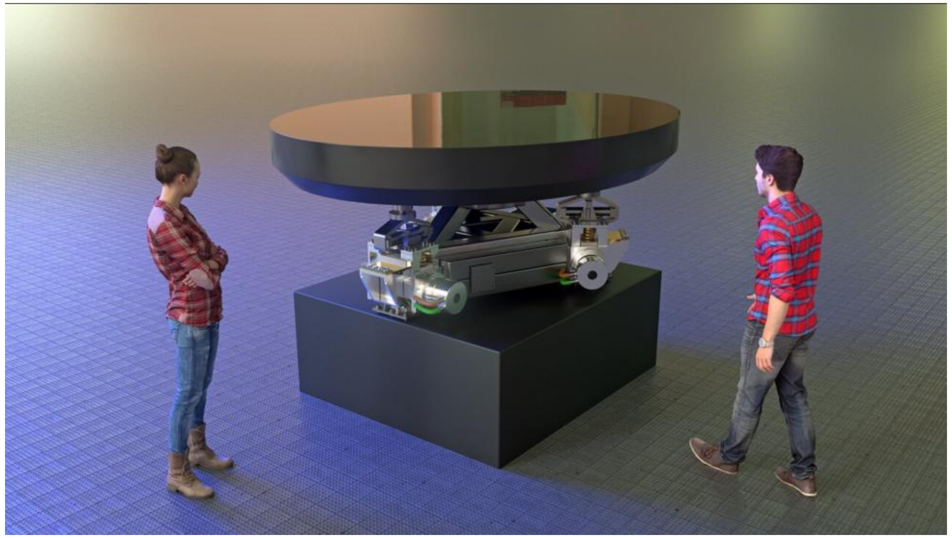


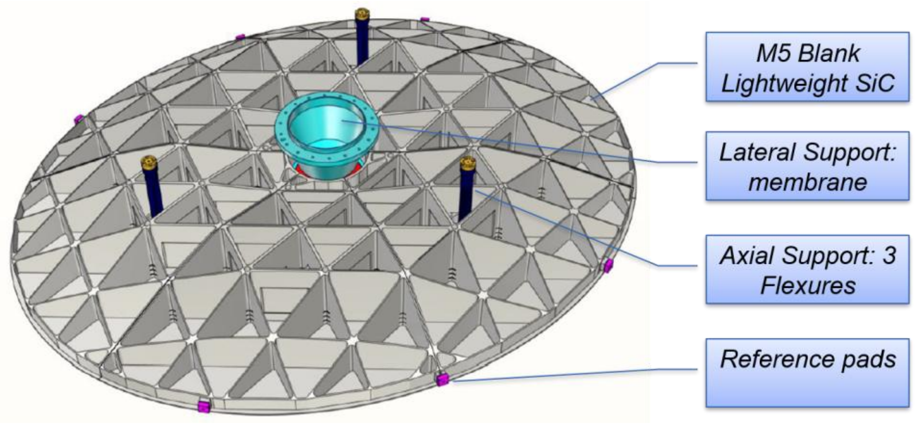


M5 Unit

Flat, fast Tip-Tilt (~10Hz): lightweight, SiC

Moved by strong, long range High Voltage Piezo actuators



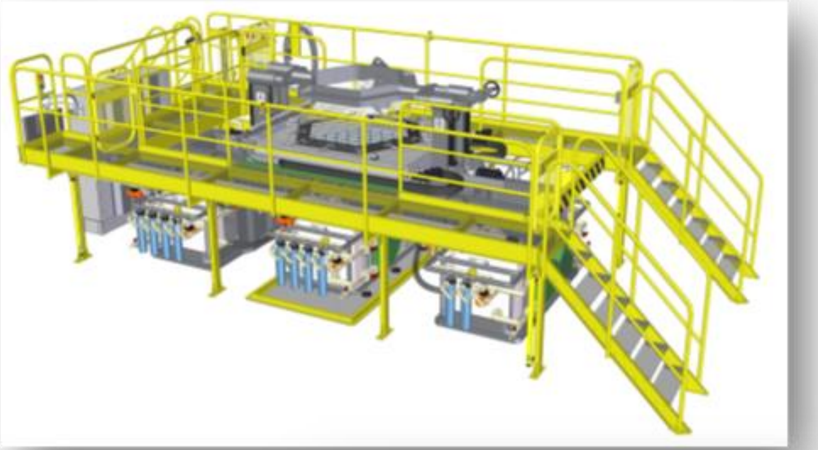


Scale 1 Prototype Unit

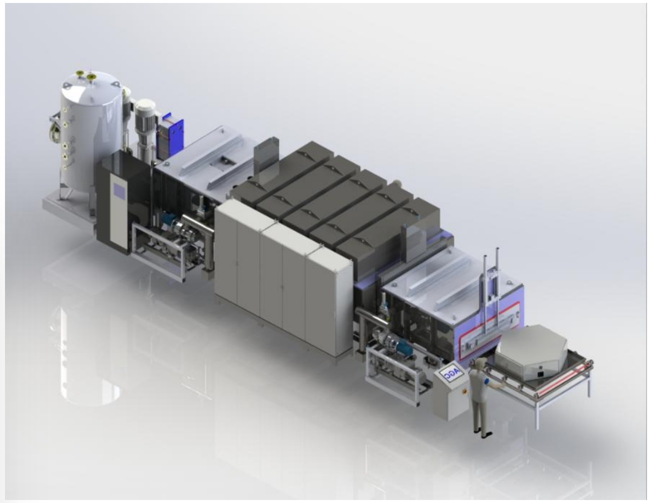
Mirrors Processing

The coating degrades with time, mirrors need to be re-coated periodically (1.5-5 years)

First stripped to remove the old coating



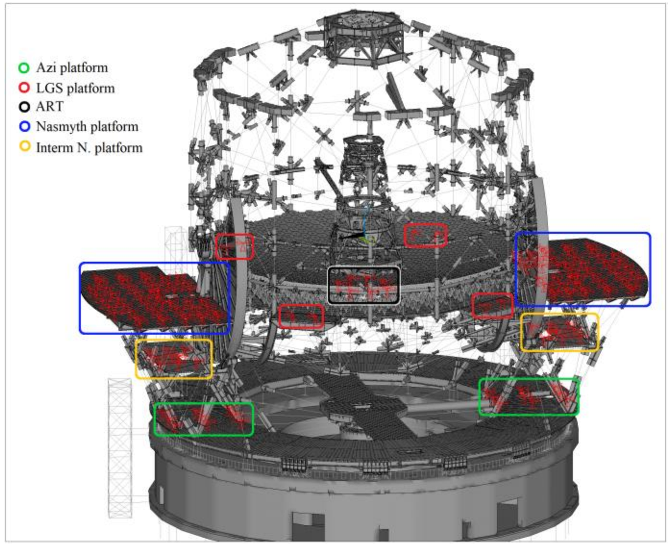
Then coated

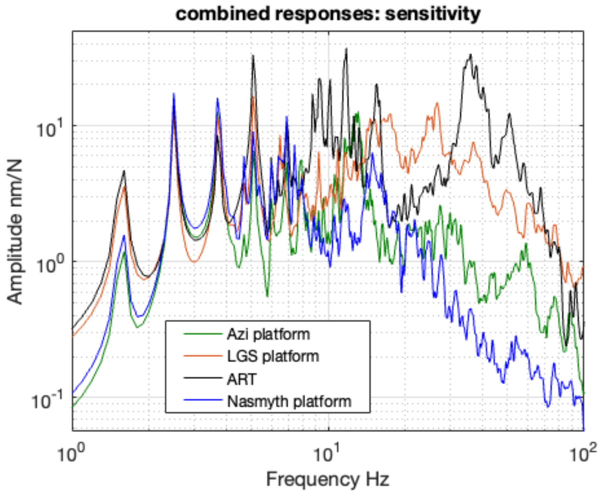


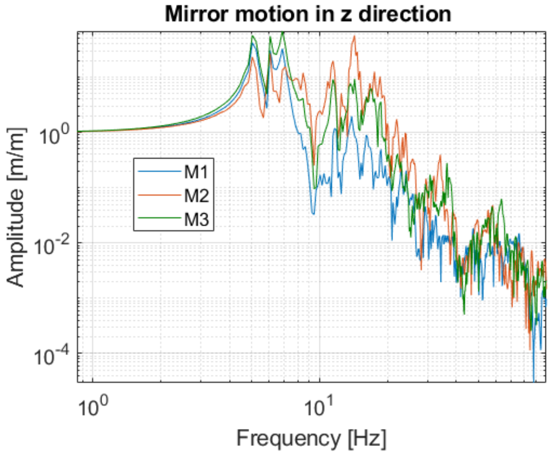
This represents a major overhead, extending the duration of the coating by "in situ cleaning" would reduce down time and costs. Investigations to identify suitable solutions ongoing

Numerical Analyses – Vibrations

- Dealing with accuracies in the nm range, the overall system is extremely susceptible to vibrations, whose effects the control system can reduce only to a limited extent
- Each vibration source (motors, mechanisms, fans, pumps, etc.) has been modelled, experimentally validated, and the effects on the scientific observations evaluated through numerical model
- Where necessary suitable mitigations have been implemented (active and passive dampers)

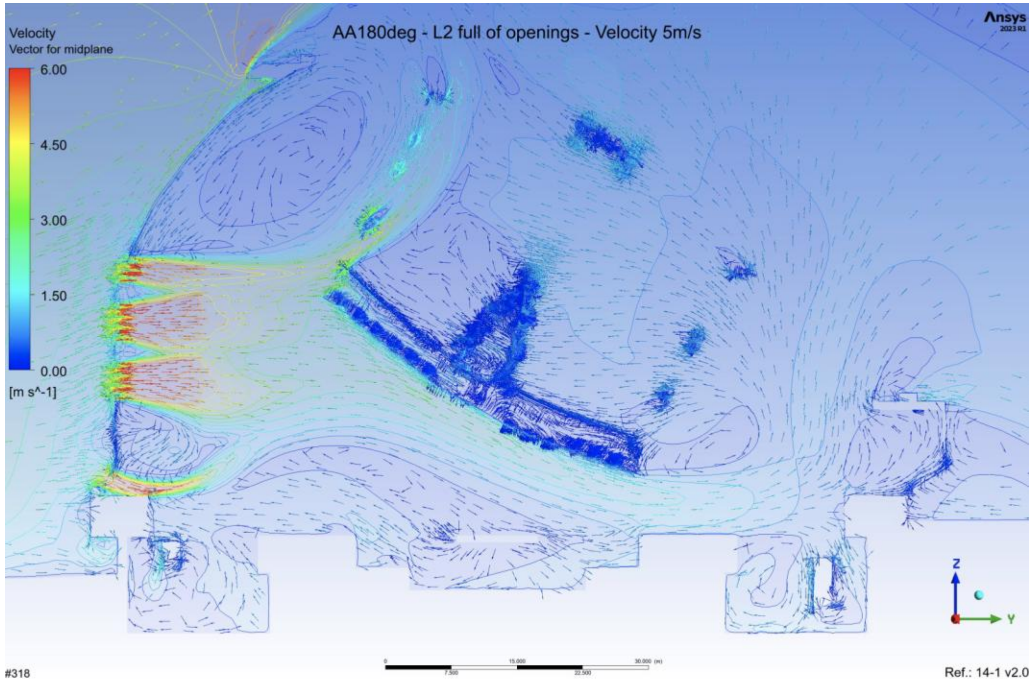


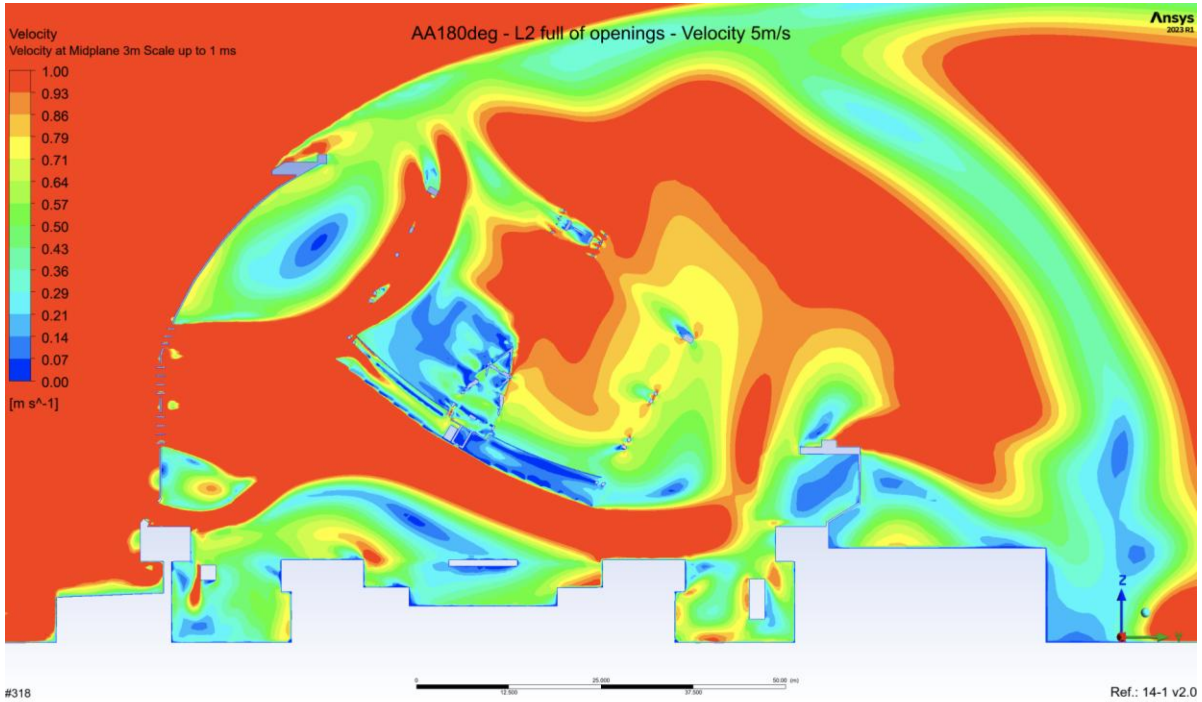




Numerical Analyses – Computational Fluid Dynamics (CFD)

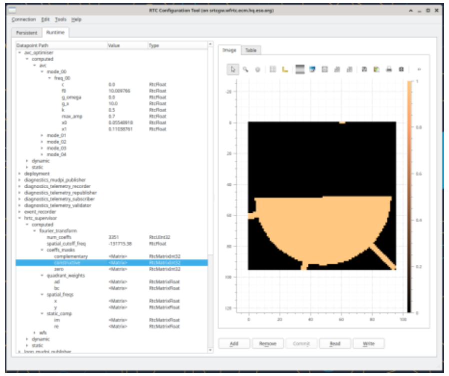
- The air movements caused by temperature gradients in the dome may create perturbations that can hardly be compensated
- To reduce the effects of heat sources and structure subcooling a suitable laminar airflow is required
- Extensive CFD simulations have been executed to identify critical areas and find/evaluate mitigations (for instance louvers design)





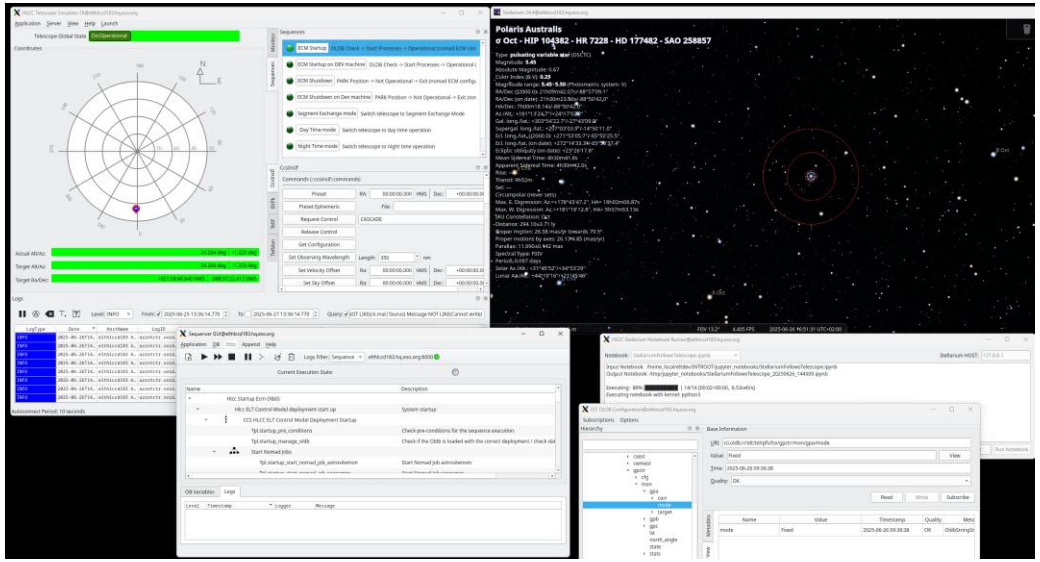
ELT Control System

- The ELT massively relies on the Control System not only for steering the complex system, but also to implement the sophisticated control algorithms
- This requires highly specialized, complex real time software and high-end computing hardware



Central Control System Development

Including platforms for INS and RTC development.



Thank you!

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