# High angular resolution science with the E-ELT

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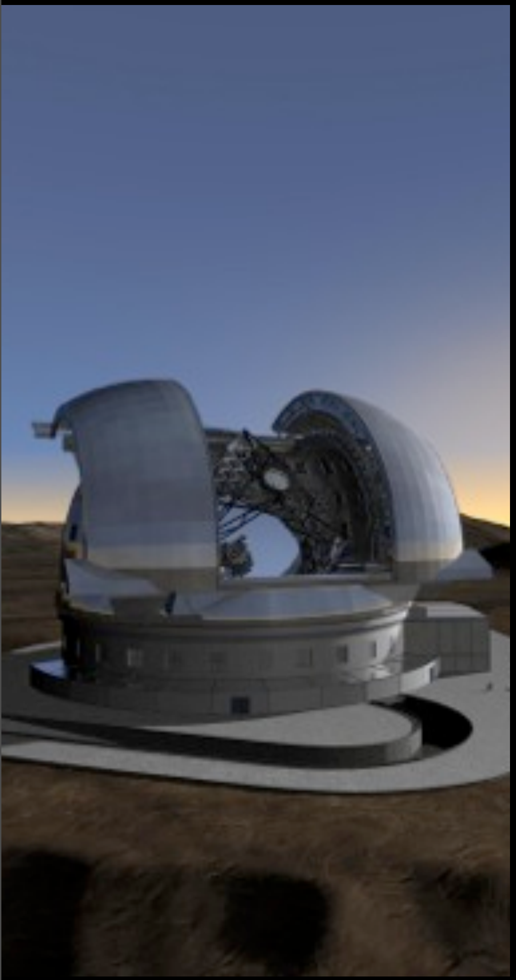
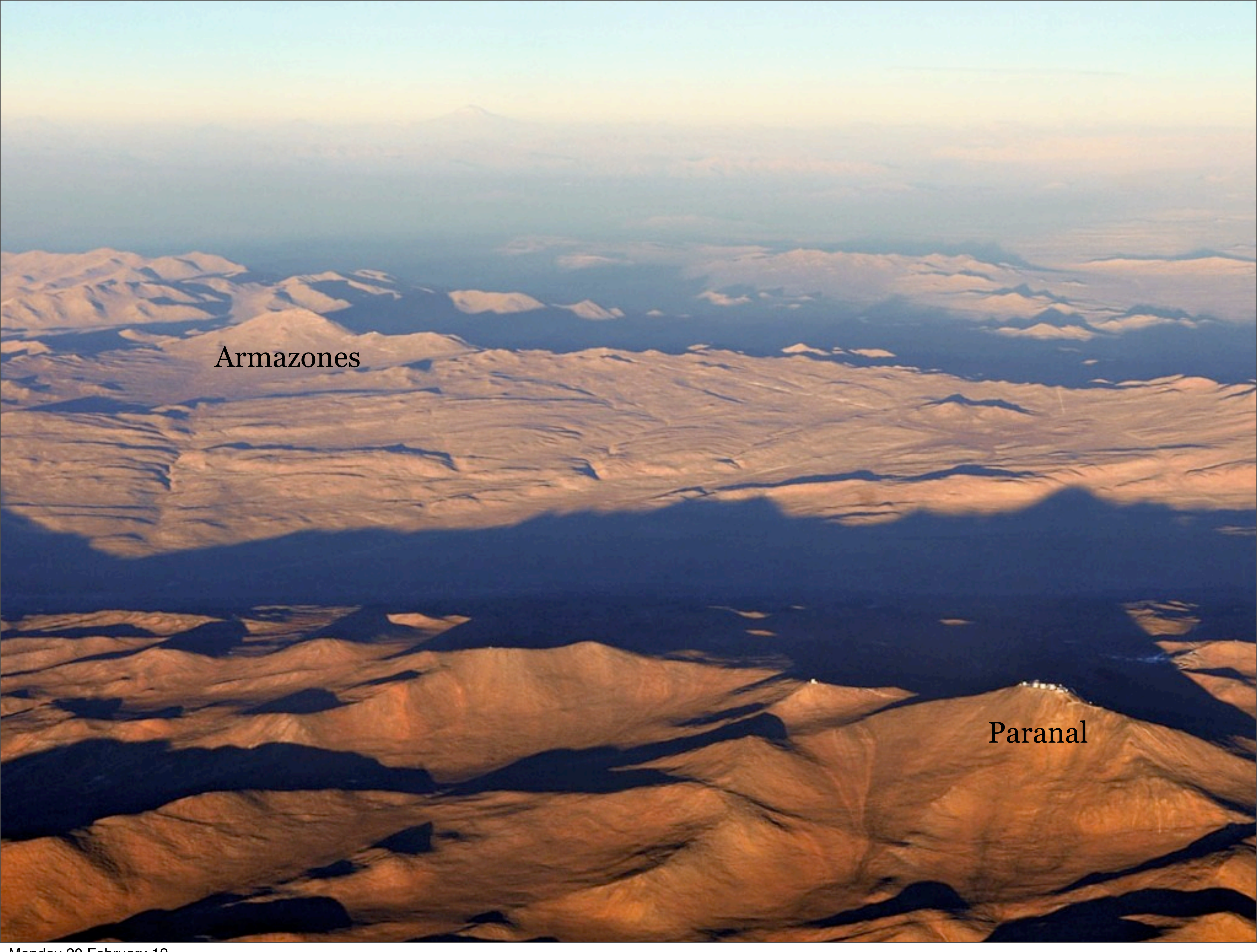
E-ELT Project Scientist

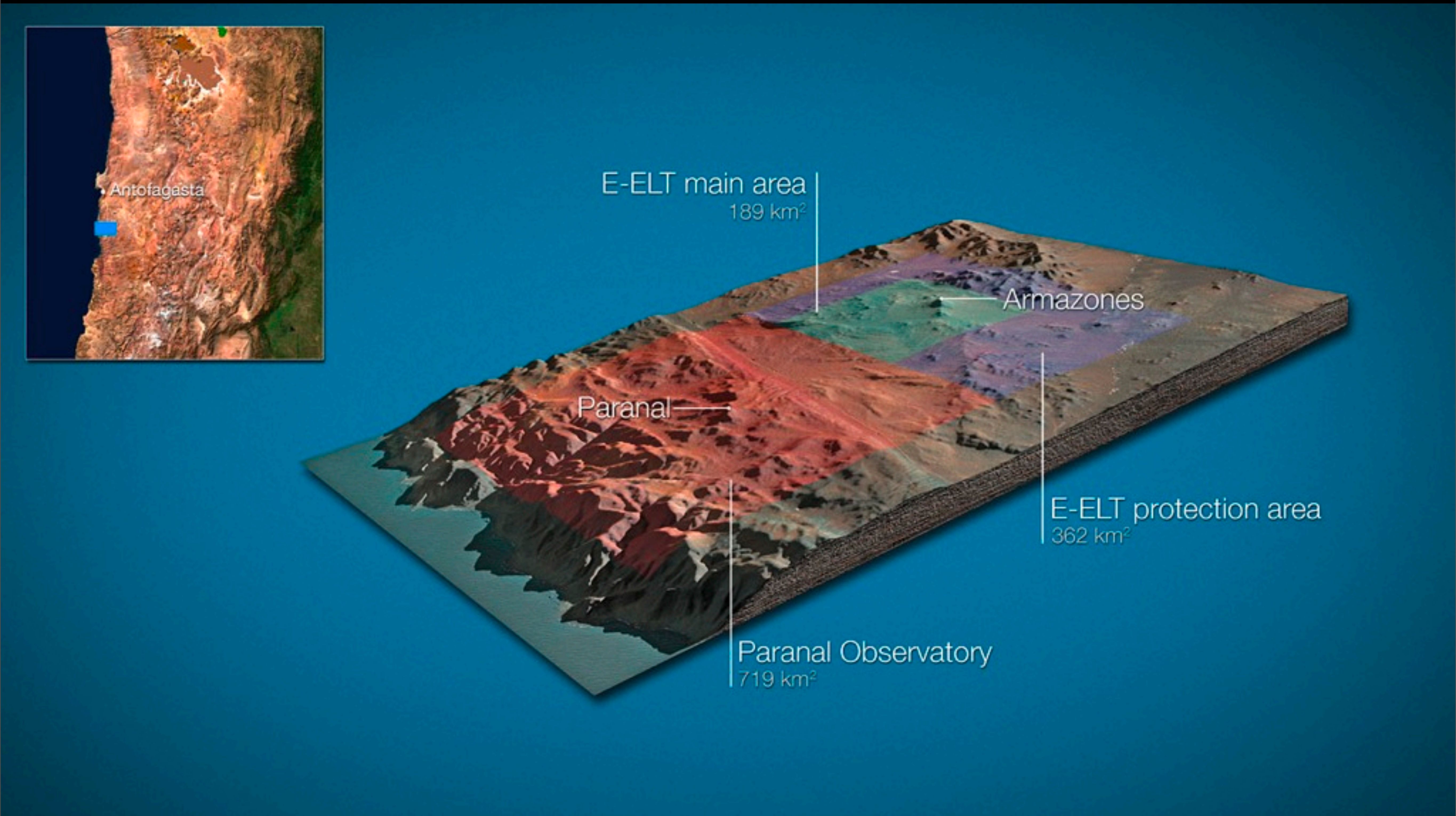
# E-ELT Overview and Status

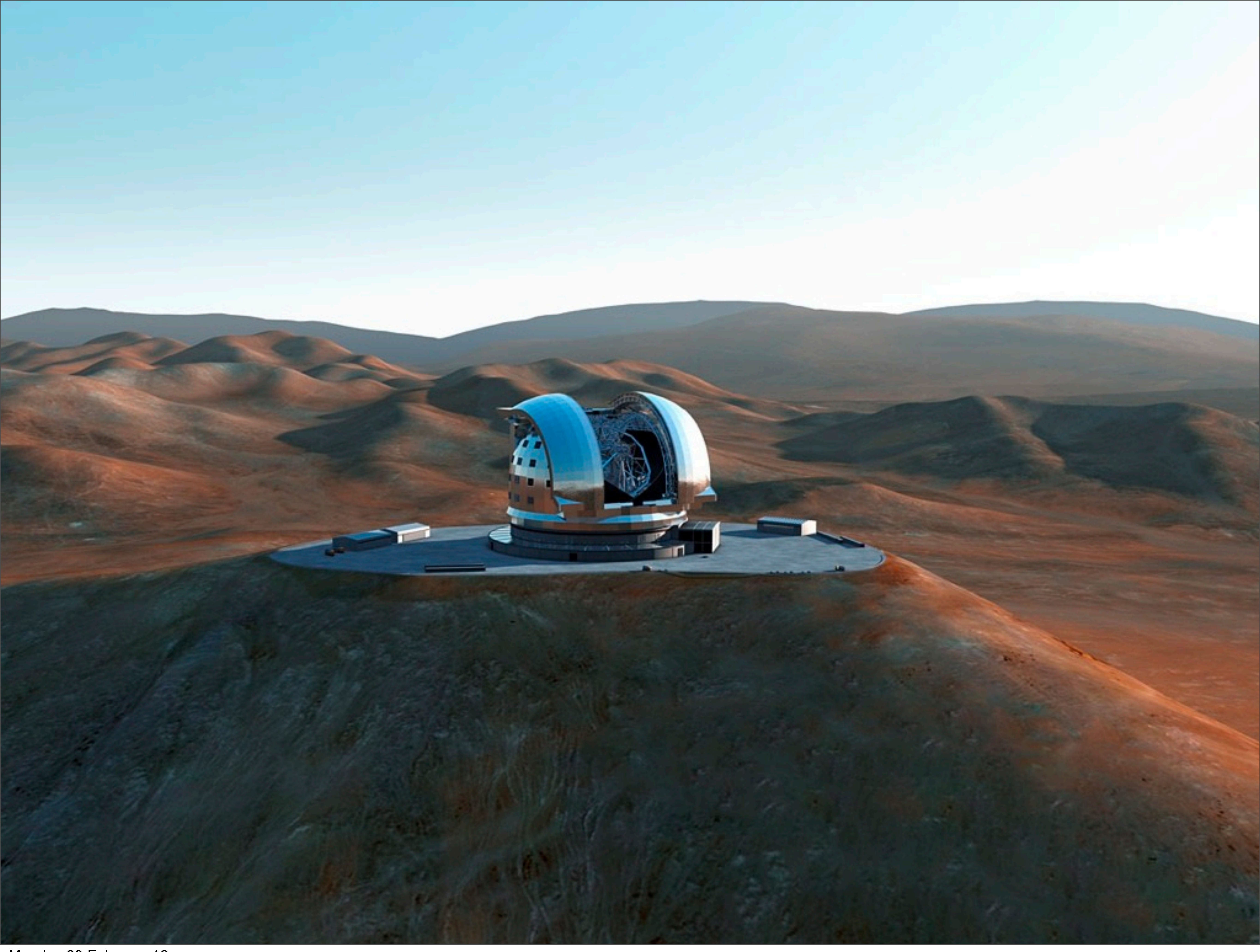
# The European Extremely Large Telescope

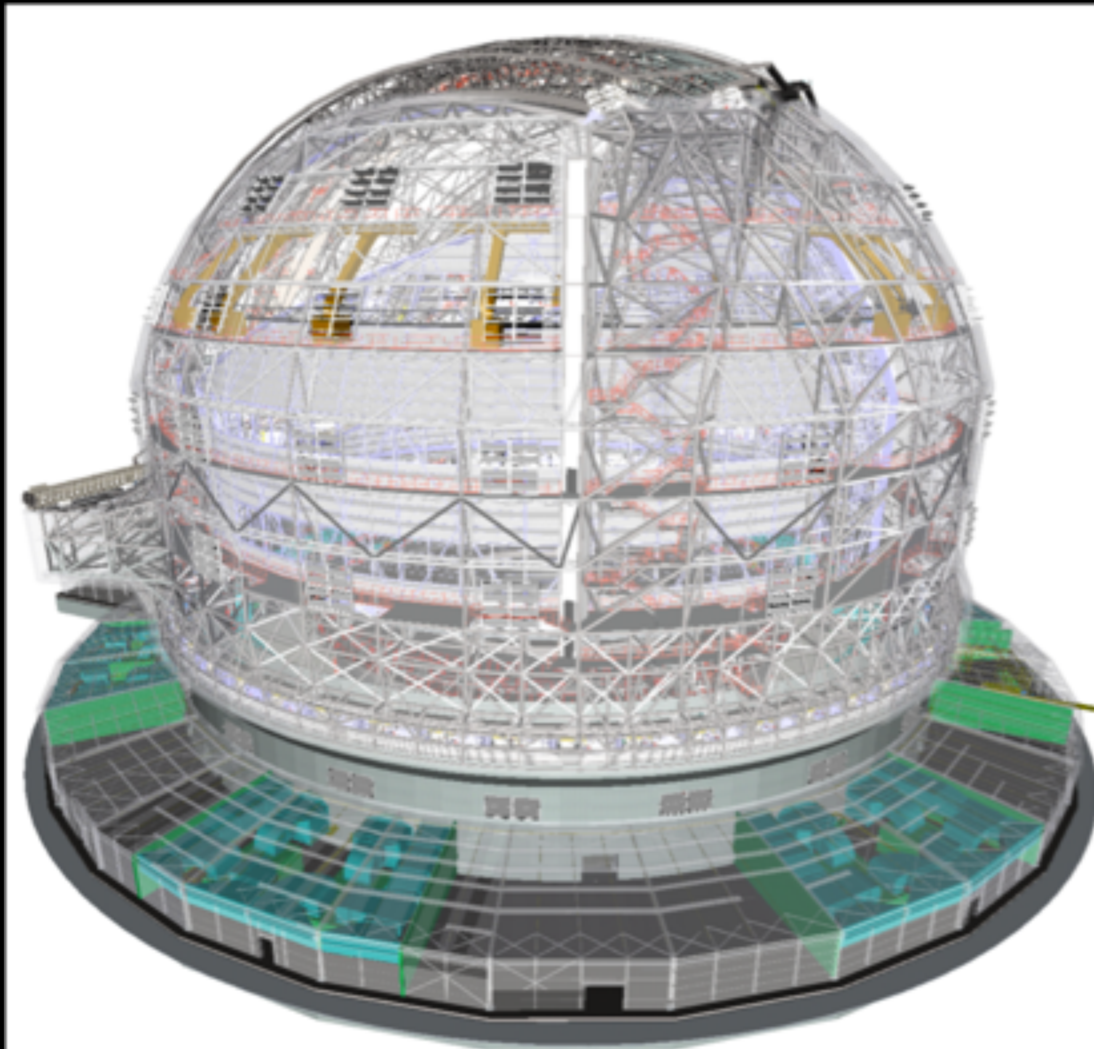


- Most ambitious optical telescope ever built
- Primary mirror of ~40m diameter
- Working at optical / infrared wavelength
- Adaptive optics with 6 lasers - diffraction limited
- Status: Handed in Construction Proposal after the detailed design phase (B)
- Start construction 2012 - first light in 2021

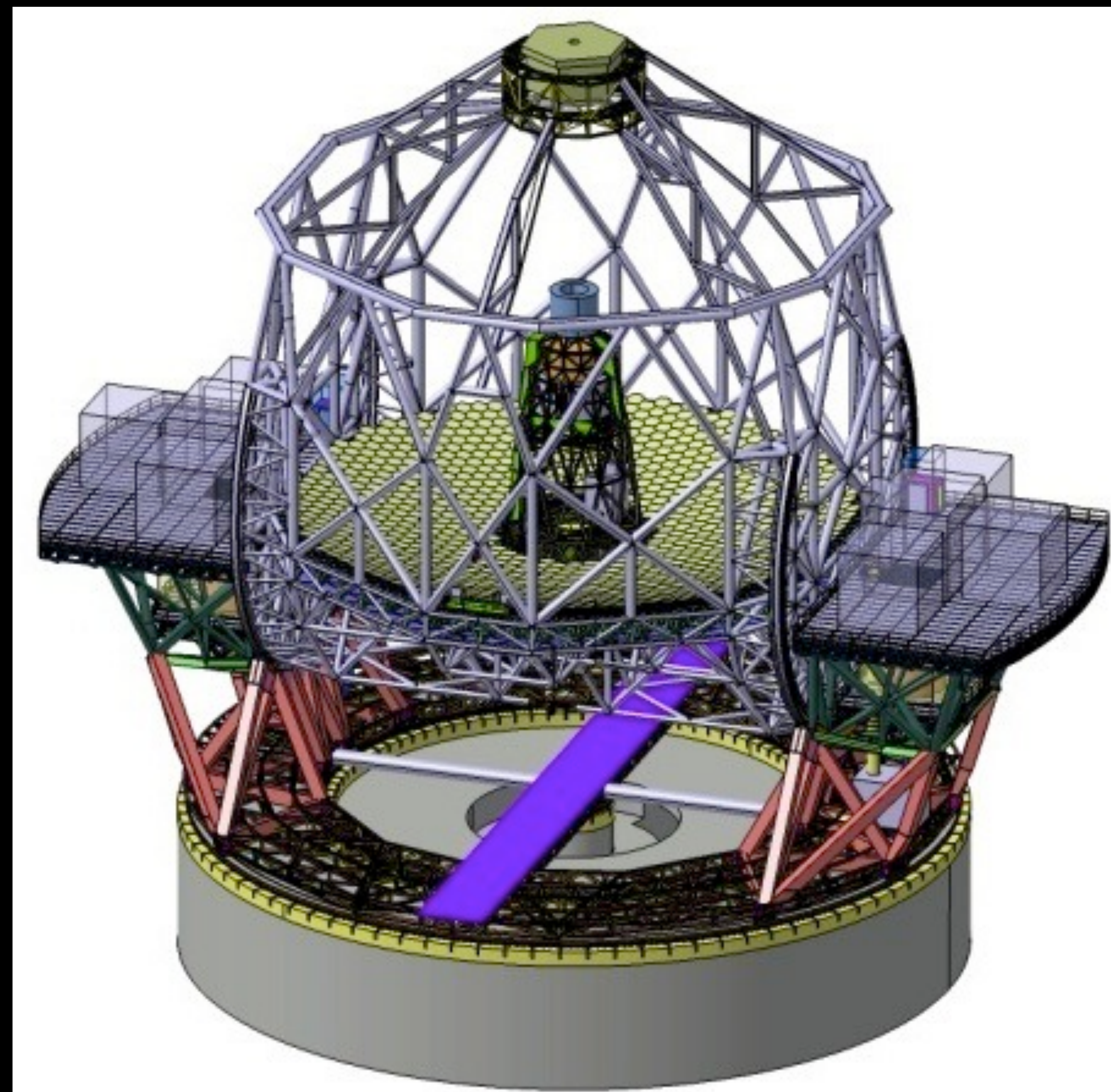

Armazones
Paranal


Antofagasta
E-ELT main area
189 km²
Armazones
Paranal
E-ELT protection area
362 km²
Paranal Observatory
719 km²

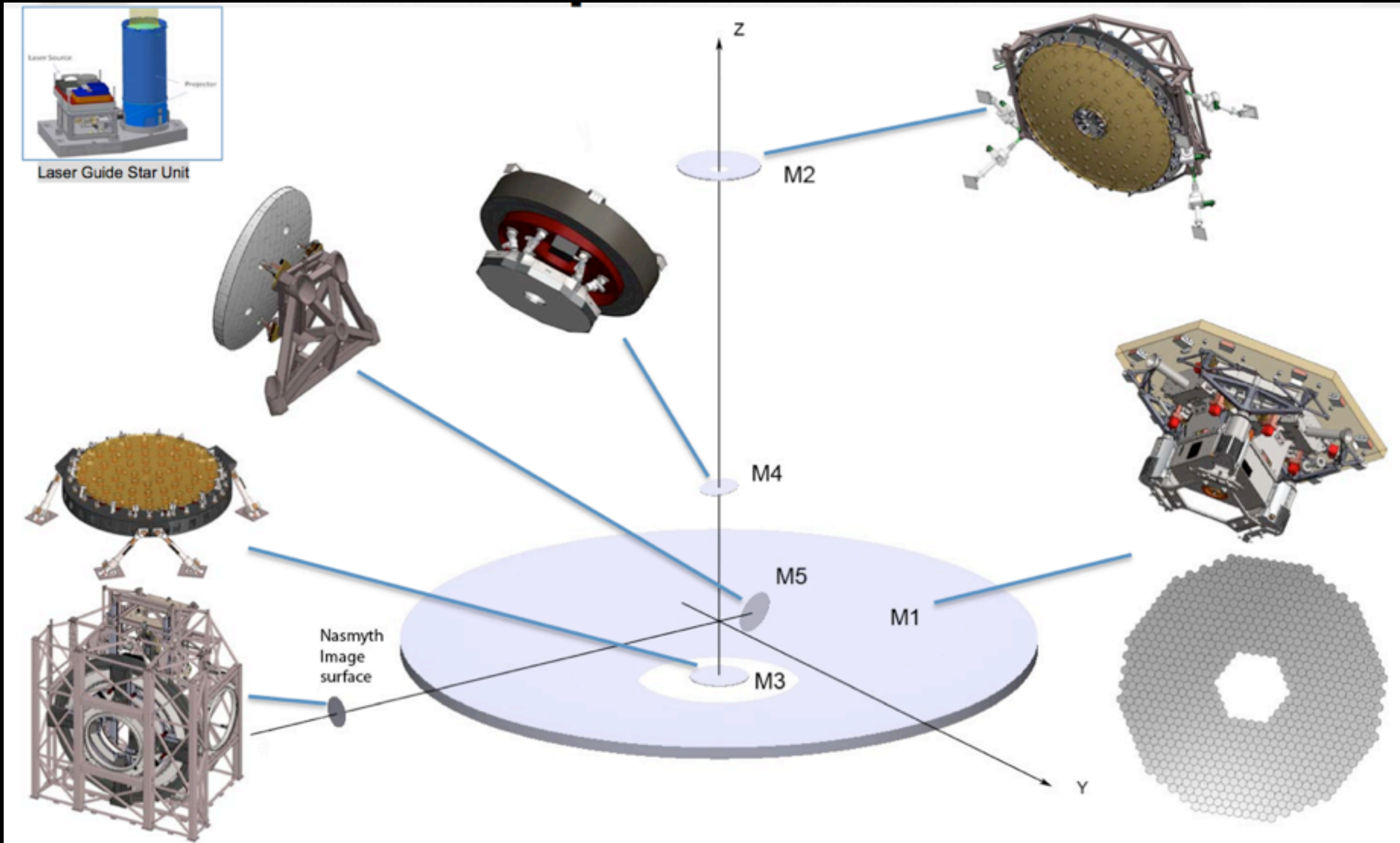




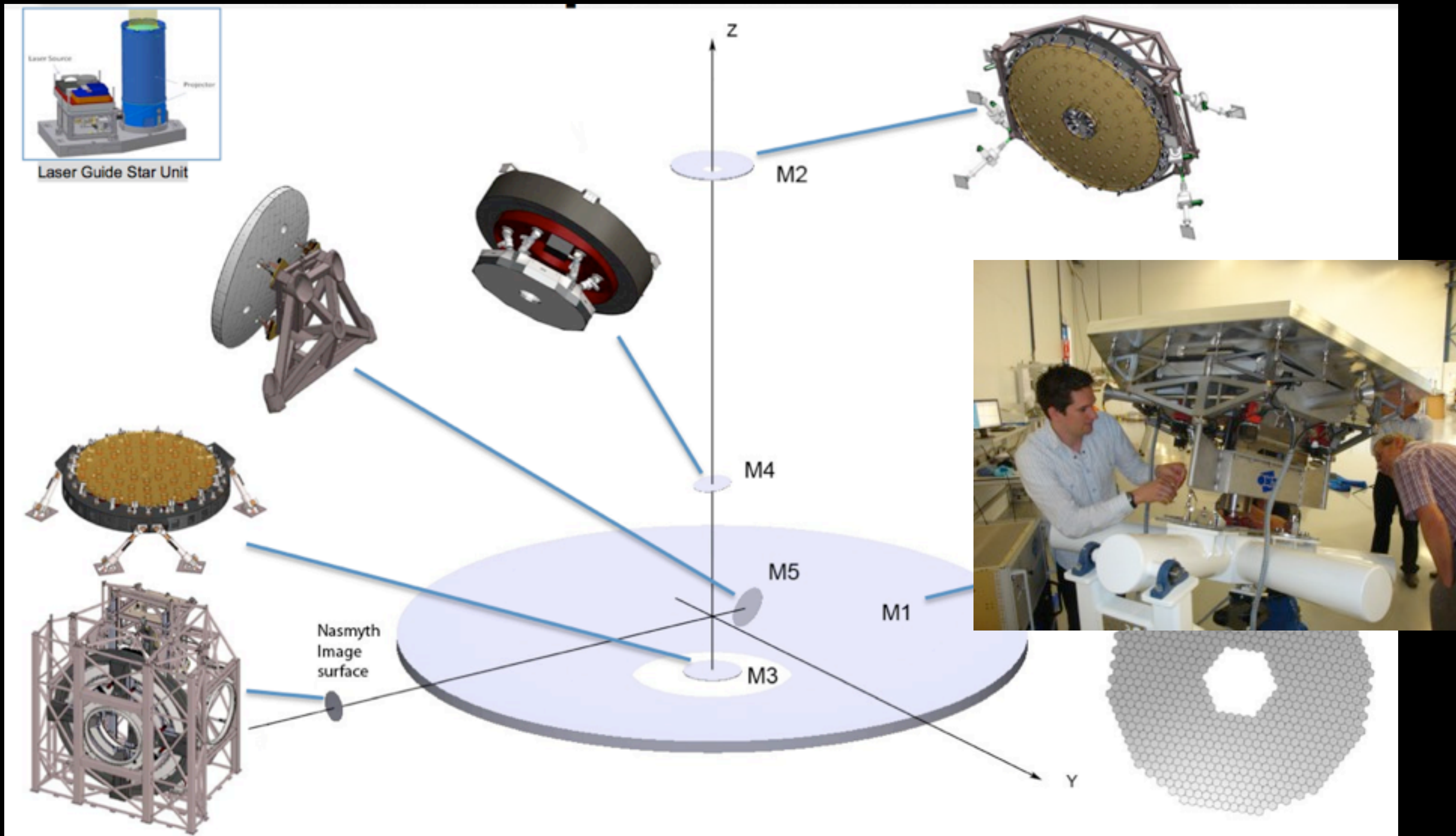
**Dome:**
80m x 90m ∅, fully air conditioned



**Main structure:**
Alt-Az mount, 2800 t




Three mirror anastigmat + two flat mirrors (M4, M5)
Strehl > 99% out to 3’ radius for λ > 360nm

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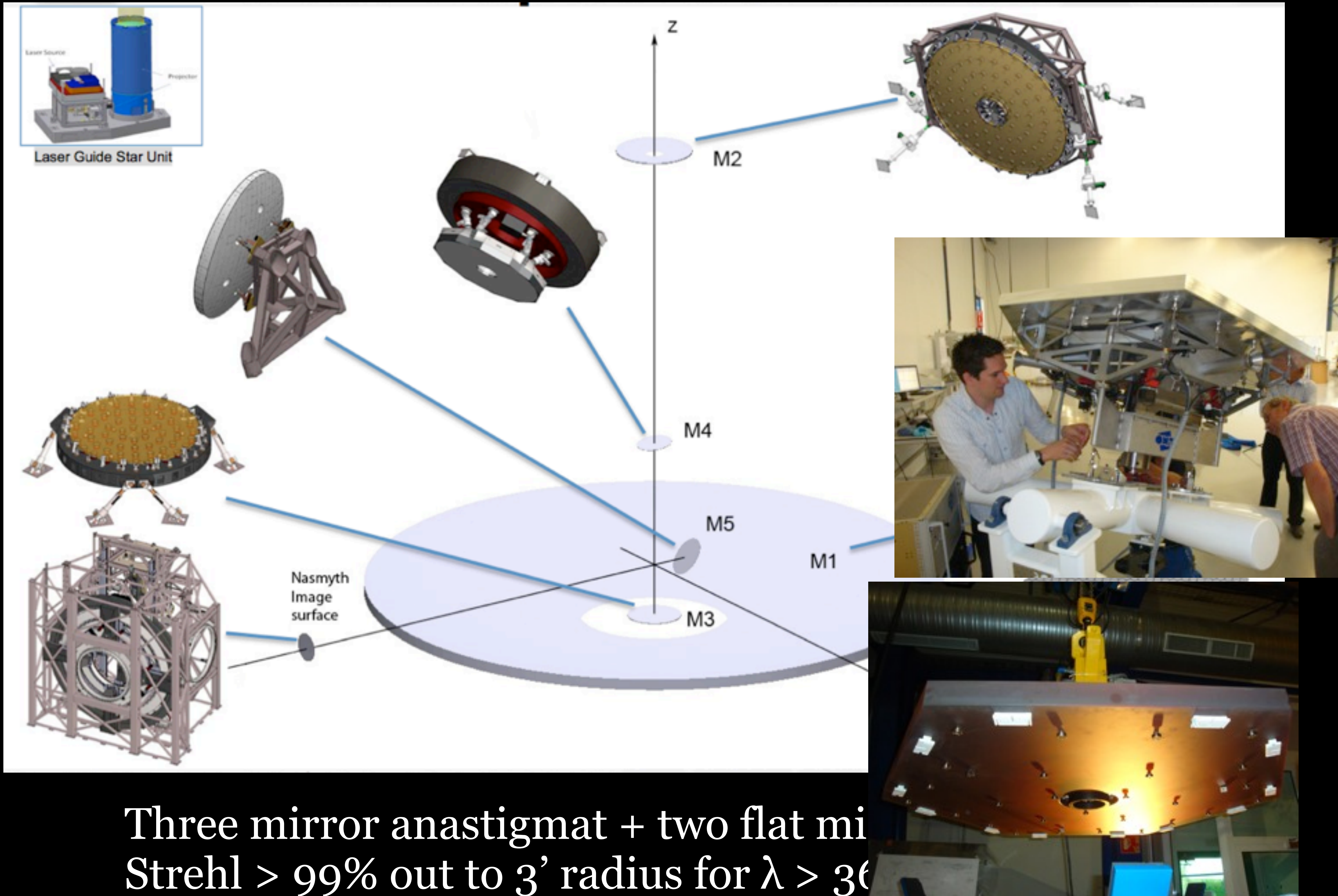
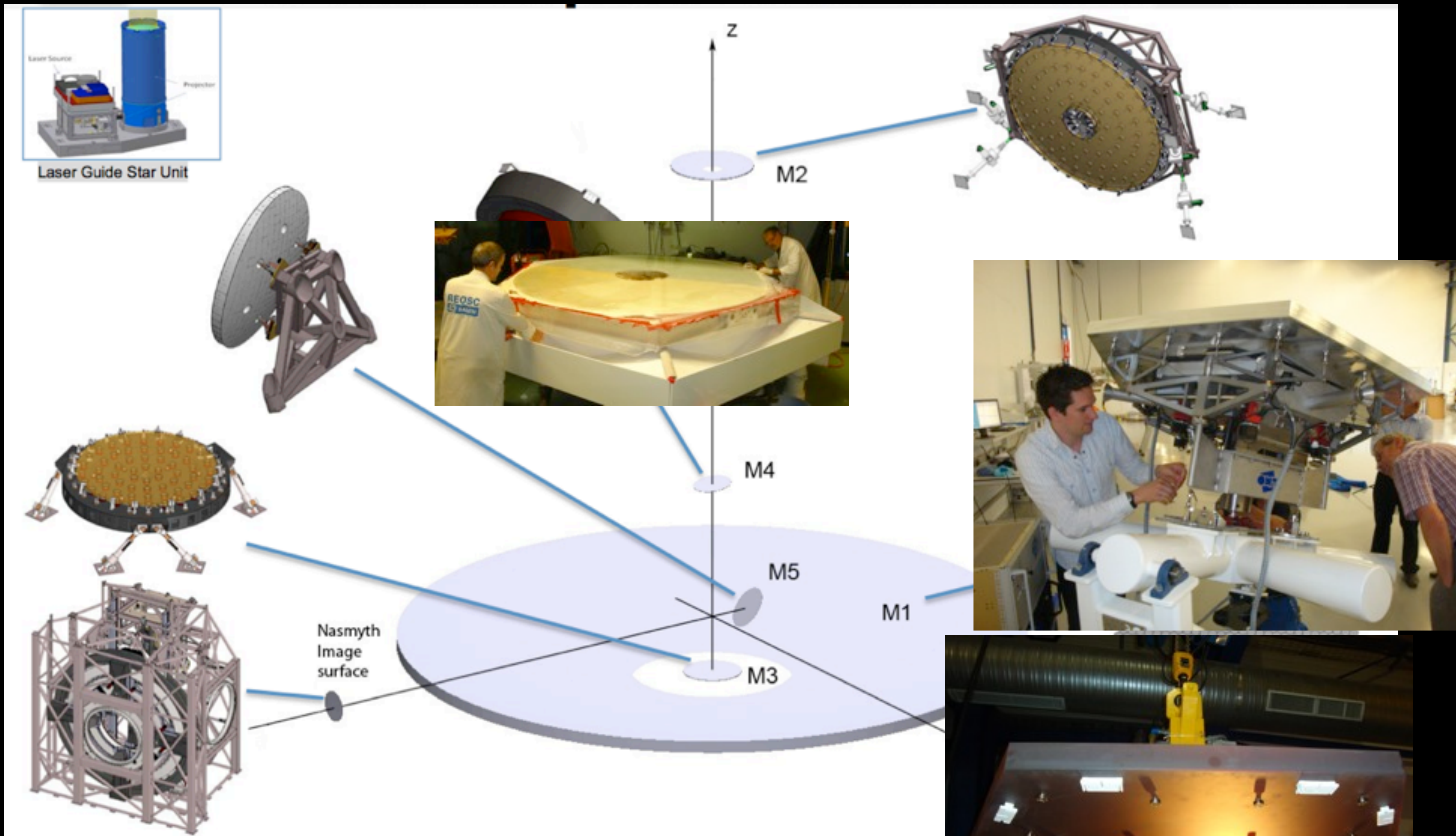



Three mirror anastigmat + two flat mi
Strehl > 99% out to 3’ radius for λ > 36

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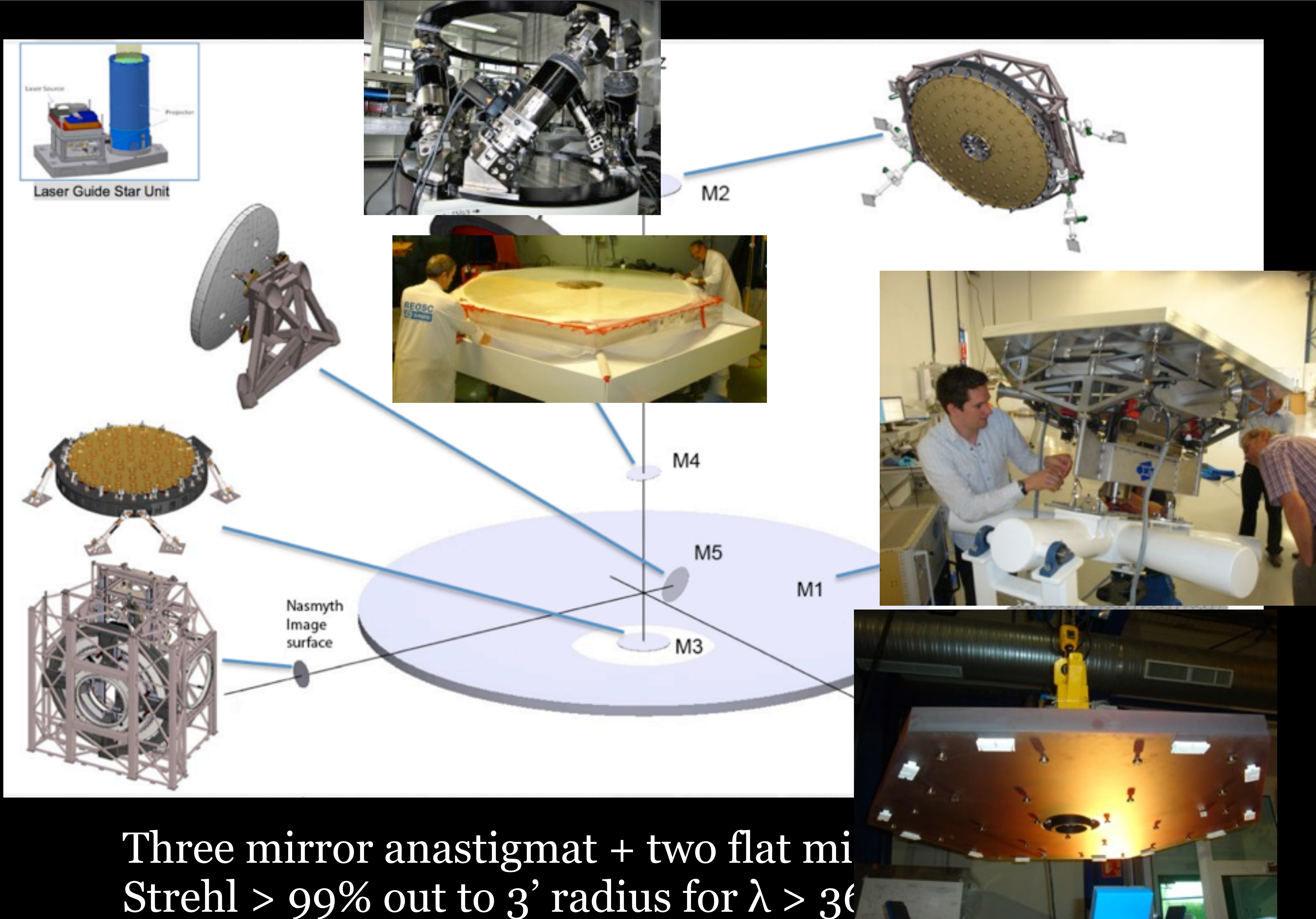


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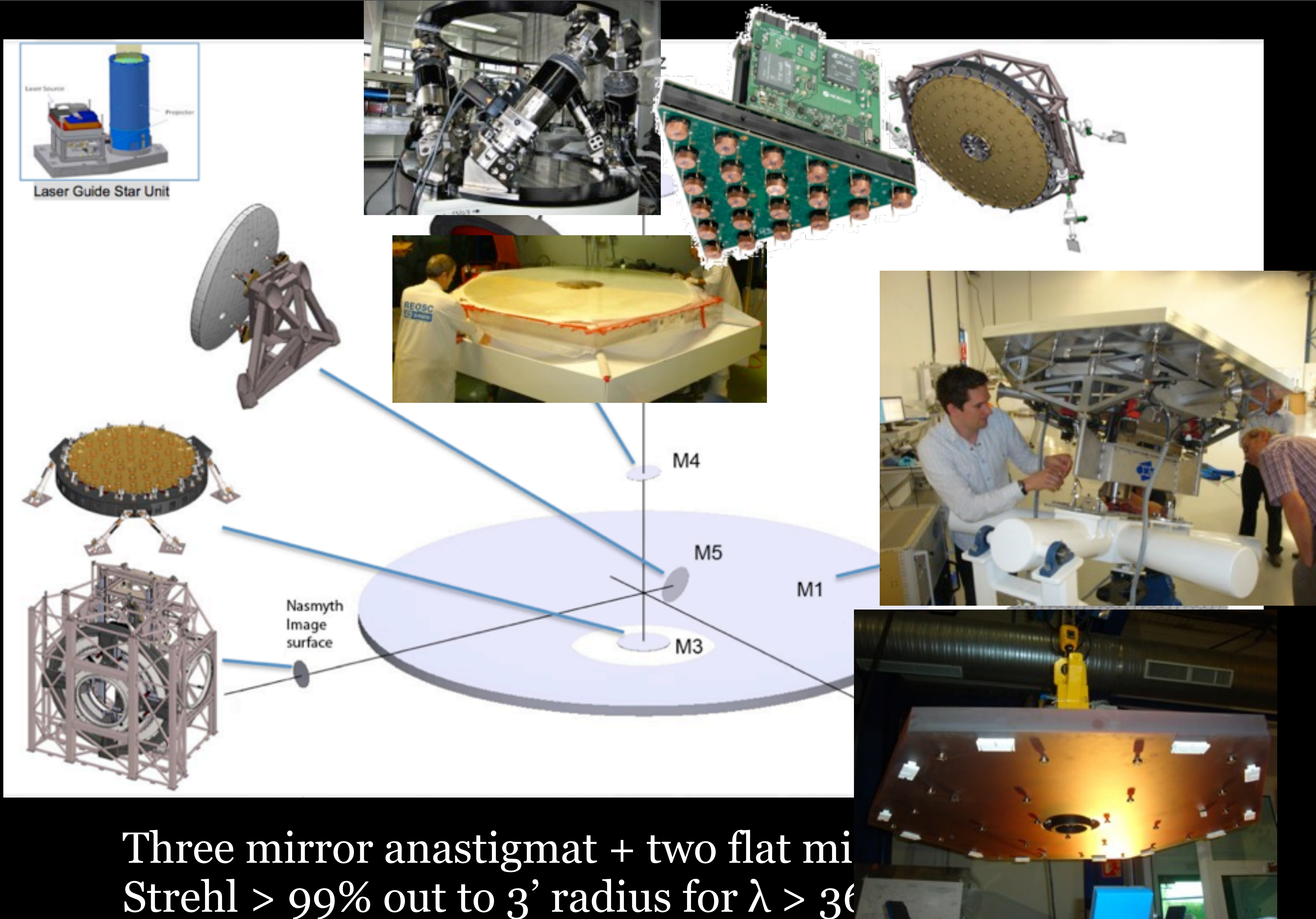


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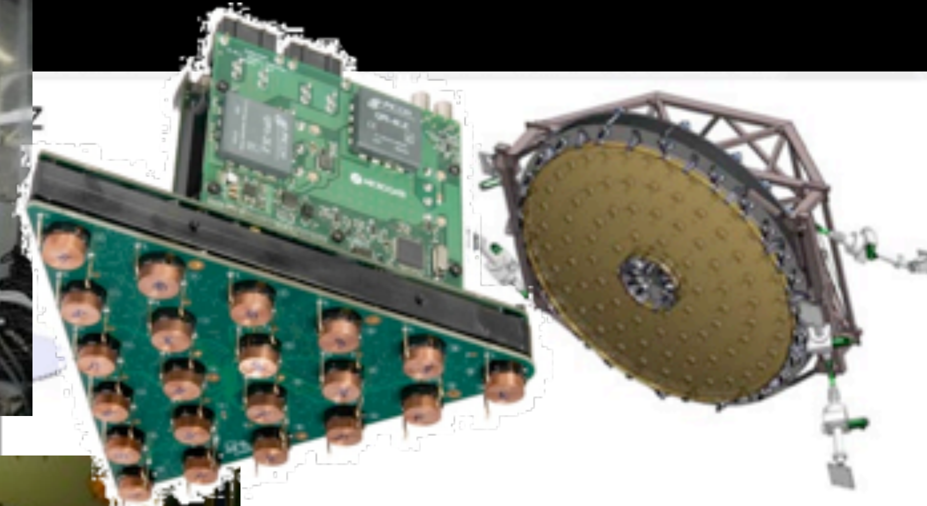

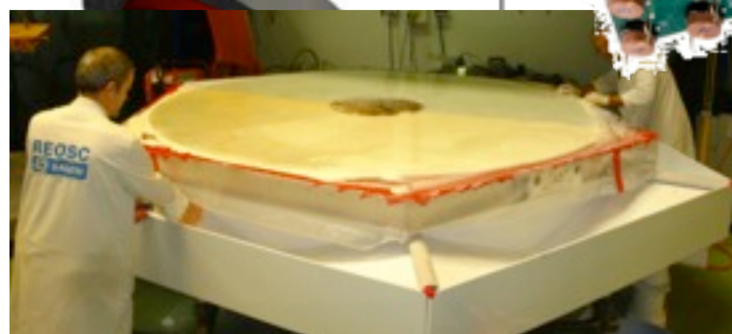


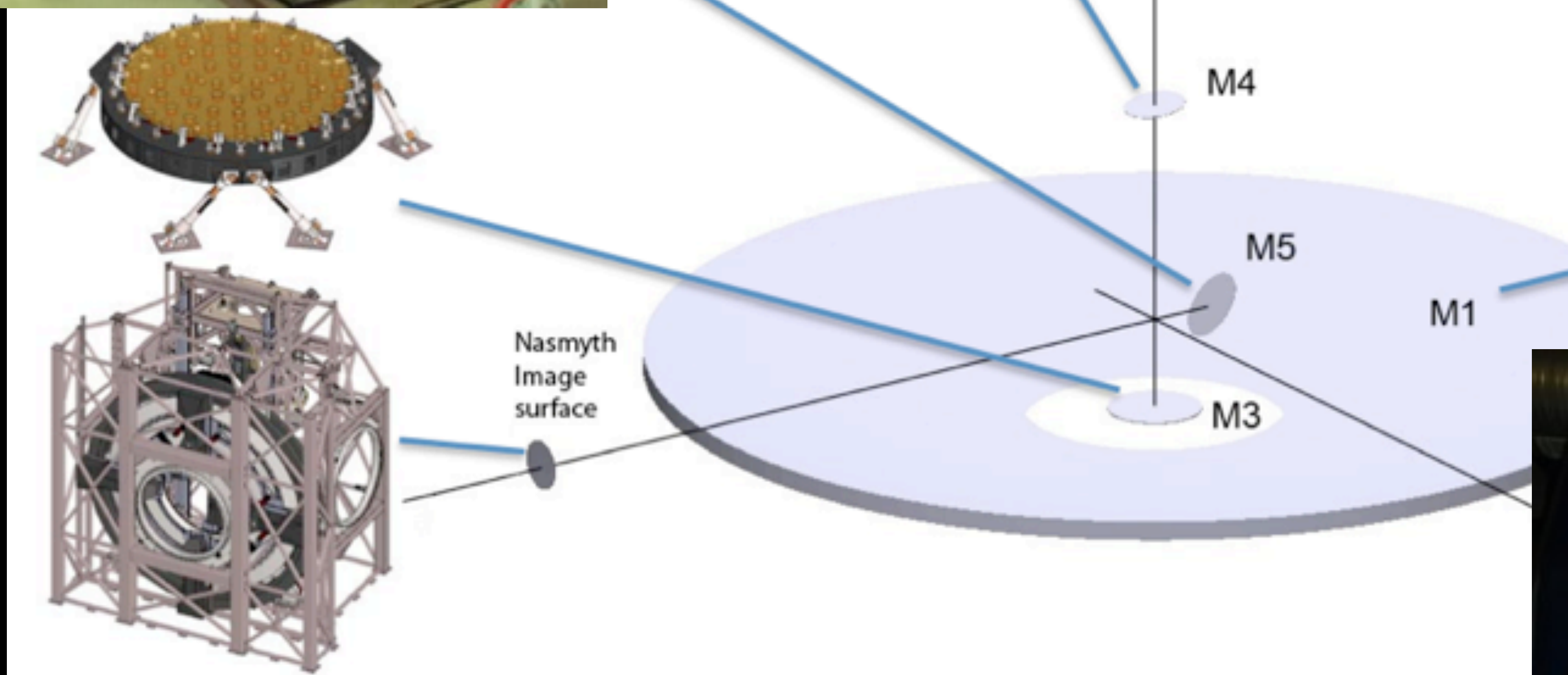


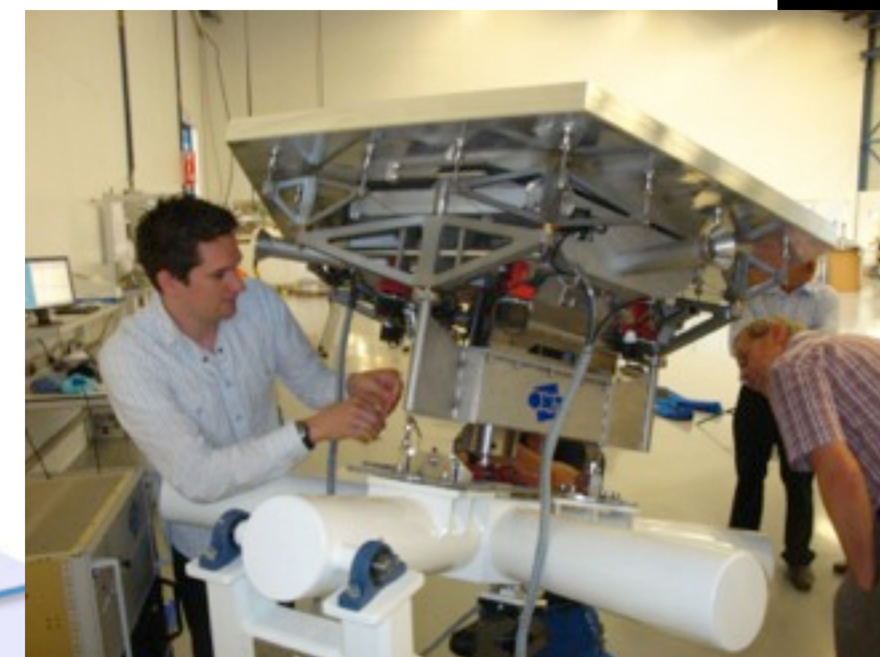

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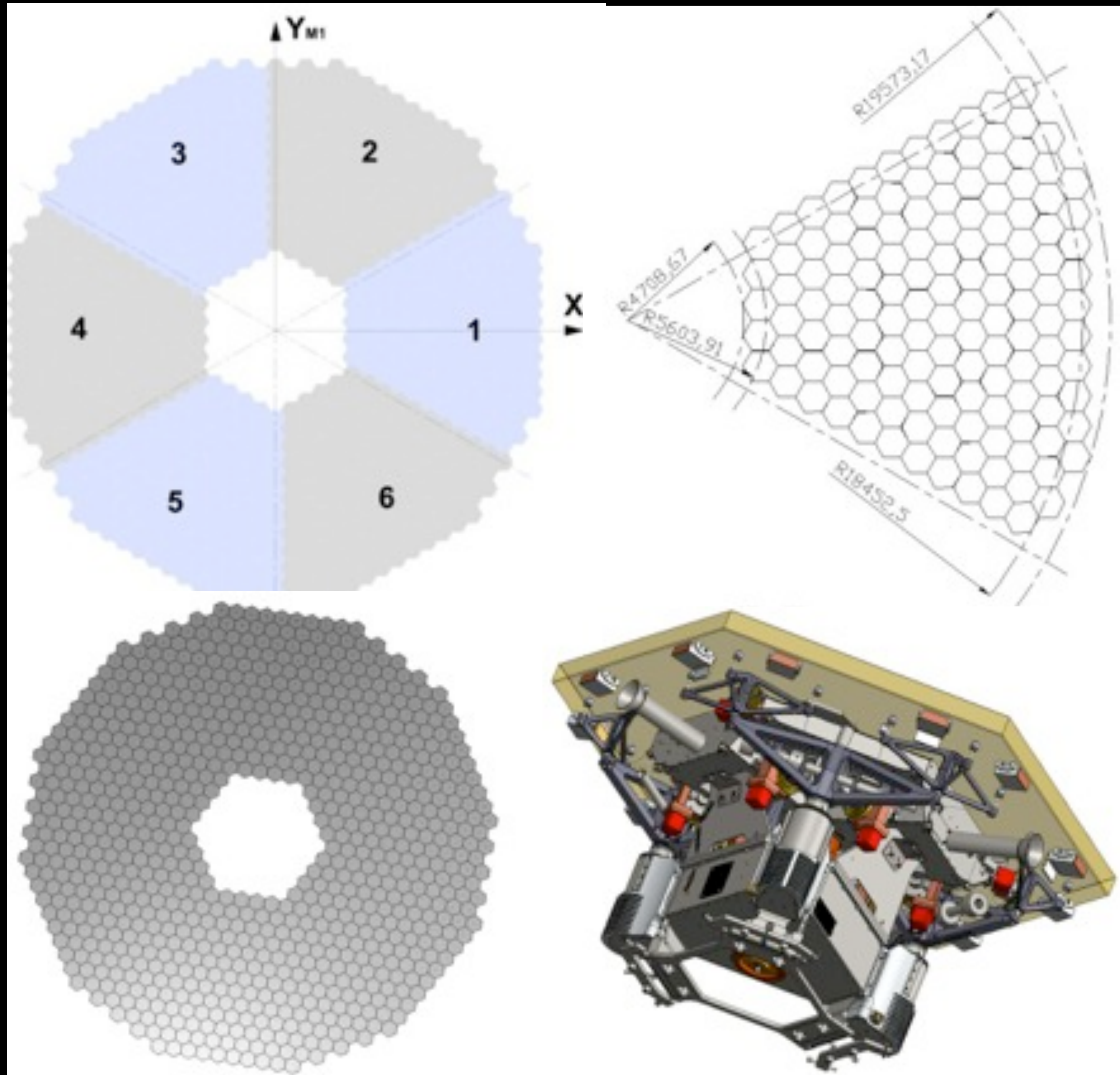
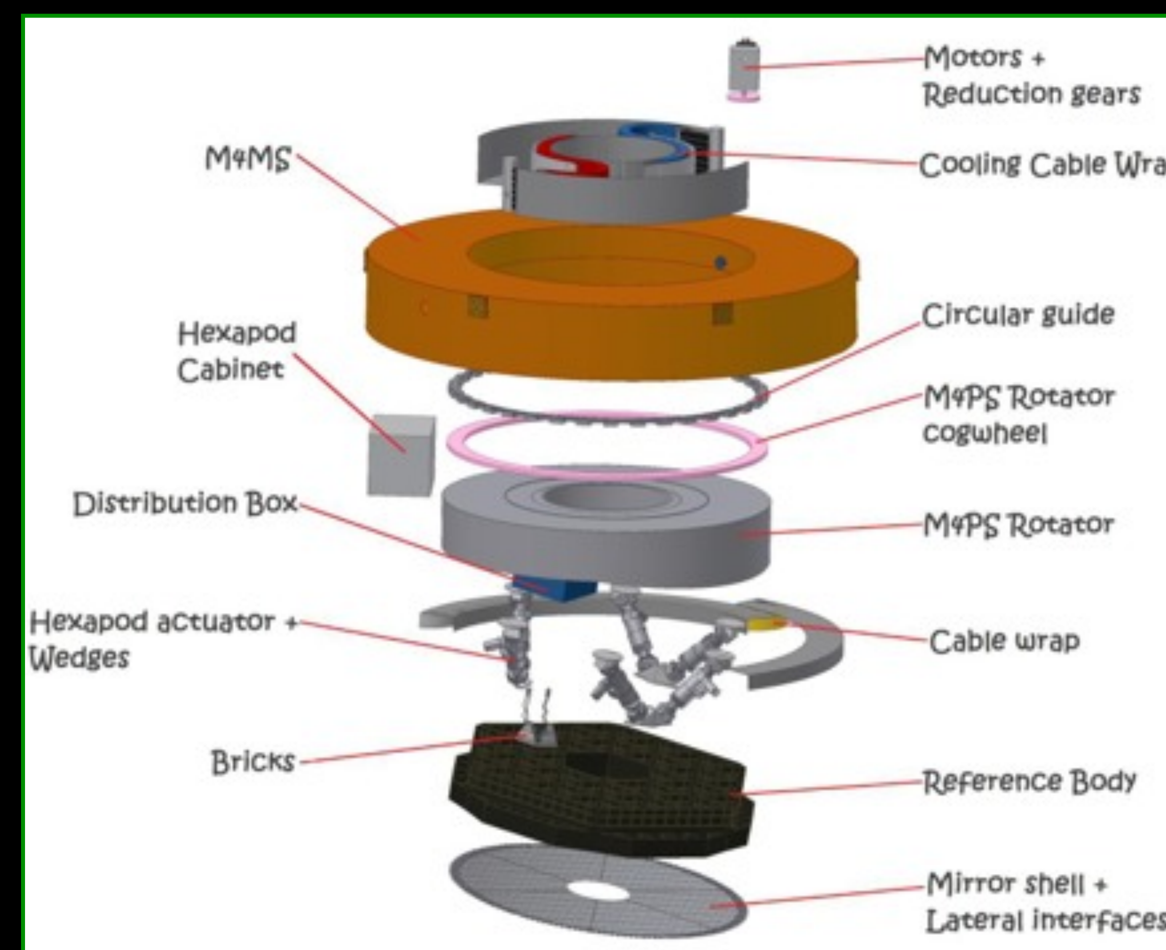



## M1: F/0.93, 39-m diameter

- 798 Segments 1.44-m average size (corner to corner)
- 6 sectors of 133 segments + 1 spare set – 931 total
- Each segment controlled in Piston / Tip / Tilt position
- Each segment controlled in shape

## M4: flat, 2.4-m diameter

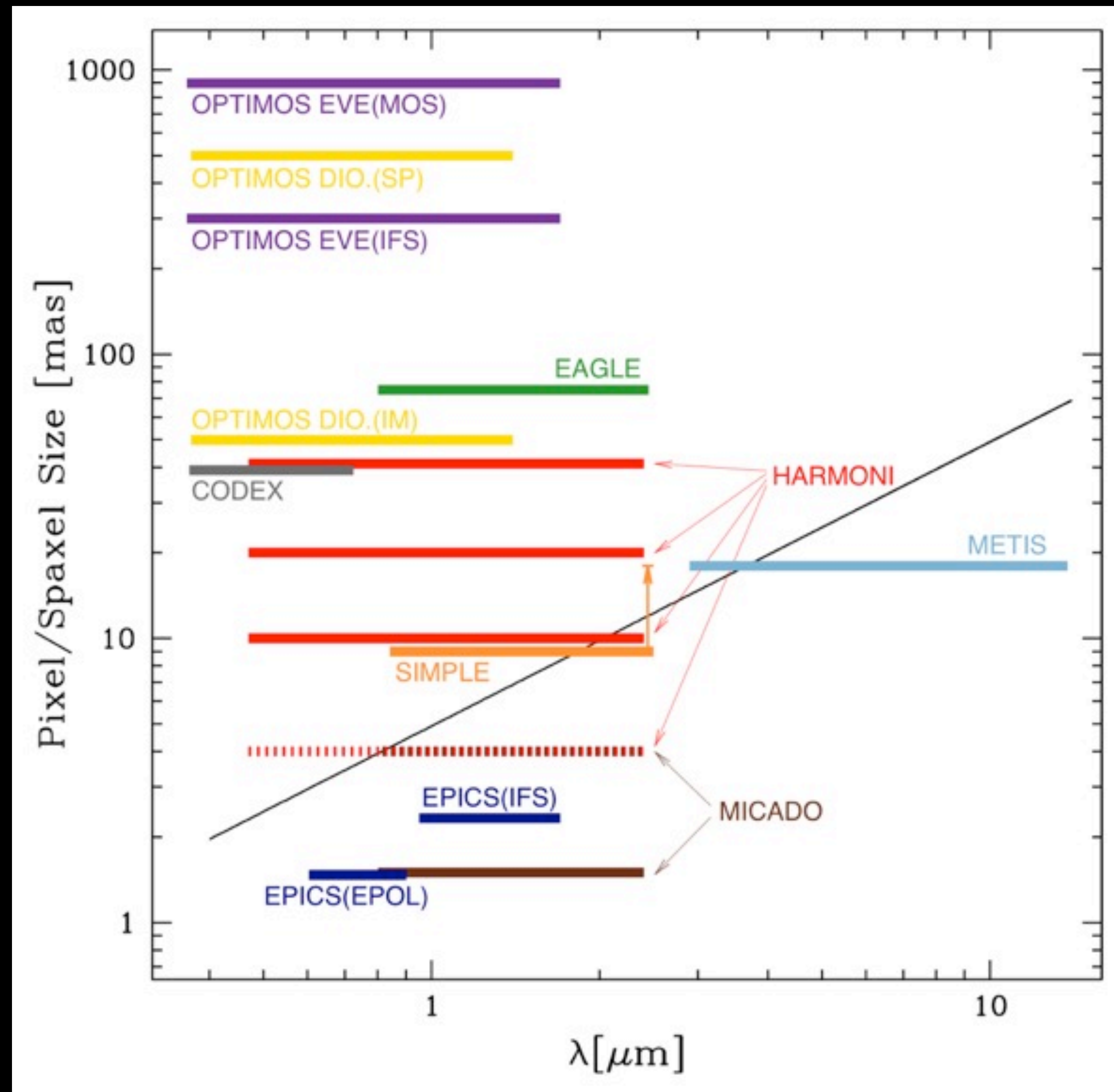
- Zerodur 2mm thin shell
- 5000 contact-less actuators
- 198 removable actuator bricks
- Fitting error 145nm rms @ 0.85” seeing
- 10 tons, 8.4 kW



# E-ELT instruments at the diffraction limit

# Eight instruments and two adaptive optics modules were studied in phase A (2007-2010)

All instruments working in the near- or thermal infrared intend to exploit the diffraction limit of the telescope




AT baseline ~200m
UT baseline ~130m

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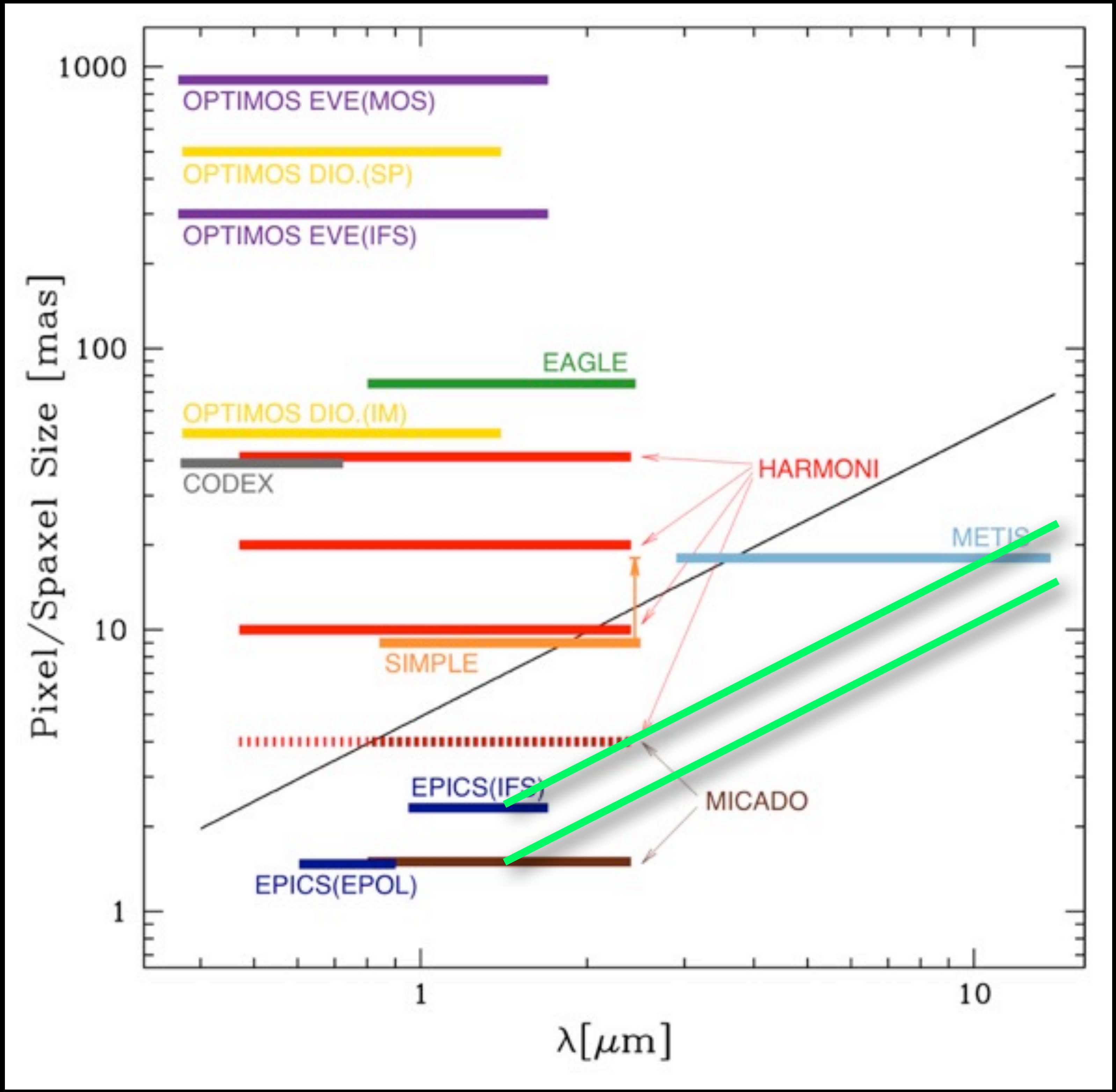


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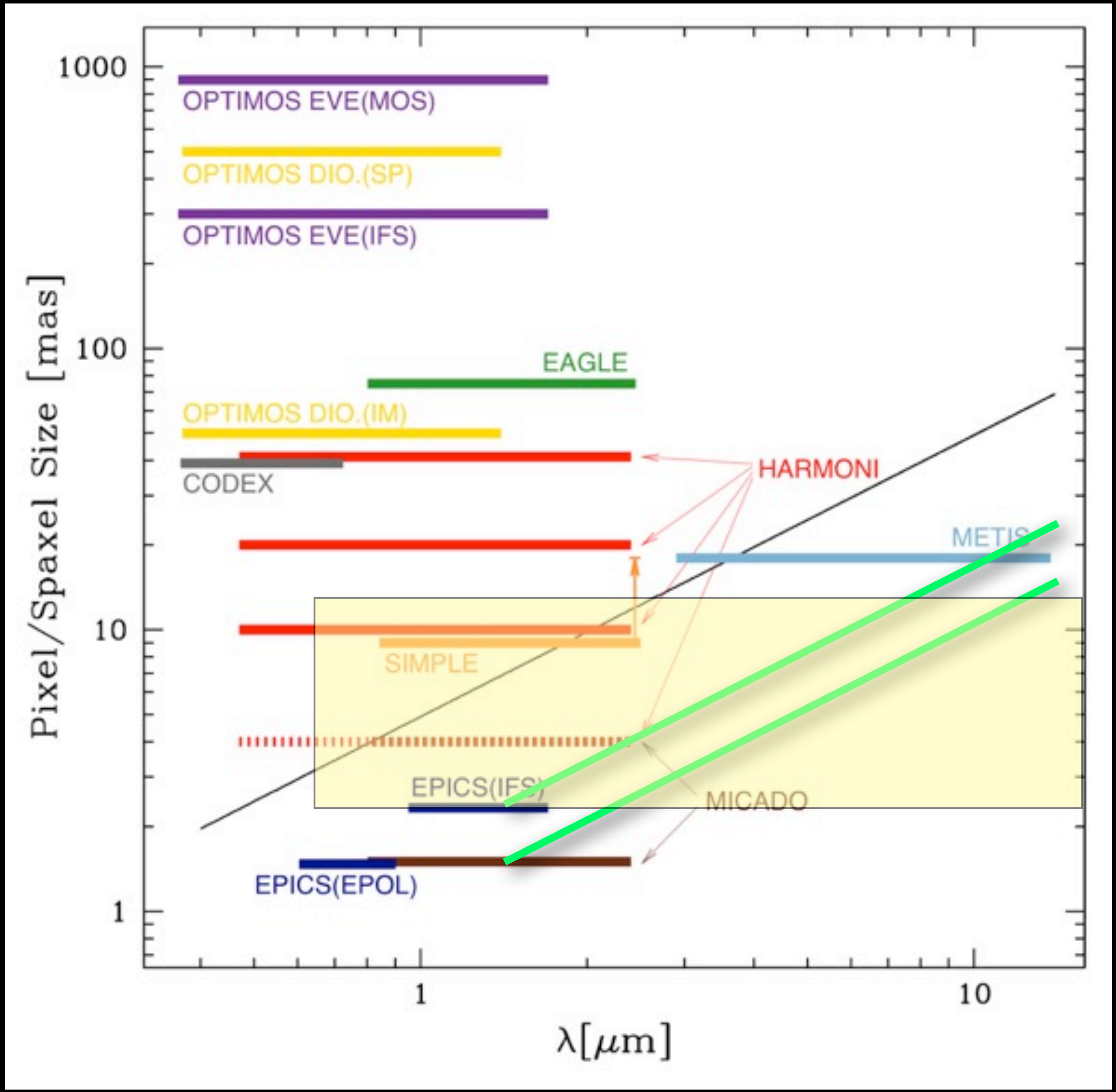


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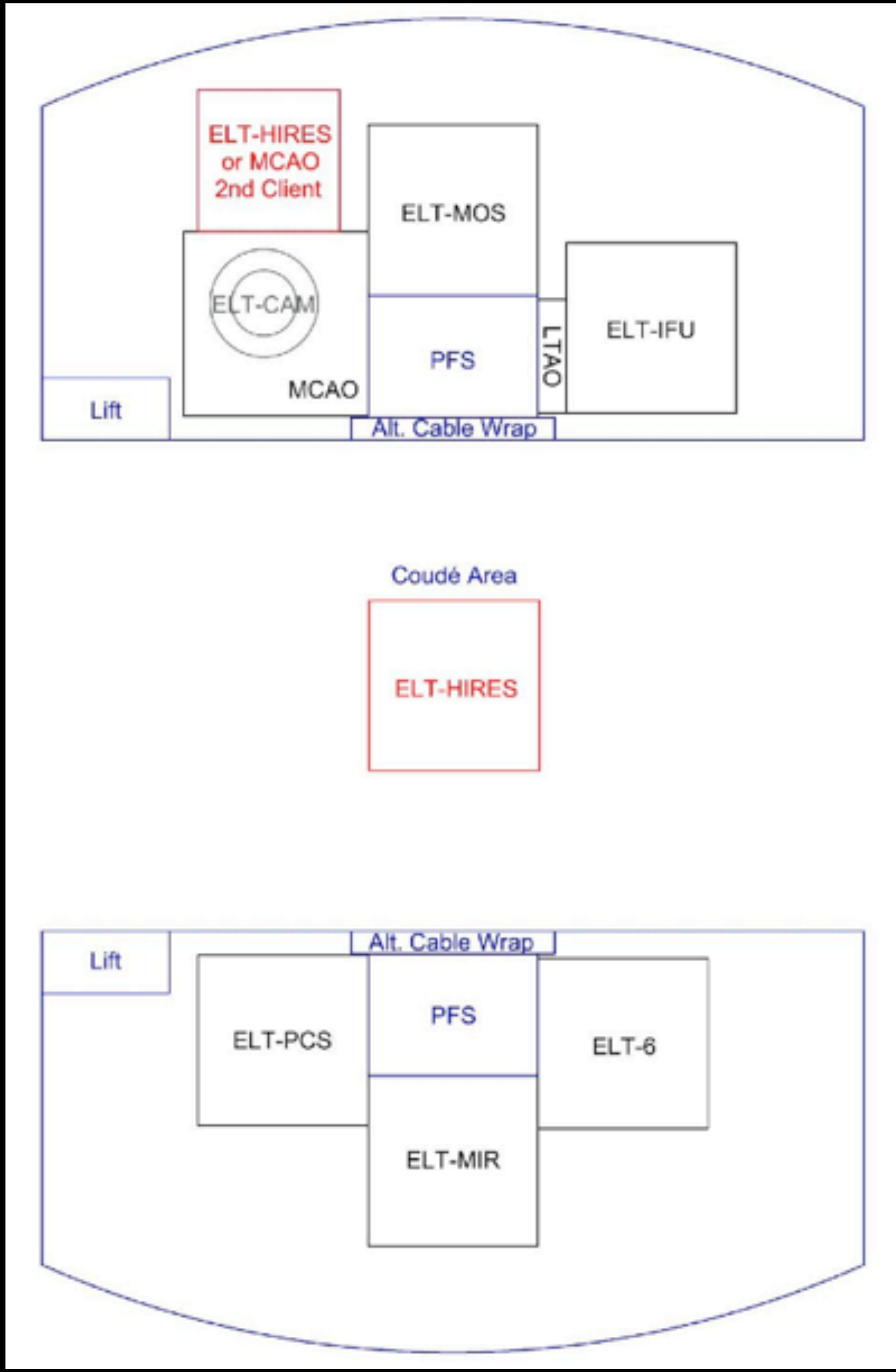
# Implementation of the instrument plan




| year | ELT-IFU | ELT-CAM | ELT-MIR | ELT-4 (MOS or HIRES) | ELT-5 (MOS or HIRES | ELT-6 | ELT-PCS |
|---|---|---|---|---|---|---|---|
| 2012 | Decide science requirements, AO architecture. | | VISIR start on-sky | Develop science requirements for MOS/HIRES | | | Call for proposals for ETD |
| 2013 | | | TRL Review | Call for proposals for MOS/HIRES | | | |
| 2014 | | | | | | | |
| 2015 | | | | Selection ELT-MOS/HIRES | | Call for proposals | |
| 2016 | | | | | | | |
| 2017 | | | | | | | TRL check |
| 2018 | | | | | | | TRL check |
| 2019 | | | | | | Selection | TRL check |
| 2020 | | | | | | | TRL check |
| 2021 Tel technical 1$^{st}$ light | | | | | | | TRL check |
| 2022 Inst Comm starts | | | | | | | |

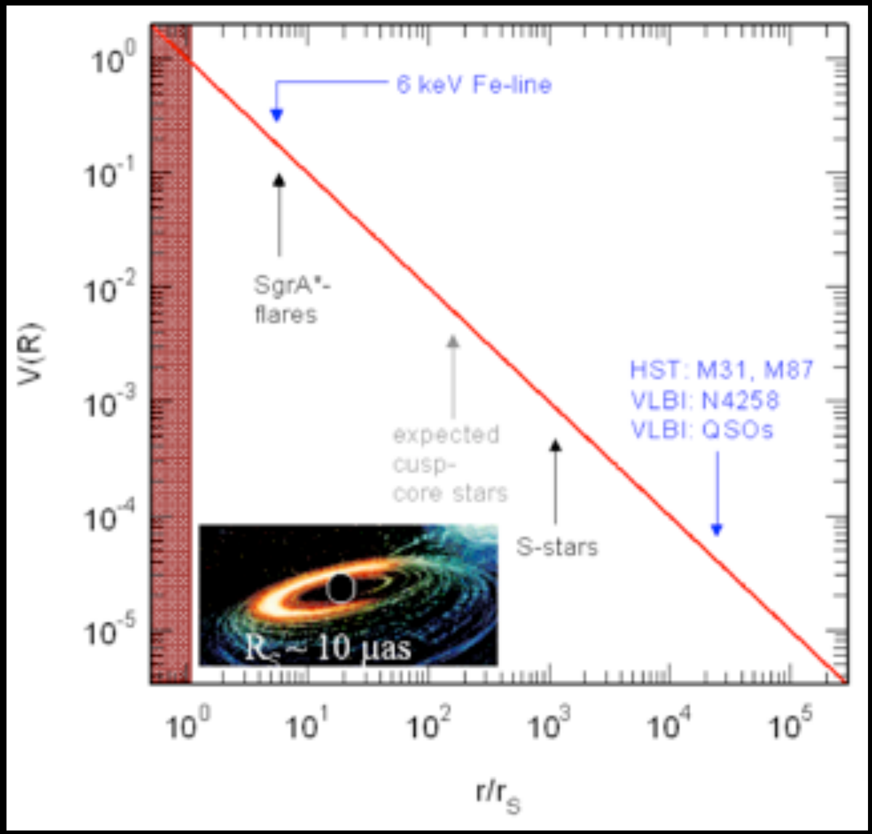
| | |
|---|---|
| (grey) | Pre-studies taking the form of Phase-A or Δ-Phase-A work and/or ESO-funded enabling technology development (ETD) |
| (yellow) | Decision point |
| (green) | Development of Technical Specifications, Statement of Work, Agreement, **Instrument Start.** |

# High Angular Resolution Science Cases

# Selected Highlights:

Long term astrometric precision of 50-100 μarcsec

## Galactic Centre




## Proper motions

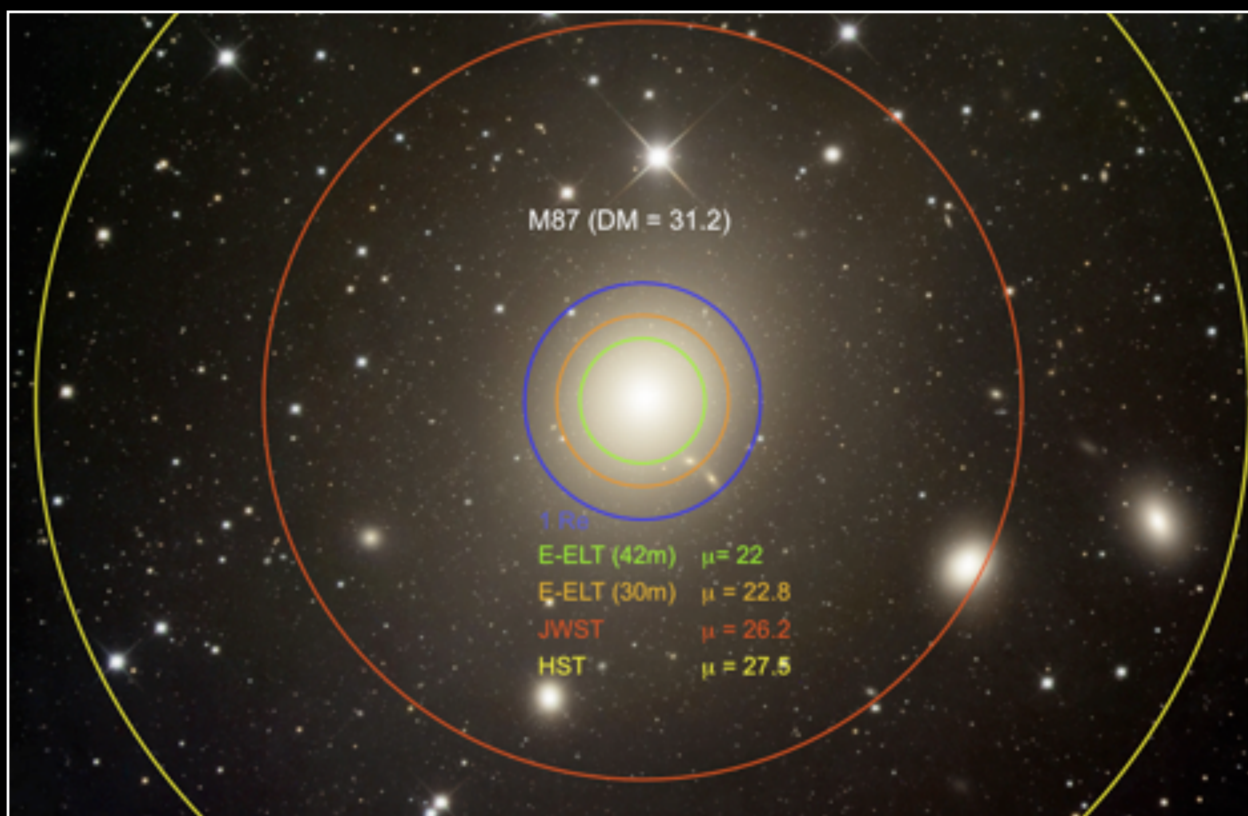
10 μarcsec/year

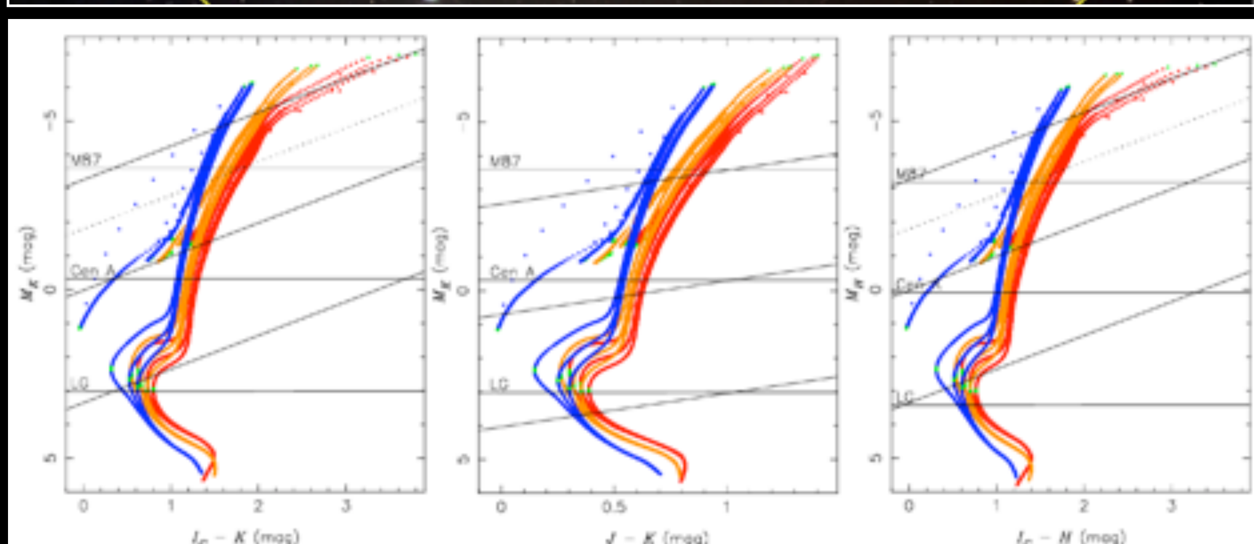
at 10kpc: 0.5 km/s

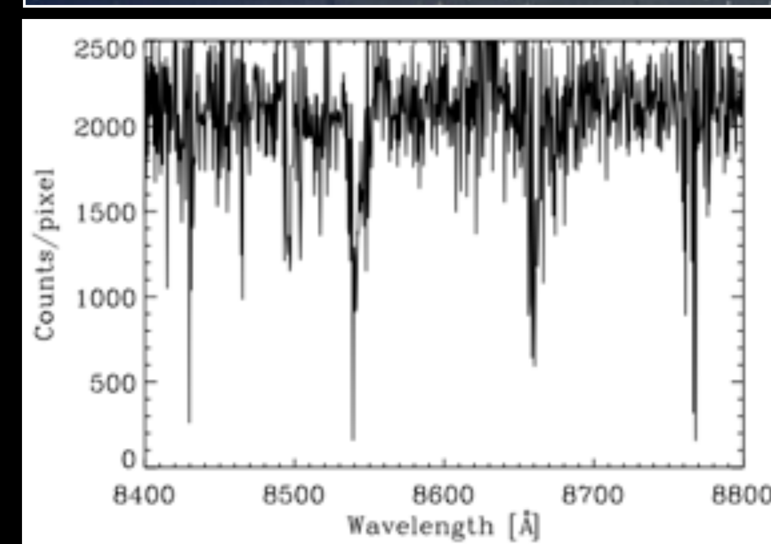
at 50kpc: 2.5 km/s

# Selected Highlights:

## Photometry and spectroscopy of individual star beyond the Local Group



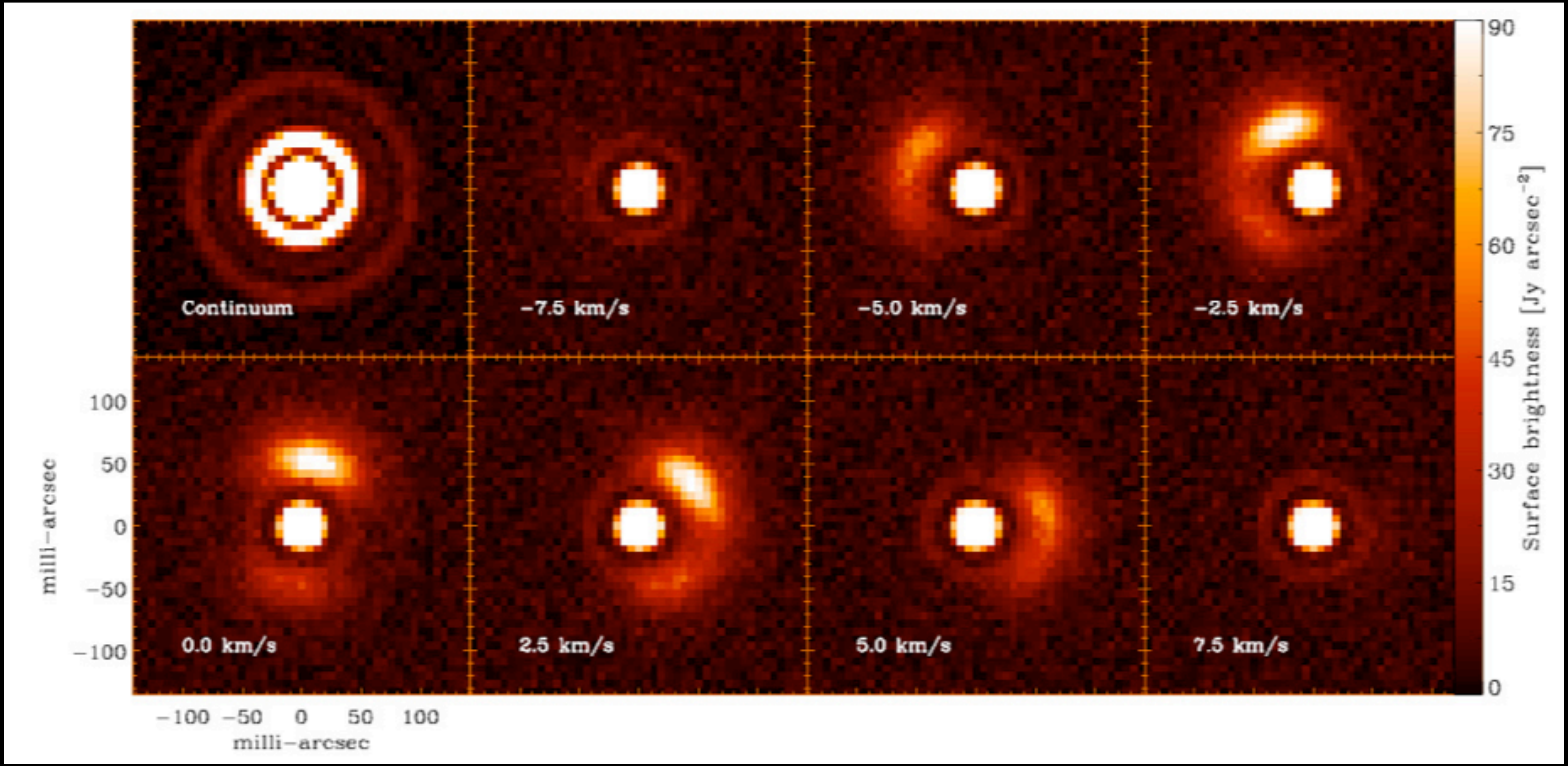




Simulations taken from the Design Reference Mission report: http://www.eso.org/sci/facilities/eelt/science/drm/drm_report.pdf

# Selected Highlights:

## mid-IR: combining highest spectral with highest spatial resolution

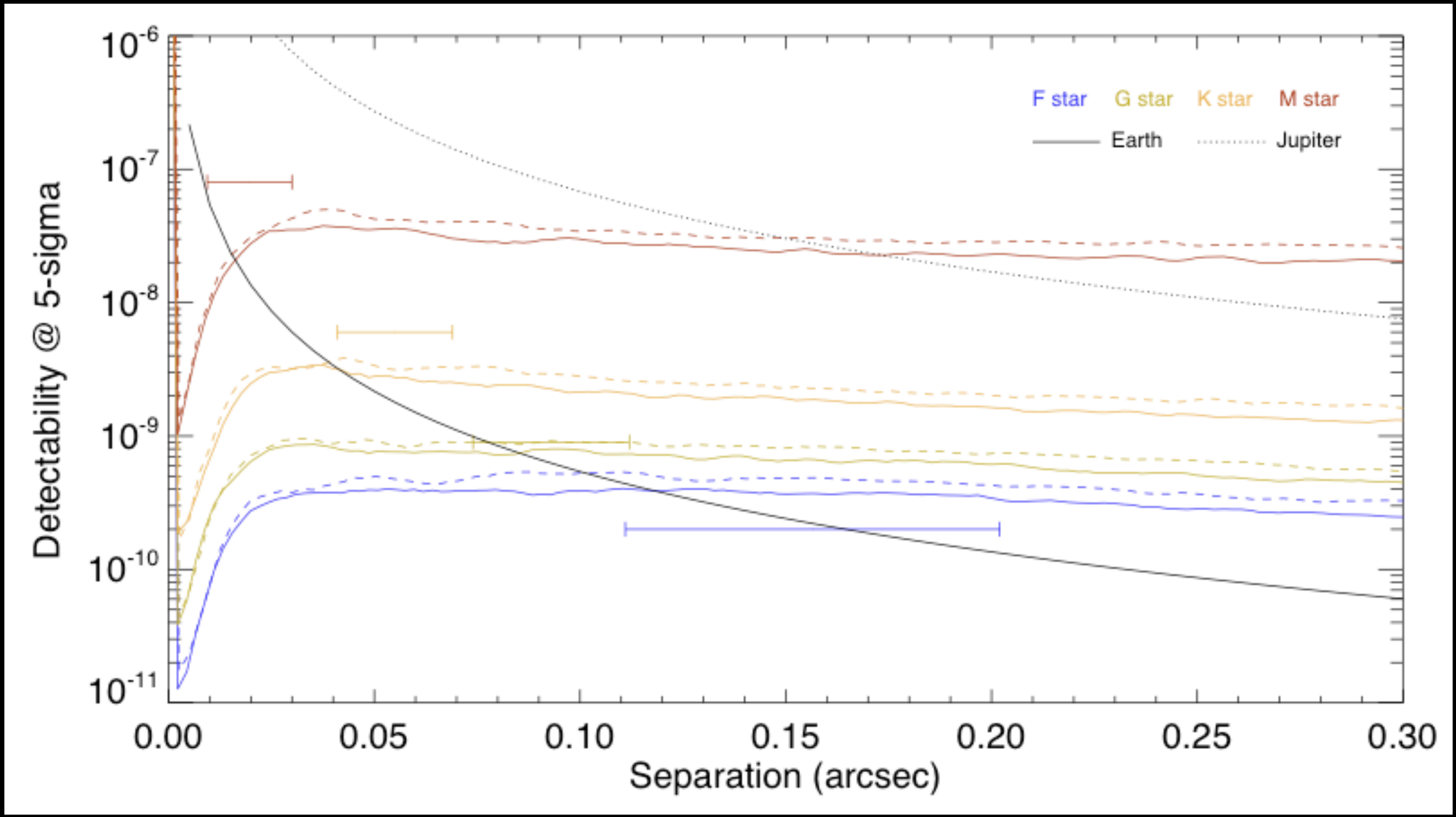



Simulation of a METIS image cube of the CO P(8) line from SR 21 for an assumed distance of 125 pc (Pontoppidan et al. 2009).

Resolve proto-planetary disks to a few AU at 150 pc distance,
with a spectral resolution of 100.000

# Selected Highlights:

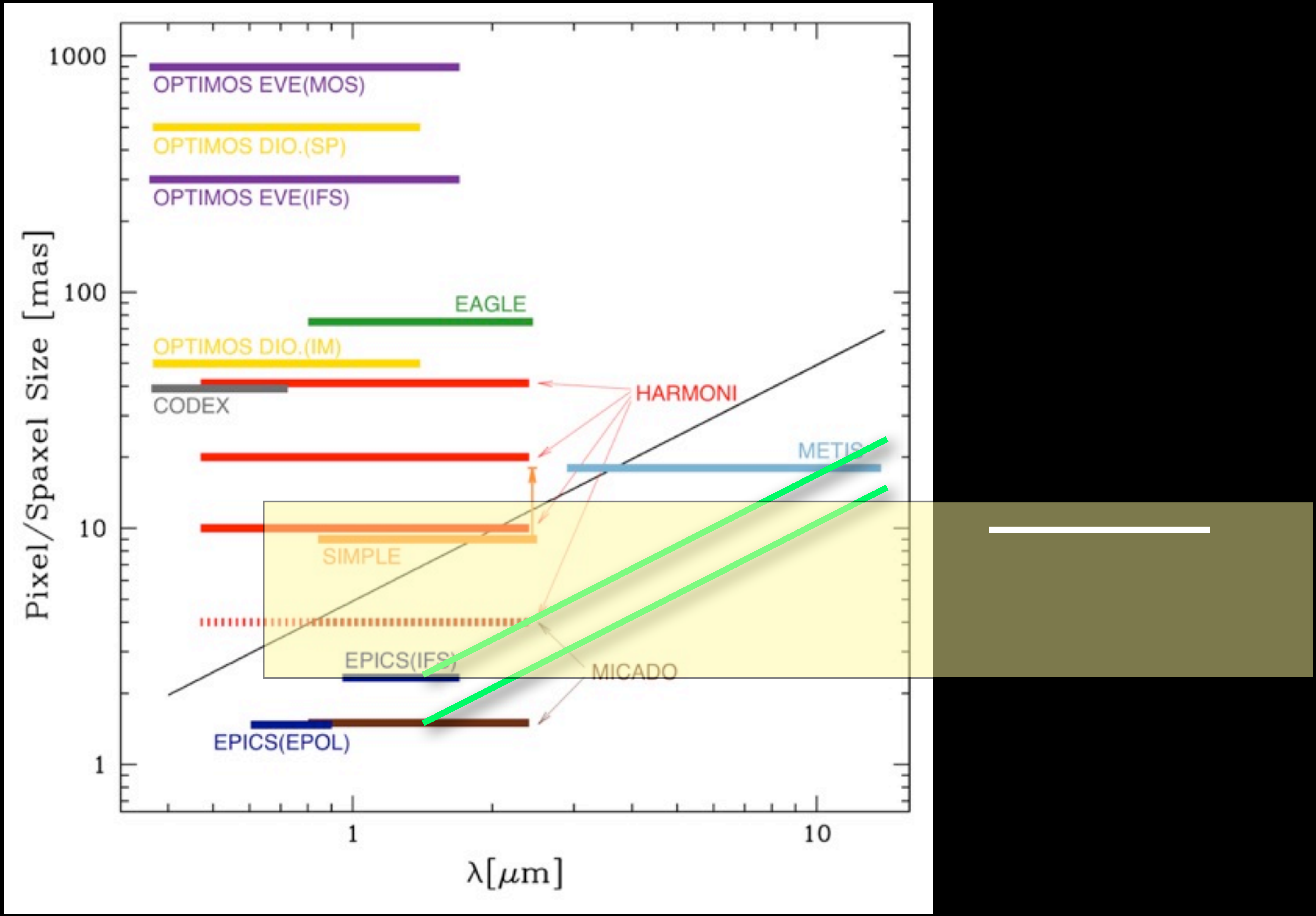
## Contrast: reaching Earth-mass planets in habitable zones




Simulation for the E-ELT project by S.Gladysz, analysed by J.Ascenso

For stars at < 10 pc, contrasts allowing to detect Earth-like planets can be reached, also inside the respective habitable zones

# Conclusions




E-ELT VLTI ... ALMA


The End