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
Paranal

Armazones

Paranal
Dome:
80m x 90m Ø, 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 $\lambda > 360\text{nm}$
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Monday 20 February 12
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Strehl > 99% out to 3' radius for \( \lambda > 360 \text{nm} \)
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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All instruments working in the near- or thermal infrared intend to exploit the diffraction limit of the telescope

AT baseline ~200m
UT baseline ~130m
Implementation of the instrument plan

<table>
<thead>
<tr>
<th>Year</th>
<th>ELT-IFU</th>
<th>ELT-CAM</th>
<th>ELT-MIR</th>
<th>ELT-4 (MOS or HIRES)</th>
<th>ELT-5 (MOS or HIRES)</th>
<th>ELT-6</th>
<th>ELT-PCS</th>
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<tbody>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td>Decide science requirements, AO architecture, VISIR start on-sky</td>
<td>Develop science requirements for MOS/HIRES</td>
<td></td>
<td>Call for proposals for ETD</td>
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<td>2013</td>
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<td>TRL Review</td>
<td>Call for proposals for MOS/HIRES</td>
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<td>2014</td>
<td></td>
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<td>Selection ELT-MOS/HIRES</td>
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<td></td>
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<td>2017</td>
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<td>2018</td>
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<td>2021 Tel technical 11th light</td>
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<td>2022 Inst Comm starts</td>
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- Pre-studies taking the form of Phase-A or Δ-Phase-A work and/or ESO-funded enabling technology development (ETD)
- Decision point
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

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

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

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