Astronomy

Study of everything beyond the Earth

Objects are far away, hence appear small and faint
- Need for large telescopes: resolution and sensitivity

Observationally-driven science
- Visual light and radio signals can be detected with telescopes on the ground

Technology now available to
- Study objects over 95% of the age of the Universe
- Detect and study planets around other stars
ESO

1962
- ESO created by five Member States with the goal to build a large telescope in the southern hemisphere
- This became the 3.6m telescope on La Silla (1976)
- Portugal joined in 2001 after a ten-year association

2013
- 14+1 Member States (~30% of the world’s astronomers)
- Paranal is the world-leading ground-based observatory
- ALMA (in partnership) on Chajnantor completed in 2013
- Construction of 39m E-ELT on Armazones to start soon
La Silla, Paranal & Chajnantor
Very Large Telescope
ALMA & APEX on Chajnantor

- Detect submillimeter radio waves from the Universe
  - Requires minimal water vapour: 5100m altitude

- APEX
  - 12m antenna in partnership with Sweden and Germany

- ALMA
  - 66 antennas: tremendous resolution and sensitivity
  - Global partnership with North America and East Asia
n Largest optical/infrared telescope in the world
  ſ 39m segmented primary mirror: transformational step
  ſ Design essentially complete, incl. instrumentation roadmap

n Project
  ſ Construction 2013-2024, on Cerro Armazones
    • As integral part of the Paranal Observatory
  ſ ESO cost: ~1100 MEUR incl. instruments and contingency
Armazones and Paranal
Five-mirror design

1. The 39.3-metre primary mirror collects light from the night sky and reflects it to a smaller mirror located above it.

2. The 4-metre secondary mirror reflects light back down to a smaller mirror nestled in the primary mirror.

3. The third mirror relays light to an adaptive flat mirror directly above.

4. The adaptive mirror adjusts its shape a thousand times a second to correct for distortions caused by atmospheric turbulence.

5. A fifth mirror, mounted on a fast-moving stage, stabilises the image and sends the light to cameras and other instruments on the stationary platform.
E-ELT, is there life outside Earth?
E-ELT Programme

Funding comes from
- Regular ESO income
- Additional contributions from 14 Member States
- Accession of Brazil (entrance fee + annual contributions)

E-ELT Programme approved in Dec 2012
- When required two-thirds majority (10 MS) was reached
- Portugal joined 7 May 2013
- 13 Member States have now formally committed
  - Expectation is that Spain will join soon
E-ELT Construction

- Spending on major items authorized once 90% of cost-to-completion pledged
  - Reached once Brazil ratifies Accession Agreement
    - Process moving forward steadily
  - Initial civil works (road + platform) allowed to start sooner
  - Contracts only to Member States that participate

- Baseline procurement plan is being implemented
  - CfT for construction of road and platform in May 2013
  - CfT for construction of dome & main structure by Sep 2013