ESO’s Programme

- Visual/infrared light
  - La Silla telescopes incl. 3.6m and NTT
  - VLT, VLTI, VISTA and VST on Paranal
  - E-ELT construction on Armazones
  - Instrumentation development

- Submillimeter radio waves
  - APEX & ALMA partnerships at Chajnantor

- High-quality user support
La Silla - ESOs first observatory
GL581

- Result from the HARPS precision spectrometer
- Three orbiting planets
- One is in the “habitable” zone
  - Temperature of 0 – 40°C
Paranal Observatory
Very Large Telescope (VLT)
Very Large Telescope (VLT)

4 x 8.2m telescopes
4 x 1.8m ATs (interferometry)
VST (2.6m visible survey telescope)
VISTA (4.1 m infrared survey telescope)
Laser for artificial stars
Instrumentation Programme

- Long-range plan
  - Upgrades and new instruments in budget through 2030+

- In-house development programme
  - Detectors, controllers
  - Adaptive optics systems
  - Innovative fiber lasers (patented)

- Infrastructure upgrades
  - Adaptive Optics Facility on UT4 in 2015/16
    - Four powerful lasers plus deformable secondary
  - Key components for VLTI
    - NAOMI: Adaptive Optics units for ATs
  - Commissioning of incoherent combined focus allowing ESPRESSO to use 4 UTs
Partnership with Community

- Future Paranal instruments
  - VLT: ESPRESSO, CRIRES+, CUBES, ERIS, MOONS, …
  - VLTI: GRAVITY, MATISSE, …
  - VISTA: 4MOST

- Most instruments built by consortia of institutes
  - ESO pays hardware (~1/3rd of total cost)
  - Consortia provide staff effort at own cost
  - compensated in Guaranteed Time

- Well funded programmes
  - 4-5M€ per year for VLT instrumentation
  - ELT first 3 instruments + AO systems approx. 60M€
VISTA for wide angle surveys
Seeing the heart of our Galaxy...
Using ESO instruments we can see the region surrounding the 2 million solar mass Black Hole at the heart of our galaxy, even though this is over 25,000 light-years away, and observe the orbits of these stars in exquisite detail.
The Chajnantor Plateau
5000 m
APEX

- Atacama Pathfinder Experiment (since 2006)
  - 12m sub-millimeter antenna at 5100m on Chajnantor
  - Partnership of MPIfR (50%), OSO (23%) and ESO (27%)
    - Agreed through 2017, consider extension after review in 2015
    - Operated by ESO @ Sequitor since 2007

- Instrumentation
  - Facility, PI- and visiting bolometers and spectrometers
  - Kilo-pixel cameras A-MKIDS and ArTeMiS commissioned
Atacama Large Millimeter/sub-millimeter Array
ALMA

- International Project
  - Europe (ESO)
  - North America (USA, Canada)
  - East Asia (Japan, Taiwan, South Korea)
- 66 Antennas combine to provide high angular resolution
- Position of antennas is configurable
Atacama Large Millimeter/submillimeter Array

- 54 x 12m + 12 x 7m antenna’s on Chajnantor at 5050m
- 7 – 0.35 mm (30-900 GHz) in 10+ atmospheric windows
- World’s most powerful radio interferometer
- Cold Universe: formation of planets, stars and galaxies

Construction essentially completed

- All equipment procured by Partners
- ESO contribution corresponds to ~485 MEUR
- Transition to full operations will take few more years
Overview of ALMA
Transporting one of the 100 tonne radio telescopes
The ALMA instrument can probe through the dust and gas surrounding young stars and image regions which have been cleared of dust and gas by orbiting planets. The resolution of the image is finer than the normal resolution of HST.
HL Tau

Protoplanetary disc

Gaps indicate regions where larger bodies have swept up loose material
Interest from the community (demand)

There is continuing growth in those using ESO facilities

![Graph showing growth in proposals and PI numbers from 1977 to 2014]
Available time (supply)

Pressure factor indicates demand for particular instruments – variations occur when new instruments come on-line, but older instruments continue to be popular (typically over-subscribed by a factor of ~3)
Scientific papers per year (output)
Comparative output

Publications of major observatories by year

- ESO total
- HST
- Spitzer
- VLT/VLTI
- NRAO
- Chandra
- XMM
- Swift
- La Silla
- Keck
- Gemini
- ING (may contain duplicates)
- Subaru
- ESO survey tel.
- APEX (ESO) ALMA (Eur.)
Conclusion

- Largest ground-based programme in the world
- Steady growth for many years
- Critical components are well-funded
  - Instrumentation
  - Operations
  - Data processing and distribution to the community
  - Vigorous outreach programme in Europe
Next step.....