ESO's Future Plans

Bruno Leibundgut

European Southern Observatory

- ESO's Mission
  - Develop + operate world-class observing facilities for astronomical research
  - Organise collaborations in astronomy
- 1962
  - ESO created by 5 Member States: BE, FR, DE, SE, NL
  - Goal: build a large telescope in southern hemisphere
  - Became the 3.6-m telescope on Cerro La Silla (1976)
- Currently 16 Member States
  - *Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom*
  - ~30% of world's astronomers
  - Host state: *Chile*
  - Strategic partner: *Australia (until 2027)*

European Southern Observatory

European Southern Observatory

La Silla and Paranal observatories in operation:

4 x 8m UTs, 4 x ATs for interferometry, (2 survey telescopes), 3.6m and NTT

European Southern Observatory

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Atacama Large Millimetre Array (ALMA)

European Southern Observatory

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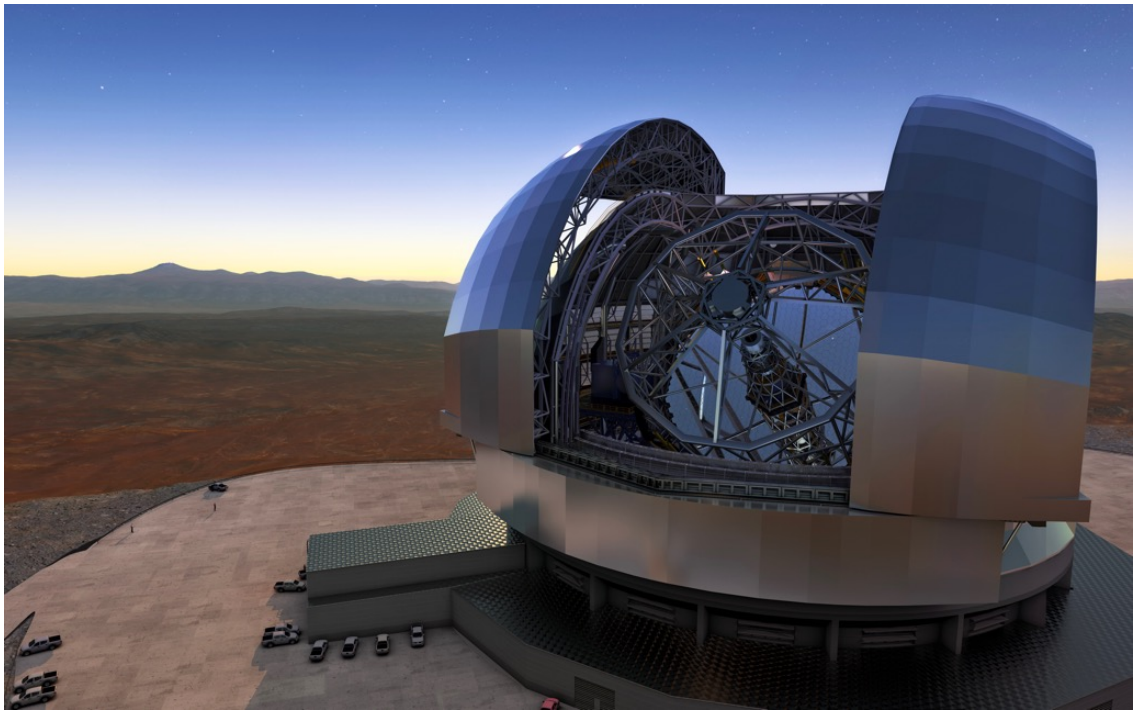
Atacama Large Millimetre Array (ALMA)

Public data archive

ESO Extremely Large Telescope



European Southern Observatory

La Silla and Paranal observatories in operation:

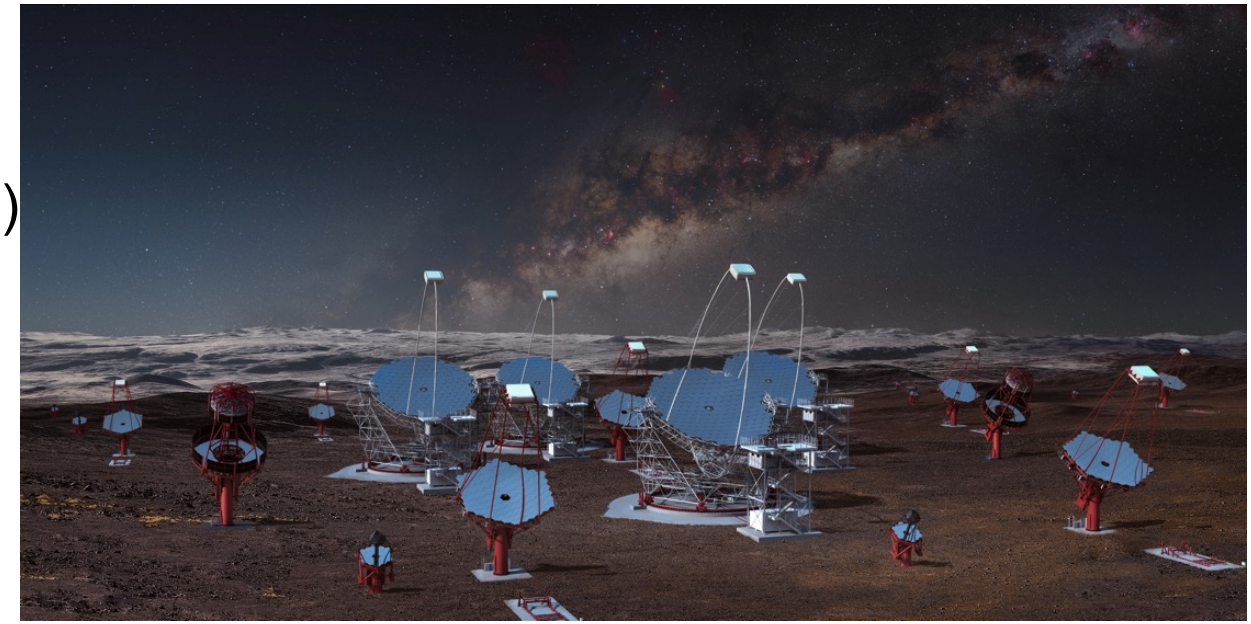
4 x 8m UTs, 4 x ATs for interferometry, 2 survey telescopes, 3.6m and NTT

Atacama Large Millimetre Array (ALMA)

Public data archive

ESO Extremely Large Telescope

Cherenkov Telescope Array (South)



News from Paranal instrumentation

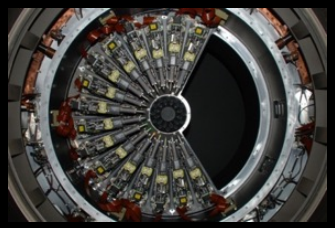

La Silla Paranal Facilities
• VLT
• Instrumentation operating, in assembly and planned
• Covers the available optical infrared wavelengths 300nm to 20µm
• Angular resolution from seeing limit to 50 µ-arcseconds
• FORS2, UVES, FLAMES, VISIR, HAWK-I, X-Shooter, AOF, KMOS, MUSE, SPHERE, ESPRESSO, CRIRES, ERIS, MOONS, MAVIS, CUBES
• VLTI
• PIONIER, GRAVITY(+), MATISSE
• VISTA
• VIRCAM → 4MOST
NTT
EFOSC2, SOFI, SOXS
3.6m
HARPS, NIRPS

VLT Instruments 2022

UT1

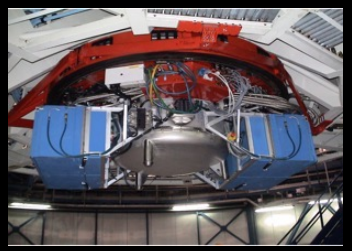
FORS2

KMOS



UT2

VISIR

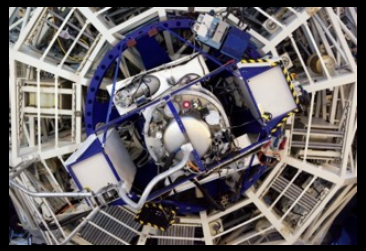


UVES

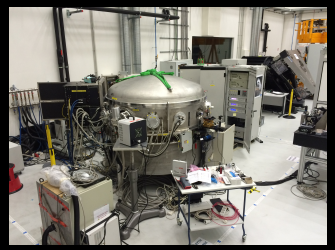
FLAMES

UT3

X-SHOOTER



CRIRES



SPHERE

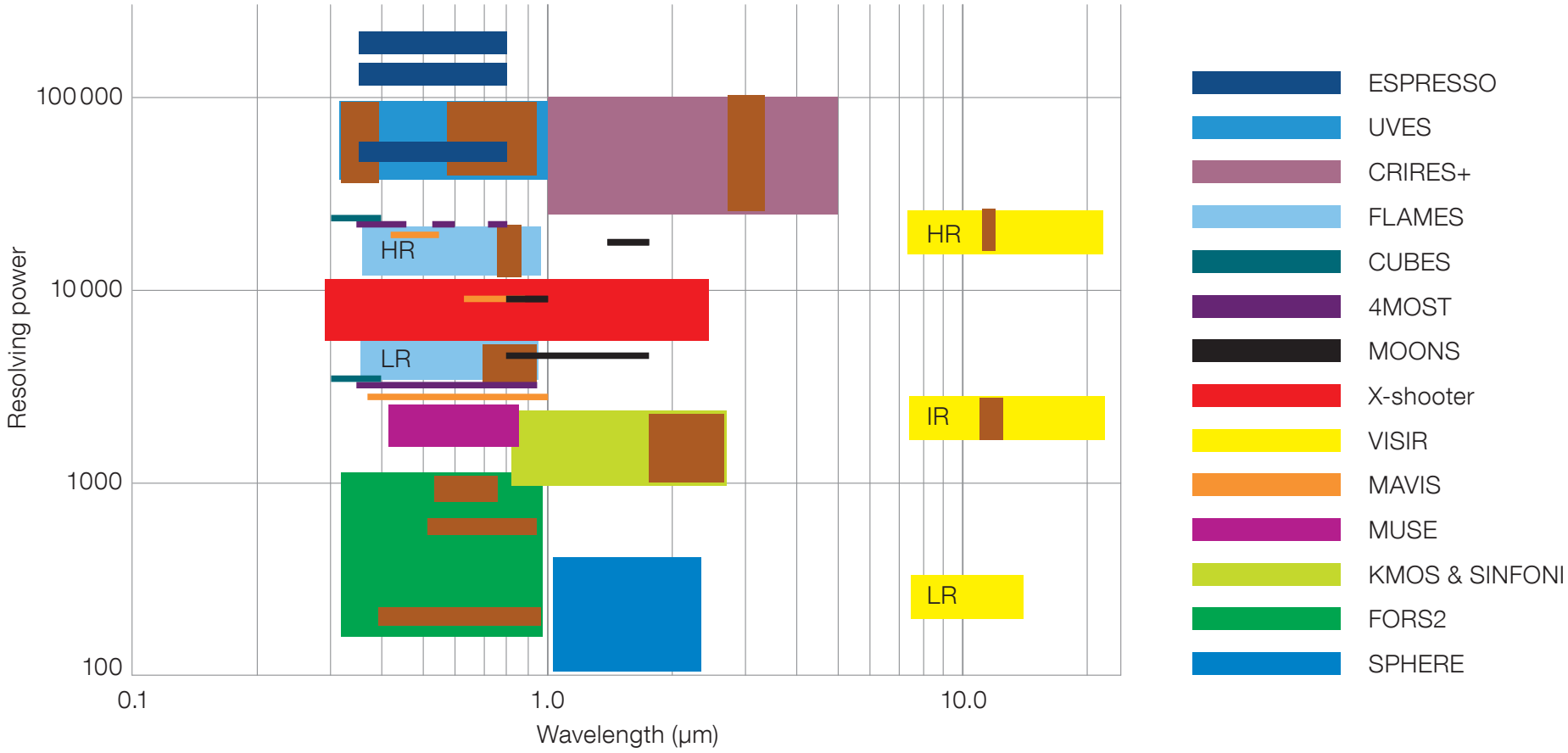
UT4

ERIS

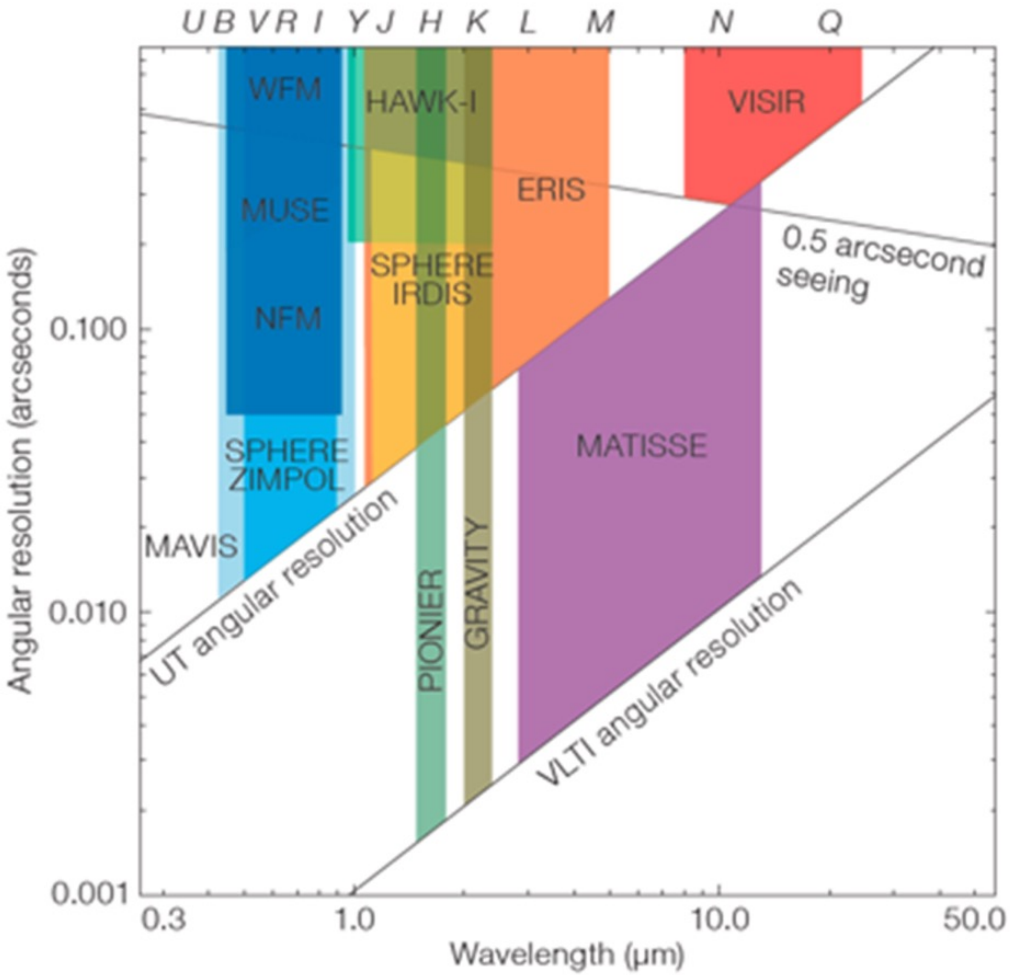
MUSE

HAWK-I

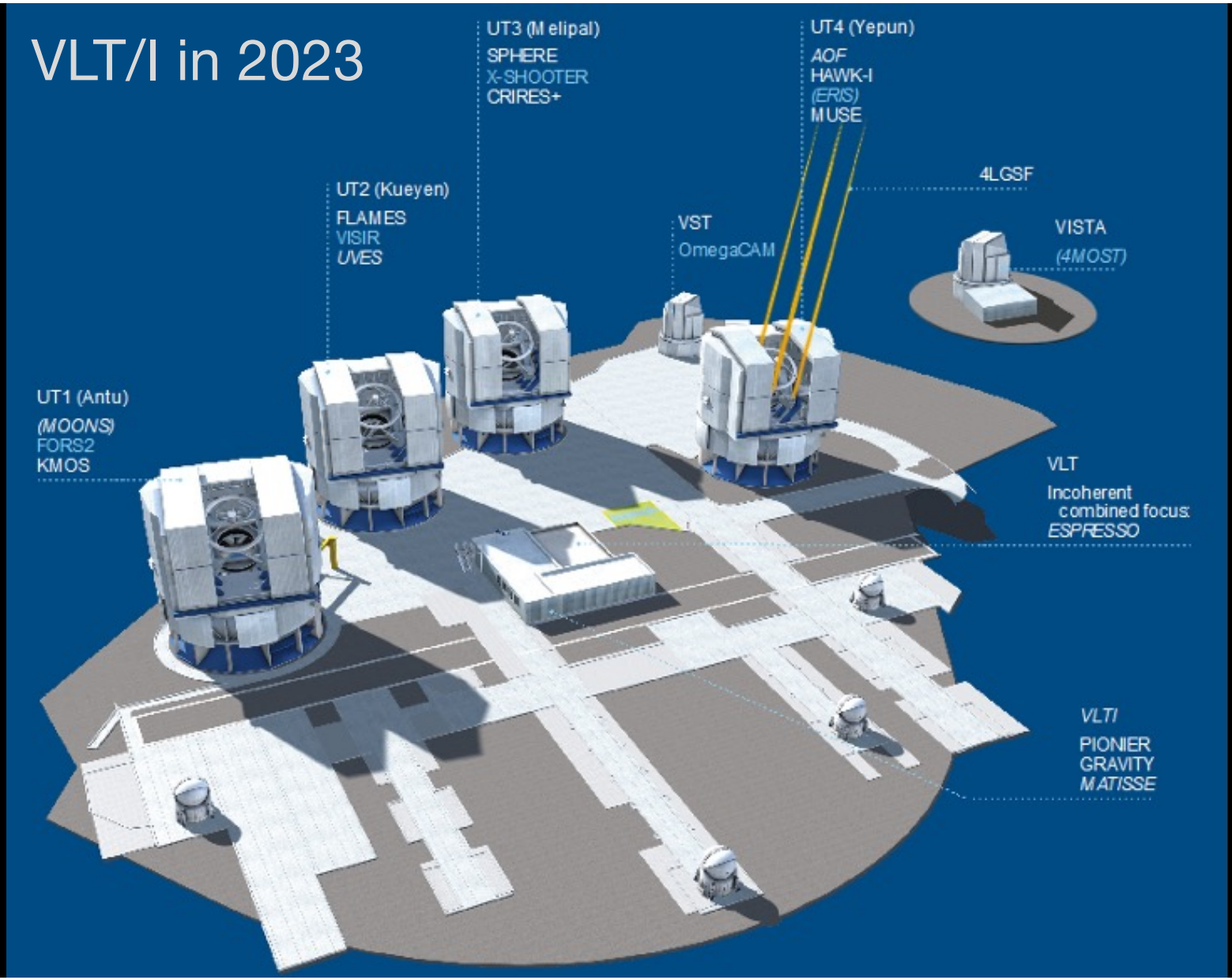
VLT Optical/Near-IR coverage



VLT/I Optical/Near-IR Coverage



VLT/I in 2023


UT3 (Melipal)
SPHERE
X-SHOOTER
CRIRES+
UT4 (Yepun)
AOF
HAWK-I
(ERIS)
MUSE
4LGSF
UT2 (Kueyen)
FLAMES
VISIR
UVES
VST
OmegaCAM
VISTA
(4MOST)
UT1 (Antu)
(MOONS)
FORS2
KMOS
VLT
Incoherent
combined focus:
ESPRESSO
VLTI
PIONIER
GRAVITY
MATISSE

Atacama Large Millimeter Array

Observe the cold universe

- wavelengths from 300μm to 1.3mm (1 THz to 200 GHz)

Global Partnership

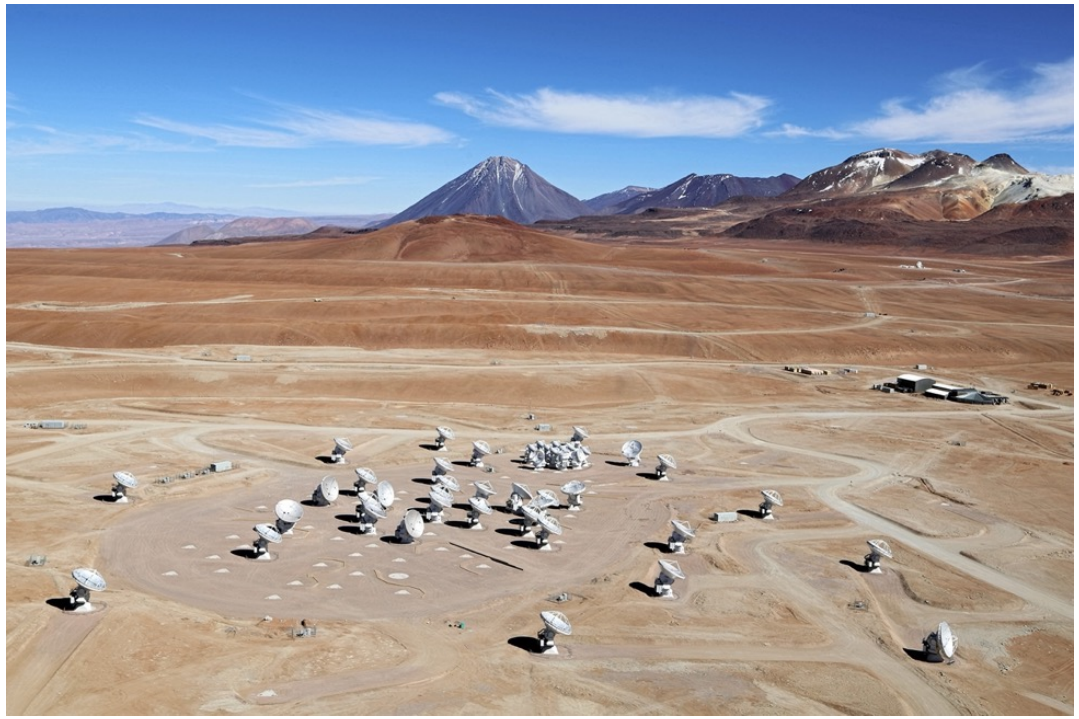
- Europe (ESO), North America (USA/NSF and Canada/NRC), East Asia (Japan/NINS, Taiwan/NSC/ASIAA, South Korea/KASI)

66 antennas located at 5000m altitude

- 50 12m antennas
- 12 7m + 4 12m antennas (compact array)

The ALMA observatory

- Partnership: ESO (37.5%), NSF (37.5%), NINS (25%)
- JAO established by the executives to run the on-site part of the observatory
- Off-site operations at the ALMA Support Centres
- ALMA Director leads the entire observatory

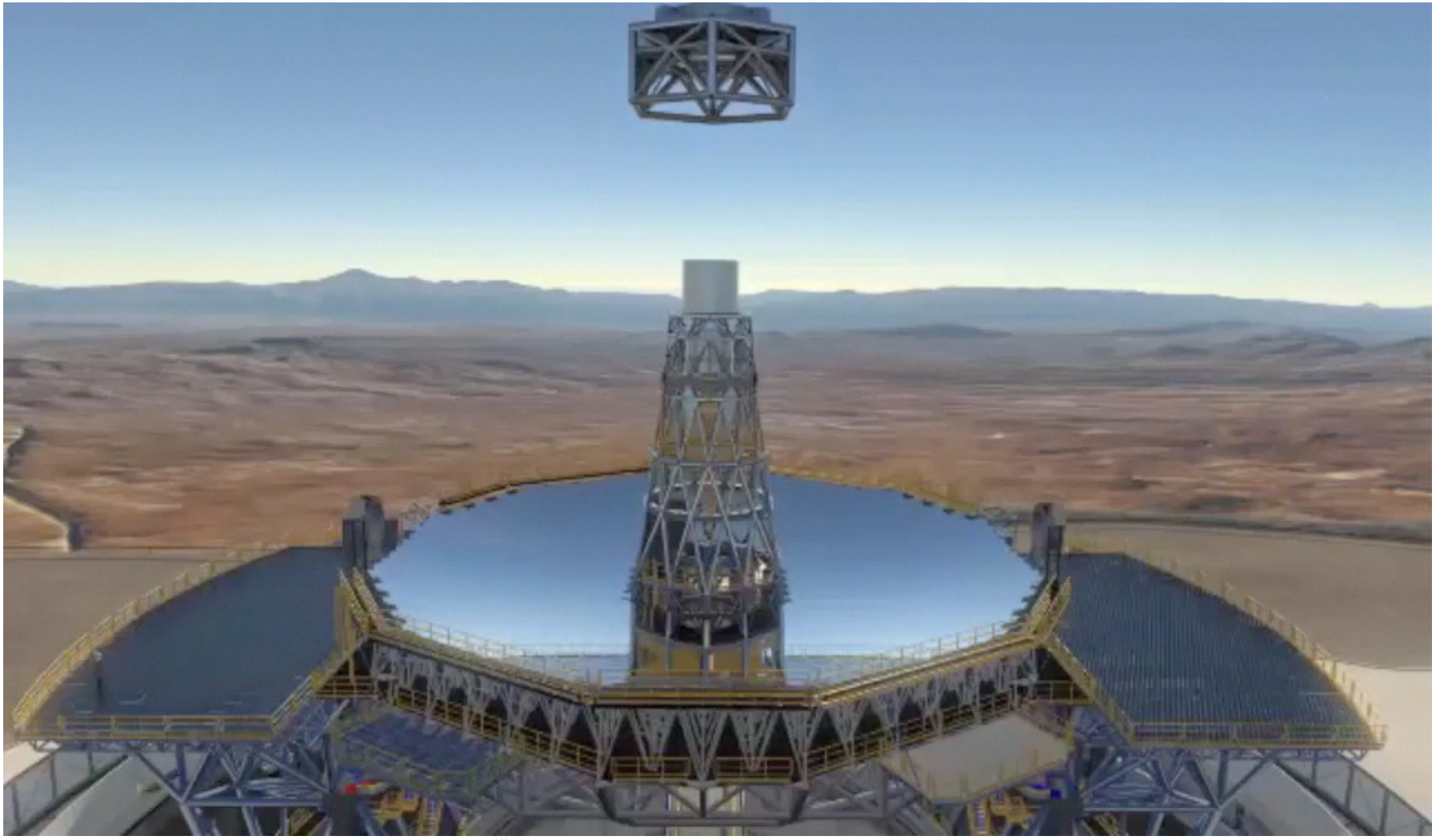


ALMA offsite activities at ESO

- Operations:
  - Technical maintenance support
  - SW development & maintenance
  - ALMA archive
  - ALMA Regional Centre (ARC) provides science operations support, including user support
    - The European ARC is led by ESO and has contributions from several nodes across Europe
- On-going development projects at ESO:
  - Band 2 receivers in pre-production
  - New Generation Observing Tool (incl rescue project)
- Contribution to Wide-band Sensitivity Upgrade (WSU) planned


ESO
60
years
ESO's upcoming
Extremely Large Telescope

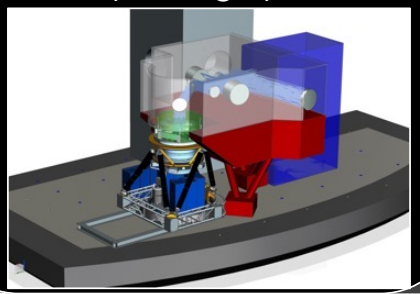
ELT Optomechanics



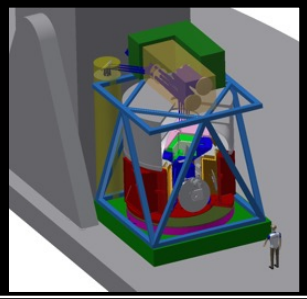
ELT Instrumentation Programme

First generation instruments (2024-25)

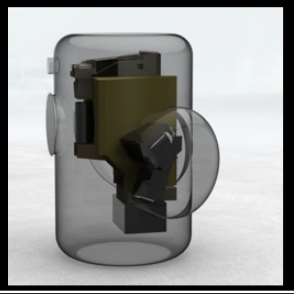
MICADO+MORFEO
Imager and single slit spectrograph



HARMONI
Integral Field Spectrograph

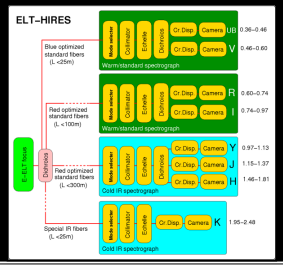


METIS
Mid-IR imager and spectrograph

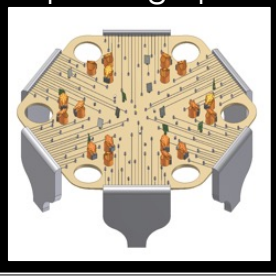


Second generation instruments (completed Phase A)

ANDES
High resolution spectrograph

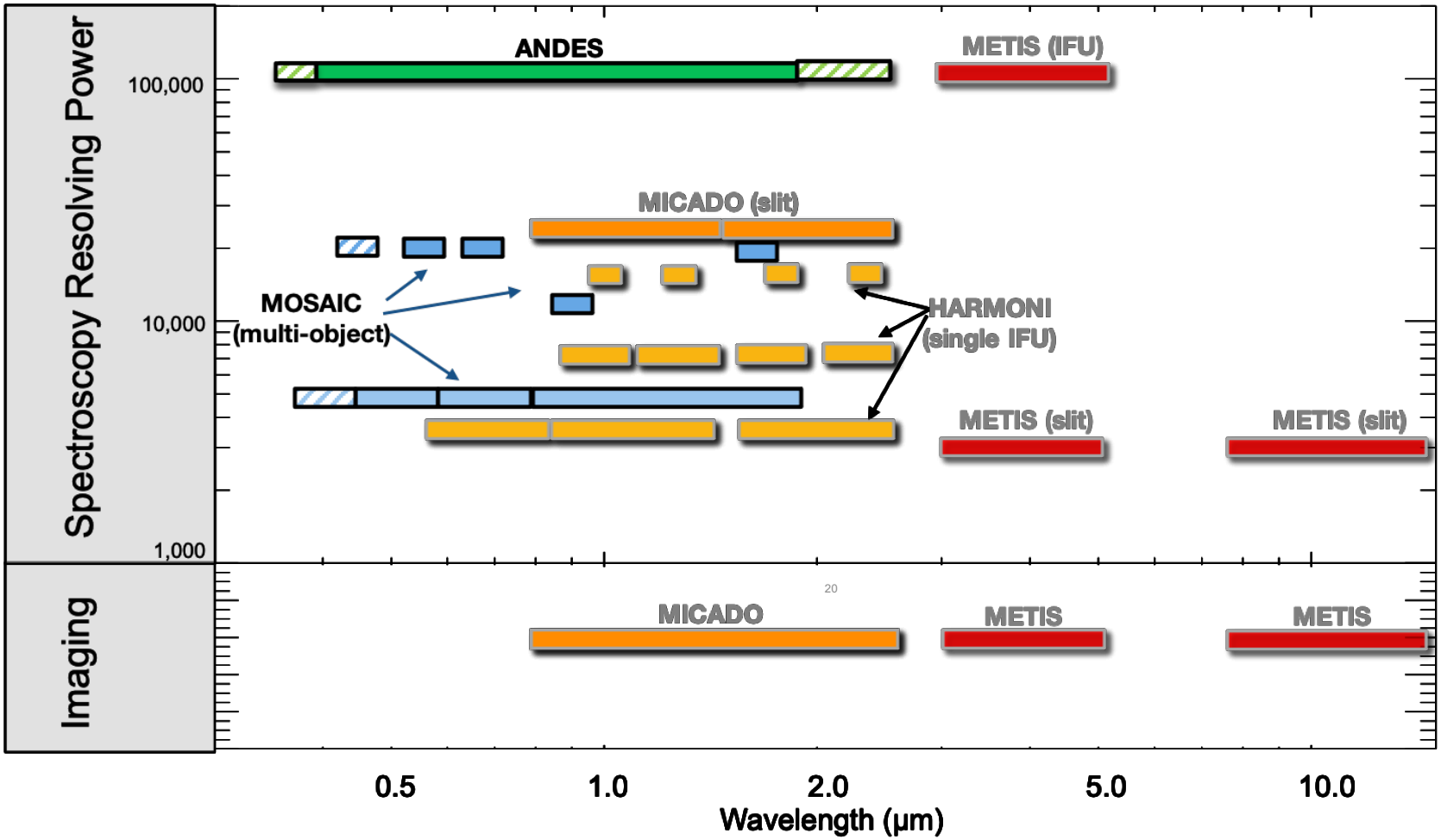


MOSAIC
Multi-object spectrograph

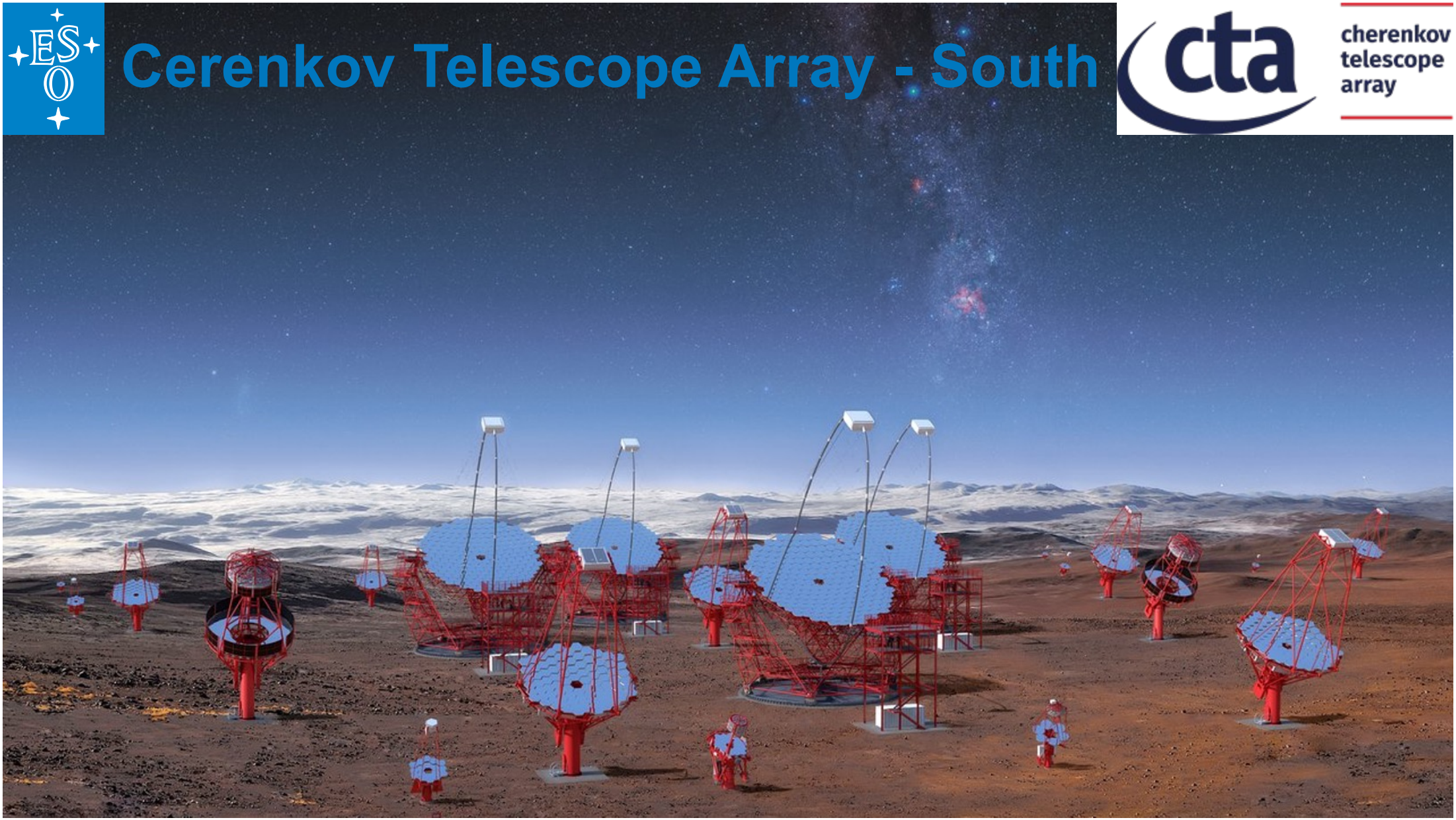


PCS
Extreme AO imager and spectrograph

ELT Capabilities

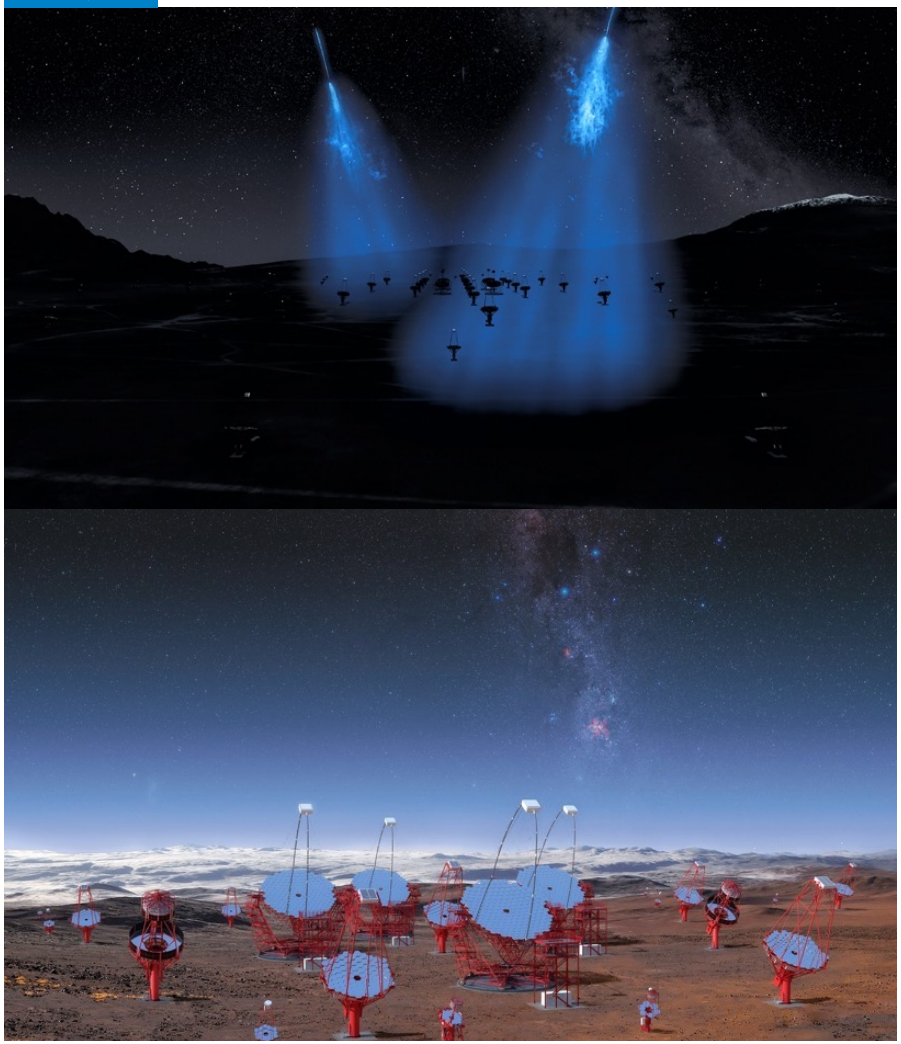


Cerenkov Telescope Array - South



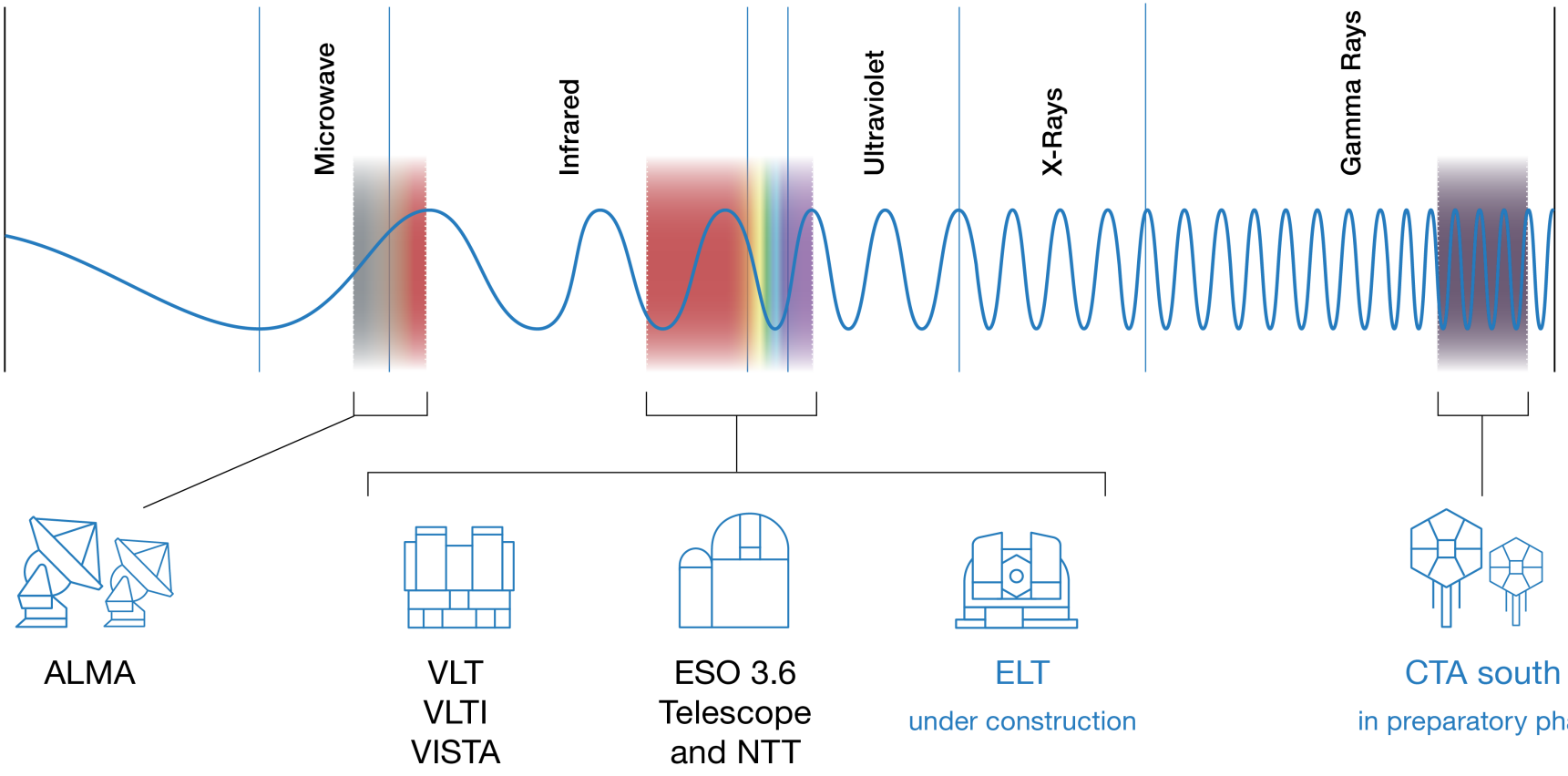
cherenkov telescope array

Čerenkov Telescope Array - South



- CTA-Southern array to be hosted and operated by ESO in the Paranal-Armazones area
- ESO is 8% partner of CTAO
- Offers important operational and scientific synergies
- Infrastructure construction ongoing
- Construction of CTA may formally start in 2023

ESO across the electromagnetic spectrum



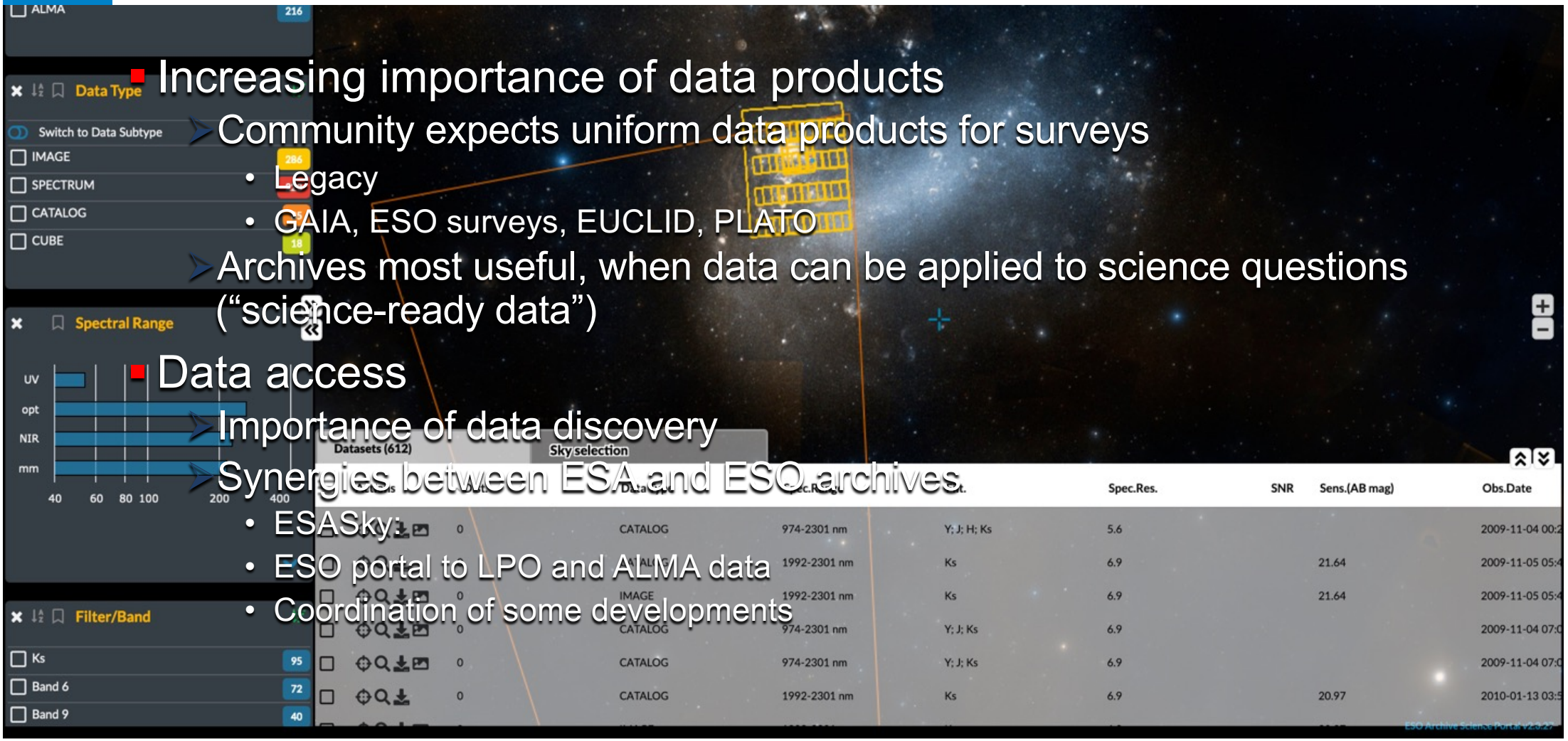
ESO Opportunities

- Flexibility
  - large instrumentation complement
- Uniqueness
  - explore special features of our observatories
    - e.g. interferometry (VLTI)
  - provide unique capabilities for simultaneous coverage of large wavelength ranges
    - e.g. observations of Comet Shoemaker-Levy 9 or Hale-Bopp, AT2019gfo/GW170817
- Complementarity
  - spectral follow-up of imaging surveys
  - monitoring of special objects

ESO – an integrated system

- ALMA and ELT: flagship facilities
- VLT: unique capabilities
  - Interferometry → VLTI
  - Large instrument complement, adaptive optics, flexibility, modern operations model
- La Silla/4m telescopes: dedicated
  - Transients: NTT; SOXS
  - Exo-planets: 3.6m; HARPS/NIRPS
  - Multi-object spectroscopy: 4MOST@VISTA
  - Platform for smaller experiments: La Silla
- ESO and ALMA Archives
  - Rich resources of optical/NIR and sub-mm data
    - Large coherent data sets from surveys
    - Advanced data products

Data Curation/Archives



- Increasing importance of data products
  - Community expects uniform data products for surveys
    - Legacy
    - GAIA, ESO surveys, EUCLID, PLATO
  - Archives most useful, when data can be applied to science questions ("science-ready data")
- Data access
  - Importance of data discovery
  - Synergies between ESA and ESO archives
    - ESASky:
    - ESO portal to LPO and ALMA data
    - Coordination of some developments

Reaching out

- ESO disseminates scientific and engineering breakthroughs of ESO's community at large and brings the public closer to science
- Organise public visits to ESO observatories
  - New model in conceptual development
- Foster engagement in STEM fields at the ESO Supernova Planetarium & Visitor centre
- Broaden support to local communities





ESO
60 years
FEET ON THE GROUND
EYES ON THE SKY