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ESO Facilities in the 2030s

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An overview of the ESO facilities that will be offered at the beginning of the next decade is presented. We describe the existing and expected capabilities and put them into context with other facilities either under construction or in development for the next decade.

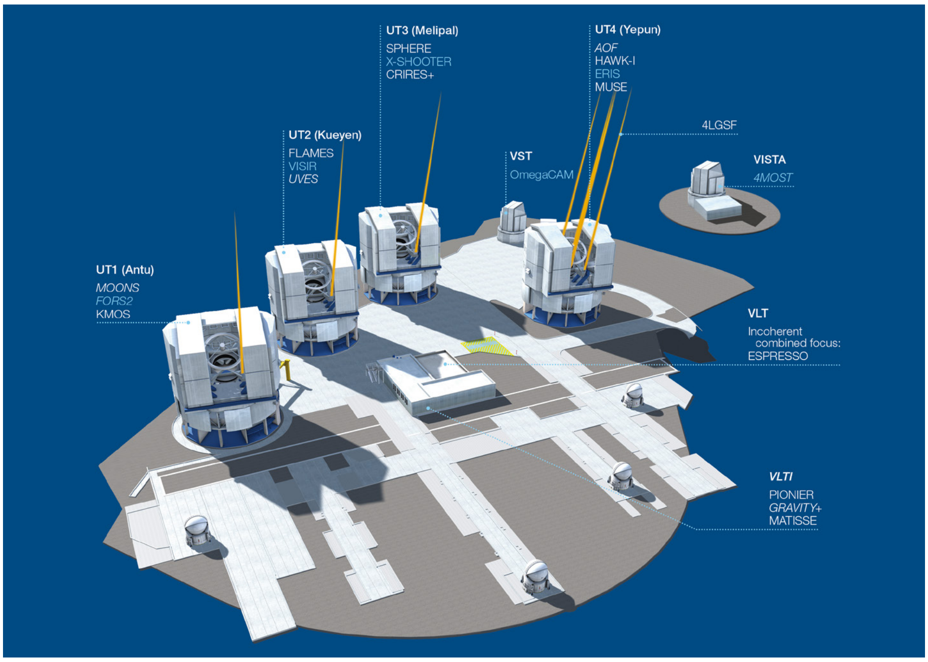

Figure 1. Instruments on the VLT/I in 2025. MOONS and the lasers on UT1, UT2 and UT3 will become operational in 2026 and 4MOST will start operations on VISTA from 2026. The VLT Survey Telescope (VST) is now a hosted telescope operated by INAF, the Italian National Institute for Astrophysics.

Introduction

Currently, ESO operates optical/near-infrared telescopes on La Silla and Paranal, while ESO's Extremely Large Telescope (ELT) on Cerro Armazones is under construction with a planned start of operations at the end of this decade. ESO is also a partner in the Atacama Large Millimeter/submillimeter Array (ALMA) observatory and in the Cerenkov Telescope Array (CTA) which plans to start operating in the next few years. ESO provides resources, such as user support and science archives, to empower the community to make best use of the offered facilities. The existing and planned ESO facilities cover a large parameter space in the electromagnetic spectrum, angular, spectral and time resolution, multiplex and observing methods. The development of the facilities follows planning that is discussed with the ESO governing bodies to derive the best synergies amongst the facilities.

ESO Facilities in the 2030s

La Silla

The future plans for the La Silla observatory were outlined in a Council document in 2024[1]. In 2030 the ESO 3.6-metre telescope, the New Technology Telescope (NTT) and several hosted telescopes will be operating. The 3.6-metre is equipped with two stable high-spectral-resolution spectrographs, one for the optical, the High Accuracy Radial velocity Planet Searcher (HARPS), and one for the near-infrared (NIR), the Near Infra Red Planet Searcher (NIRPS). They are used for highly accurate radial velocity measurements and are primarily employed to search for and characterise exoplanets. The NTT will be equipped with a medium-resolution spectrograph and imager, Son Of X-Shooter (SOXS), mostly dedicated to follow-up observations of transient sources, and will continue to host a visiting instrument, ULTRACAM, for very high-time-resolution imaging. The NTT will maintain a visitor focus for other instruments. La Silla also hosts smaller telescopes operated by consortia and universities in agreement with ESO.

Paranal

The Paranal Observatory is the home of the Very Large Telescope (VLT), which is composed of four optical-infrared Unit Telescopes (UT) with 8.2-metre primary mirrors. Each telescope has three direct foci (two Nasmyth and one Cassegrain). One UT is equipped with an adaptive optics (AO) facility consisting of four laser guide stars and a deformable secondary mirror to correct for atmospheric turbulence. By 2030 the remaining UTs will each have a single laser (being commissioned at the time of writing) and one more UT will be equipped with a deformable secondary mirror for on-axis corrections. Light from all UTs can be combined for incoherent or coherent (interferometric) beam combination. The VLT Interferometer (VLTI) can also use the four relocatable 1.8-metre Auxiliary Telescopes (AT).

The 4-metre Visible and Infrared Survey Telescope for Astronomy (VISTA) is dedicated to large surveys and will host the 4-metre Multi-Object Spectroscopic Telescope (4MOST) instrument from 2026 onwards. The 4MOST public surveys (see papers in The Messenger issues 175 and 190) have been defined for a five-year duration. Several smaller telescopes are hosted on Paranal and operated by external consortia.

The VLT/I is operated in both visitor and service modes, enabling a variety of observational options. Target of Opportunity (ToO) observations, monitoring of variable

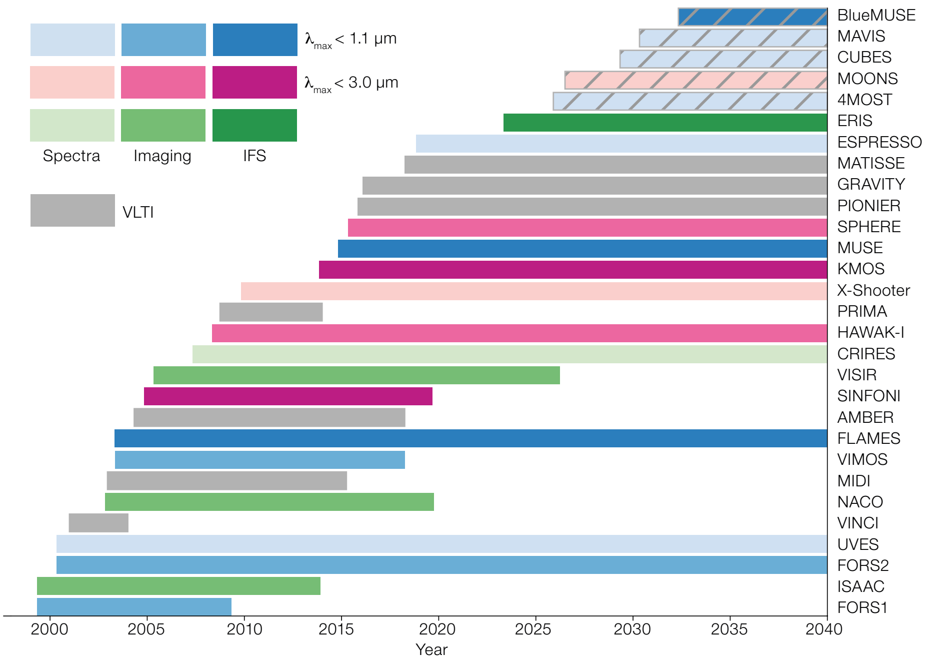

Figure 2. Past, current and future VLT/I instrumentation. The different modes are indicated with shading, while the wavelength ranges are encoded by colours. VLTI instruments are distinguished in grey and the instruments not yet in regular operation have a hatched fill.

sources and focusing on single objects have become standard with the service mode model, while public surveys have been added to enable massive coherent data samples for specific science cases. Visitor mode and delegated visitor mode observations enable real-time interaction with the telescope operators and can be used for specialised observation techniques or timing constraints. The end-to-end data flow model, which ESO implemented for VLT operations, has been very successful and has continuously been adapted to new technologies and observational needs.

The VLT instrumentation has been developed over many years and sees continuous upgrades (Figure 2). With twelve foci available, the instrumentation consists of 'workhorse' instruments, which cater for a large community and have versatile applications to many astrophysical problems, and specialised instruments to serve particular and more focused needs. It is an advantage that the VLT offers so many foci and can also serve specialised techniques and communities. While twelve VLT instruments started operations in its first decade, only four new instruments became available in the second decade. The VLT receives on average a new instrument every two years. This pace will be maintained with the current instrument plan. Five new instruments are in development and a roadmap for future instruments should be added in the coming years through the VLT beyond 2030 process[2] (Mérand & Leibundgut, 2019).

The current VLT instrumentation[3] covers a large parameter space and offers integral-field spectroscopy (three with AO assistance), several multi-object spectroscopic capabilities, highly stable spectrographs, fast photometry, coronagraphy and polarimetry.

New instruments will expand the current parameter range. The Multi-Object Optical and Near-infrared Spectrograph (MOONS) will add massive multi-object (1000 fibres) spectroscopy ($R \approx 5000$ and $R \approx 20\,000$) covering the wavelength range from 650 nm to 1.8 µm. The Cassegrain U-band Efficient Spectrograph (CUBES) will cover the bluest part of the accessible spectrum from 300 to 400 nm at $R \approx 7000$ and $R \approx 20\,000$ to complement the Ultraviolet and Visual Echelle Spectrograph (UVES) and the Echelle SPectrograph for Rocky Exoplanet and Stable Spectroscopic Observations (ESPRESSO). The Multi-conjugate-adaptive-optics-Assisted Visible Imager and Spectrograph (MAVIS) will provide an AO-supported imager and integral-field spectrograph at optical wavelengths. The large-area (1 square degree) integral-field spectrograph BlueMUSE builds on the success of the Multi Unit Spectroscopic Explorer (MUSE) and will extend the wavelength range from 350 to 500 nm with an average $R \approx 4000$. In general, VLT instrumentation in the future will complement the ELT by concentrating on bluer wavelengths, wider-field-of-view applications and polarimetry.

The VLTI hosts three instruments, each able to recombine light from four telescopes simultaneously, either four UTs or four ATs. The instruments complement each other in their wavelength coverage: the Precision Integrated-Optics Near-infrared Imaging ExpeRiment (PIONIER) covers the H band (1.4–1.7 µm, resolving power $R \approx 30$), GRAVITY covers the K band (2.0–2.45 µm, $R \approx 50$, 500, 4000) and the Multi-AperTure mid-Infrared SpectroScopic Experiment (MATISSE) operates in the L, M and N bands (3–12 µm, R from 30 to 1000). Additionally, the GRAVITY instrument is equipped with a fringe tracker and astrometric/phase referencing capabilities, making it a flexible and sensitive instrument. The fringe tracker of GRAVITY can also be used with MATISSE to increase its sensitivity.

All VLTI telescopes are equipped with AO. By 2026 the UTs will have new visible wavefront sensors, new deformable mirrors and laser guide stars to increase the sensitivity and sky coverage of GRAVITY in its off-axis fringe-tracking mode. This will increase the sensitivity of the GRAVITY fringe tracker to $K \approx 12$. For reference, as of 2025 GRAVITY has a sensitivity of $K \approx 11$. In the past decade, the VLTI has had a sensitivity gain of close to a factor of 250 for fringe tracking, and of the order of 100 000 for the science target, reaching $K \approx 20$ and opening a wealth of science cases: unprecedented astrometry, spectroscopy and inner-working angle detection (unmatched by any other facility on the ground or in space).

The VLTI has a typical angular resolution of a few milliarcseconds (mas), and astrometric precision of around 50 µas (see

Figure 3). This depends on the baselines (up to 140 metres for the UTs, 200 metres for the ATs), wavelength, and intrinsic precision of the instrument. This will enable a wide range of science requiring high spatial resolution and the VLTI will offer an angular resolution only matched by the Event Horizon Telescope, even in the era of the ELT and ALMA2030.

PIONIER was originally a visitor instrument from the 2010s; now another visiting instrument is in development, ASGARD, which includes a shorter wavelength spectrograph (~1–3 μm) for planet detection at extreme inner-working angles. It remains to be seen what performance such systems can achieve and how applicable ASGARD's capabilities are to a wider community. If ASGARD performs well, offering it to the ESO community might be considered.

With the advent of new and unique science cases, the impact of the VLTI will only grow, thanks to its unique parameter space in terms of angular resolution, wavelength coverage and sensitivity.

ALMA

ALMA is an interferometer located on the Chajnantor plateau at an altitude of 5000 metres, observing at millimetre and submillimetre wavelengths and operated jointly by ESO, the National Radio Astronomy Observatory (representing North America) and the National Astronomical Observatory of Japan (representing East Asia).

ALMA is composed of 66 antennas arranged in three different sub-arrays: a main array (the ‘12-metre Array’) with 50 12-metre antennas, and the Atacama Compact Array (ACA), with twelve 7-metre antennas (the ‘7-metre Array’) and four 12-metre (‘Total Power’) antennas. The antennas of the 12-metre Array can be placed at different locations on the plateau to form arrays with different distributions of baseline lengths from 15 metres to 16 kilometres to enable a range of angular resolutions and recoverable spatial scales. The ACA operates in a fixed configuration and is used to image large-scale structures. ALMA offers unique capabilities in the (sub)millimetre range and an unmatched dynamical range. In particular, the combination of sensitivity, angular resolution and frequency coverage has enabled the production of images that have changed our view of the Universe.

All ALMA observations are performed in service mode and are dynamically scheduled, except for very long baseline interferometry (VLBI) or Phased-Array observations, which are executed in dedicated campaigns. Transient and variable phenomena are accessible via ToO and monitoring observations and scientific cases requiring multi-wavelength coverage benefit from the possibility of joint proposals with JWST, the Very Large Array and the VLT.

ALMA can routinely obtain sub-mJy point source sensitivity at all observing frequencies, within ten minutes of integration time thanks to the 6569 m^2 total surface area of its antennas and the low-noise receivers at their frontend. This is coupled to an exquisite image fidelity at spatial scales all the way from total power to 4.8 mas, astrometric precision of 5% (10%) of the angular resolution for resolutions coarser/finer than 150 mas, and continuous frequency coverage from 35 to 950 GHz in all observable atmospheric windows[a] with sufficient resolution to resolve thermal line widths (0.01 km s^{-1} at 870 GHz).

ALMA offers a mosaicking capability with up to 150 pointings per mosaic. This has proven to be fundamental to image areas as large as a few square arcminutes and by 2030 is likely to be even more widely used, as are ALMA’s polarisation capabilities which have been seeing increased use in fields as diverse as protoplanetary discs or distant galaxies.

The very highest spatial resolution is offered when ALMA is operated as part of a VLBI network and this will continue to be offered in 2030. To perform the VLBI observations the ALMA array is ‘phased’. In this mode, the signal of the ALMA antennas is not correlated for interferometric imaging but simply summed up, to obtain a collecting area equivalent to that of a single dish with a diameter of 74 metres. This capability is now used for experiments that need high sensitivity and time resolution rather than images, such as the search for pulsars around Sgr A* at the centre of our Milky Way.

The line spectral resolution and sensitivity have given ALMA unique scientific capabilities which will be enhanced in the coming years, and following recommendations in the ALMA 2030 development roadmap ALMA's bandwidth will be increased by a factor of two to four by the Wideband Sensitivity Upgrade (WSU). New science goals and requirements have been defined for this upgrade, reflecting the novel science enabled by the enlarged instantaneous bandwidth. Besides ensuring spectral resolutions of 0.12 (35 GHz ν^{-1}) km s^{-1} over the full correlated bandwidth, already surpassing the current finest achievable resolution, the WSU will also enable ultra-high spectral resolution, of the order of 15 m s^{-1} at 35 GHz, over a limited bandwidth. The highest gains in terms of mapping speed are expected for scientific cases requiring high spectral resolution and simultaneous wide bandwidth, such as redshift searches of galaxies at the epoch of reionisation and beyond or mapping the chemical complexity of protoplanetary discs. Ultra-high resolution will enable, for example, characterisation of line-of-sight magnetic field strength through observations of the molecular Zeeman effect.

Data products are quality assessed before delivery to users, proceeding now largely automatically. In the case of Large Programmes, advanced data products from the proposing team are also fed back to the ALMA archive. European researchers are supported by the European ARC[4], which is organised as a coordinated network of scientific support nodes distributed across Europe, enabling close contact with the community as well as assistance for the use of special observing modes and techniques.

Armazones

ESO’s ELT, with its 39-metre primary mirror, will be the largest optical and infrared light telescope in the world. Its unique five-mirror design will provide an unvignetted 10-arcminute-diameter field of view (FoV). Thanks to the combined activation of its built-in adaptive M4 mirror and fast tip-tilt M5, it will be able to correct for atmospheric turbulence as well as the vibrations of the telescope structure induced by its movement and wind buffeting, a crucial aspect that will allow the ELT to reach its diffraction limit. Each of the two Nasmyth platforms will feature one straight-through and two lateral instrument ports. ELT operations will be fully integrated within Paranal operations following an evolved version of the current end-to-end science operations model.

By the mid-2030s, the ELT will have a complement of six instruments providing imaging and spectroscopy spanning from the optical to 20 μm and functioning in an integrated operational model with the VLT/I.

The Multi-AO Imaging CAmera for Deep Observations (MICADO) camera and spectrograph will first be mounted behind a set of static relay optics and operated with a single conjugate adaptive optics (SCAO) module providing a Strehl ratio of 65% in the *K* band. MICADO is expected to match the sensitivity of instruments on the JWST and to have angular resolution around six times higher. It will achieve this with two imaging plate scales: 1.5 mas (19 × 19-arcsecond FoV) and 4 mas (50.5 × 50.5-arcsecond FoV) and with up to 30 broad-, intermediate-, and narrow-band filters. The instrument will have an astrometric imaging accuracy of 50 μas (the goal being 10 μas) for relative astrometry of a given field at different epochs, essential for black hole observations in nearby galaxies and the Milky Way.

A coronagraphic imaging mode will be provided by the inclusion of focal- and pupil-plane masks and by observing in a pupil-tracking mode to allow angular differential imaging with a contrast requirement of 10^{-4} (10^{-5}) at 100 (300) mas separation from the central star. MICADO also offers slit spectroscopy over a wide wavelength range, optimised for rapid characterisation of faint point-sources. Two settings will provide coverage from 0.8 to 2.45 μm with resolving power of up to 20 000 with a 16-mas-wide slit.

The Multiconjugate adaptive Optics Relay For ELT Observations (MORFEO), the AO system for the ELT, will use two post-focal deformable mirrors together with the telescope's deformable M4 to provide a uniform point spread function for images over a wide FoV. MORFEO will also provide the AO corrections needed for the High Angular Resolution Monolithic Optical Near-Infrared spectrograph (HARMONI).

MORFEO will measure atmospheric turbulence with three natural guide stars (NGS) and six laser guide stars (LGS). The NGS (limiting magnitude $H \leq 16$) will be selected from an annular patrol field around the science field, up to 160 arcseconds from the field centre, and will provide corrections of the low-order turbulence modes; higher-order corrections will be provided from observations of the six LGS on an asterism of 45-arcsecond radius. MORFEO will provide MICADO with a uniform point spread function with a Strehl ratio of greater than 30% in the *K* band under median conditions over a 1-arcminute-diameter FoV for a sky coverage of greater than 50% at the South Galactic Pole. Under the best atmospheric conditions, MORFEO will provide Strehl ratios greater than 50% in the *K* band over a smaller 20-arcsecond FoV, enabling diffraction-limited observations at shorter wavelengths.

The Mid-infrared ELT Imager and Spectrograph (METIS) is an imager and spectrograph that will provide many modes of operation at mid-IR wavelengths (3 to 14 μm). METIS will be highly complementary to JWST offering both higher angular and spectral resolution. Two different detector technologies will be used to cover the METIS wavelength range, leading to a natural split in the instrument into two modules covering the *L* and *M* atmospheric windows and the *N*-band windows.

The modules are fed by the METIS common cryogenic fore-optics that provide a derotator, a fast (~1 Hz) chopping mirror and a suite of focal- and pupil-plane masks for coronagraphy. A dichroic in the fore-optics directs *K*-band light to a SCAO module based on a pyramid wavefront sensor. The guide star for SCAO can be selected anywhere in a 27–arcsecond-diameter FoV.

The *LM* imager offers a plate scale of 5 mas pixel^{-1} to give a 10.5 × 10.5-arcsecond FoV. A long-slit spectroscopic mode is implemented in the imager module by replacing the filters with separate grisms for the *L* and *M* bands. At a resolving power $R \approx 1400$, the *L* band from 2.9 to 4.2 μm will be covered in a single setting; likewise at $R \approx 1900$ the *M* band from 4.5 to 5.2 μm can be observed. A parallel situation exists in the *N* band imager: the imager has 7 mas pixel^{-1} for a FoV of 13.5 × 13.5 arcseconds and there is an option for spectroscopy from 7.5 to 13.5 μm with an *N*-band grism at $R \approx 400$. METIS also offers integral-field spectroscopy in the *L* and *M* bands over a FoV of 0.6 × 0.9 arcsecond (8-mas spaxels) and at very high spectral resolving power ($R \approx 100\,000$). The coronagraphic masks can also be used in combination with the Integral Field Unit (IFU) spectrograph.

HARMONI will provide the ELT with a comprehensive spectroscopic capability spanning the red optical to the *K* band. At the time of writing, HARMONI is undergoing an optimisation process and detailed instrument characteristics are still under discussion. This instrument will enable different spatial resolutions under the full range of atmospheric conditions. It will have both a SCAO (when a bright star [$V < 17$] is available) and a multiple LGS-assisted AO mode to correct for atmospheric turbulence, providing near diffraction-limited hyper-spectral imaging over a large fraction of the sky using an IFU with an image slicer. Finally, HARMONI will feature a dedicated high contrast arm to achive high contrast at small working angles in particular for the study of exoplanets.

The ArmazoNes high Dispersion Echelle Spectrograph (ANDES) will provide a high-resolving-power, single-object spectrograph ($R \approx 100\,000$) designed to tackle key ELT science cases, including the characterisation of the atmospheres of exoplanets and a direct measurement of the expansion of the Universe (the Sandage test). Both optical and NIR wavelengths (0.4 to 1.8 μm) are covered simultaneously using a highly modular instrument design. As a goal, the full scope of this instrument may extend the wavelength coverage into the *U* band (0.35 μm). To deliver the scientific goals, ANDES must be highly stable over long timescales. The instrument will be housed in a thermally controlled chamber and calibrated using a laser frequency comb to reach a stability of the wavelength calibration accuracy of less than 1 m s^{-1} over 24 hours, with a long-term stability goal of less than 0.02 m s^{-1} over 10 years.

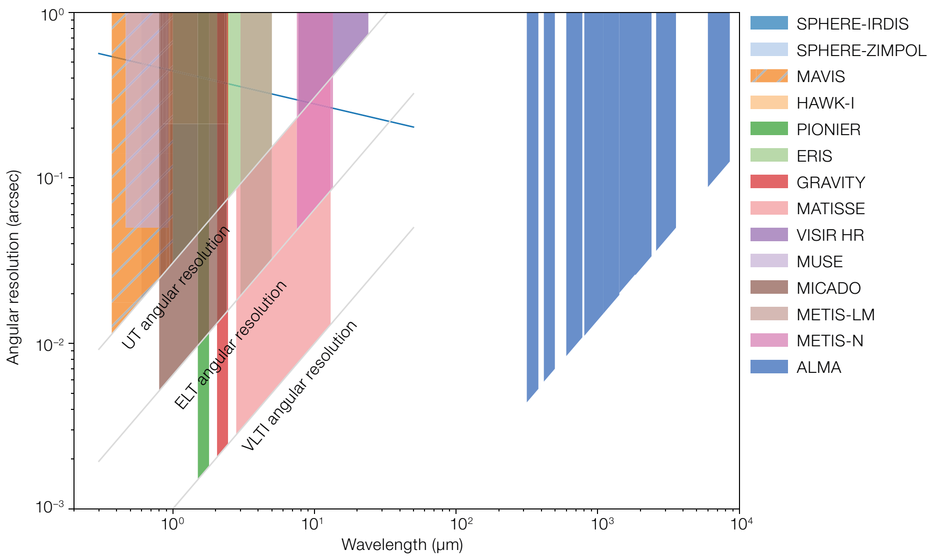

Figure 3. The angular resolution of the optical/NIR telescopes and ALMA vs offered wavelengths. The blue line shows a seeing limit of 0.5 arcseconds, while the diffraction limits of the VLT UTs and the ELT are indicated. The VLTI and ALMA reach the highest angular resolutions.

The MOSAIC fibre-based multi-object spectrograph will be mounted at one of the straight-through instrument ports. It will exploit a patrol field of greater than 7 arcminutes in diameter and has an overall wavelength range from 0.39 to 1.8 μm. In the standard multi-object spectrograph mode, MOSAIC will offer a multiplex of 140 in the visible at low resolution (R = 4000) over the full range from 0.39 to 0.95 μm and a multiplex of 65 at high resolution (R = 19 000) over four available wavelengths windows. It will offer a multiplex of 180 in the near-IR covering the range 0.95 μm to 1.8 μm at low resolution (R = 4000) or the window from 1.523 μm to 1.62 μm at R = 18 000. The visible and near-IR bands will operate in parallel. In addition, in the NIR only (0.95 to 1.8 μm) eight mini-IFUs with FoV of 2.2 arcminutes and spaxels of 150 mas will be provided. Using the adaptive M4 of the ELT, Ground Layer AO using a combination of NGSs and LGSs, will enhance the natural seeing of the telescope, providing both high sensitivity to point sources and spatial resolution well matched to observations of faint, high-redshift galaxies in the mini-IFU mode.

The characterisation of extra-solar planets is one of the driving goals of the ELT, with the search for an Earth-twin being the most challenging of these goals. The instruments currently being built for the telescope include many features, such as coronagraphy and high spectral resolving power, which will provide important advances in the field. The planned ELT instrument for this science case is the ELT's Planetary Camera and Spectrograph (PCS). The goal for this instrument is to reach a contrast of 10^{-8} at 15 mas and 10^{-9} contrast at 100 mas from the star. Before launching the design phase of the instrument itself, ESO will invest in research and development of fast deformable mirrors for eXtreme Adaptive Optics (XAO) and predictive control algorithms. Once the technologies are demonstrated to a sufficiently high level to remove the risks in the instrument design, the PCS will become the next instrument to enter the preliminary design phase, but this is not expected for the 2030s landscape.

Cerenkov Telescope Array

The Cerenkov Telescope Array (CTA) is the next-generation ground-based facility for high-energy (from 20 GeV to 300 TeV) gamma-ray astronomy and the CTA Observatory (CTAO) will be operated with sites in both the northern and southern hemispheres. The CTA will use arrays of three telescope types optimised to cover different energy ranges. ESO will host the southern array on a site close to Paranal and will have access to observing time with both arrays (10% north and 10% south).

Cosmic gamma ray production is dominated by two processes: inverse Compton scattering and high-energy neutral pion decay. High-energy electrons and high-energy pions are produced in, for example, supernovae and shock fronts of their remnants, neutron stars/pulsars, stellar binaries (including cases where one partner is a black hole), or in the jets of supermassive black holes (in active galactic nuclei). The spectrum of the gamma rays reflects that of the primary particles. Because energetic electrons lose energy more quickly the higher their energy, the spectrum strongly constrains the electron production mechanism or points to the acceleration of high-energy protons.

The CTAO project headquarters are housed in Bologna, with the science data management centre in Zeuthen near Berlin. While the northern array is already building four of the Large-Sized Telescopes (LSTs), the southern site infrastructure is being developed in the expectation of starting operations in 2027. The creation of the CTAO European Research Infrastructure Consortium, finalised in January 2025, enables the observatory's construction to advance rapidly, providing the CTAO with the legal stability and administrative structure to integrate and operate to control the telescopes and their supporting devices on-site, and to manage data processing.

Synergies between ESO facilities

ESO offers a unique combination of observational resources. Optical/near-infrared telescopes with primary mirror sizes from 4 metres to 40 metres will be offered by the end of the decade. Interferometry with 8-metre telescopes out to 140-metre baselines provides access to angular scales of microarcseconds. ALMA represents the leading millimetre/submillimetre observatory and access to the CTA offers a window to very high-energy astrophysics. Figure 3 exhibits the complementarity of the interferometers VLTI and ALMA in terms of angular resolution.

The ESO proposal system allows users to request several facilities in a single proposal (for example, joint ALMA-VLT/I proposals). All ESO observatories are operated in a flexible operational model, which enables time-domain observations from seconds (through rapid response) to monitoring of objects over decades, and large public surveys, in addition to regular observing programmes.

Summary

In 10 years, full-sky maps will be available in the γ-ray and X-ray from the INTErnational Gamma-Ray Astrophysics Laboratory (INTEGRAL), the Fermi Gamma-ray Space Telescope and the extended ROentgen Survey with an Imaging Telescope Array (eROSITA), in the ultraviolet from the UltraViolet EXplorer (UVEX), in the optical and infrared from Gaia, the Legacy Survey of Space and Time (LSST), the Two Micron All-Sky Survey (2MASS), VISTA, EUCLID, the Spectro-Photometer for the History of the Universe, Epoch of Reionization, and ices Explorer (SPHEREx), the Wide-field Infrared Survey Explorer (WISE) and the Nancy Grace Roman Space Telescope, and in the radio from the Square Kilometre Array and its precursors. Various archives (ESO, ESA, the Mikulski Archive for Space Telescopes [MAST]) will provide detailed information on many individual sources. The variable sky will be accessible through the archives from the Zwicky Transient Facility, the Asteroid Terrestrial-impact Last Alert System (ATLAS), the Panoramic Survey Telescope And Rapid Response System (PanSTARRS) and the Vera Rubin Observatory. Archives will be the backbones of many scientific projects.

In 2030 ESO will be providing a large portfolio of facilities covering the electromagnetic spectrum from the optical atmospheric cutoff (near 300 nm) through the infrared (10 μm) to 9.6 mm offering individual 4-metre, 8-metre and 40-metre telescopes and 12-metre antennas. Infrared interferometry to 200-metre baselines and millimetre/submillimetre interferometry to 16 kilometres will be offered. The instrumental capabilities will cover many observing methods, including AO accessible for large parts of the sky, multi-object instruments, and modern operations models, which enable quick reaction and monitoring capabilities. Data archives will offer advanced data products in addition to the raw data. The millimetre/submillimetre wavelength region will continue to be accessible with a newly upgraded ALMA, with improved sensitivity and extended simultaneous bandwidth coverage, providing access to cool, thermal emitters and non-thermal processes, such as synchrotron emission. Cosmic-ray astrophysics will be enabled by the CTA to access the most energetic phenomena in the Universe. ESO will provide the largest and most varied ground-based facilities in a single organisation.

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Links

[1] La Silla observatory plans: https://www.eso.org/public/about-eso/committees/cou/cou-168th/external/Cou_2127_Science_Prospects_for_La_Silla_in_the_Coming_Decade_CoC105_8_9_Oct_2024_27092024.pdf
[2] VLT beyond 2030 conference: https://www.eso.org/sci/meetings/2026/VLT_beyond_2030.html
[3] Current VLT instrumentation: https://www.eso.org/sci/facilities/lpo/cfp/cfp116/instrument_summary.html.html
[4] European ARC: https://www.eso.org/sci/facilities/alma/arc.html

Notes

[a] Band 2, planned to be available in 2026, will cover the only remaining gap of 67–90 GHz.

G. Hüdepohl (atacamaphoto.com)/ESO

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Middle: ESO/C. Malin (christophmalin.com)
Right: Gabriel Pérez Diaz (IAC)/Marc-André Besel (CTAO)/ESO/ N. Risinger (skysurvey.org)

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