

ESO – Your science under Chilean skies

Marina Rejkuba

European Southern Observatory

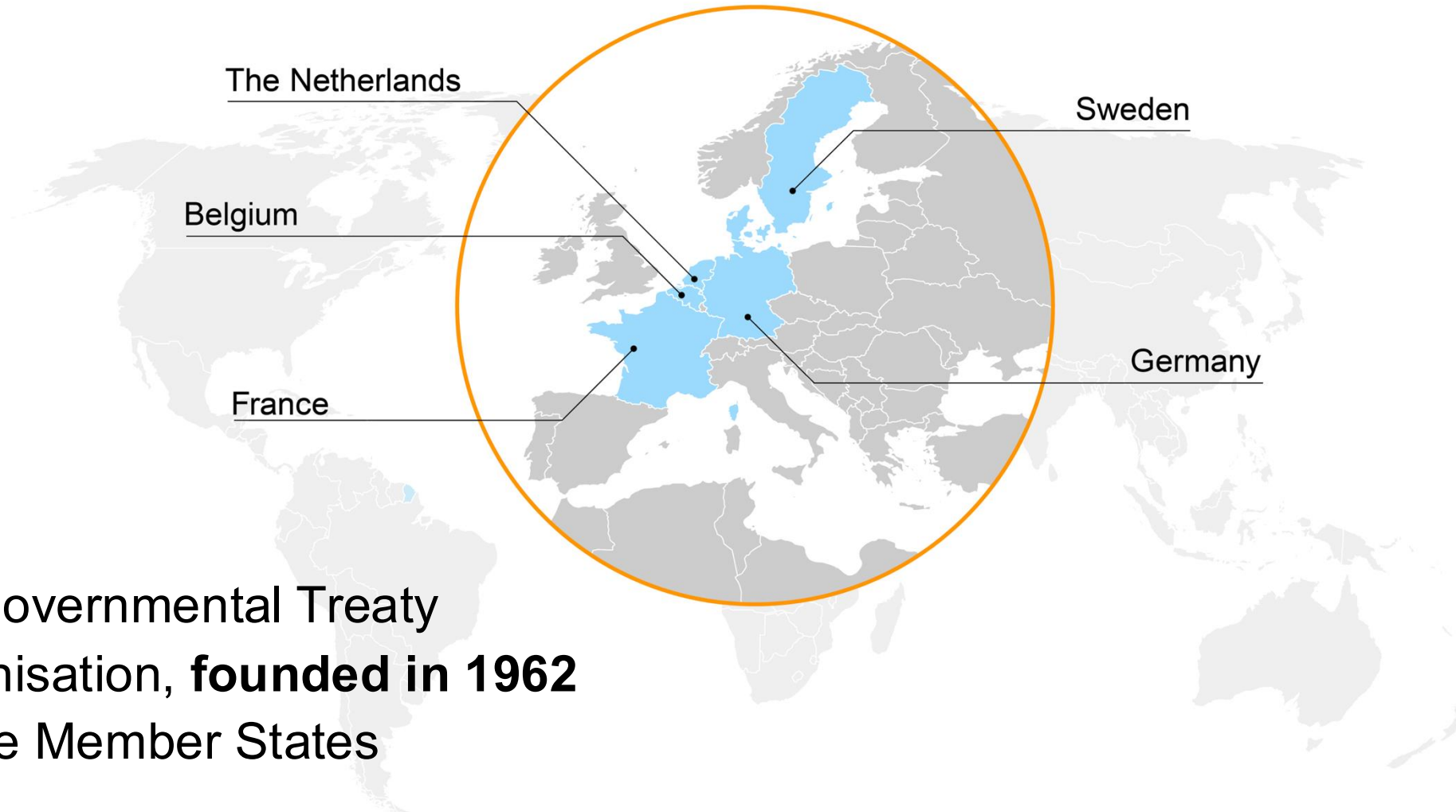




The European Southern Observatory

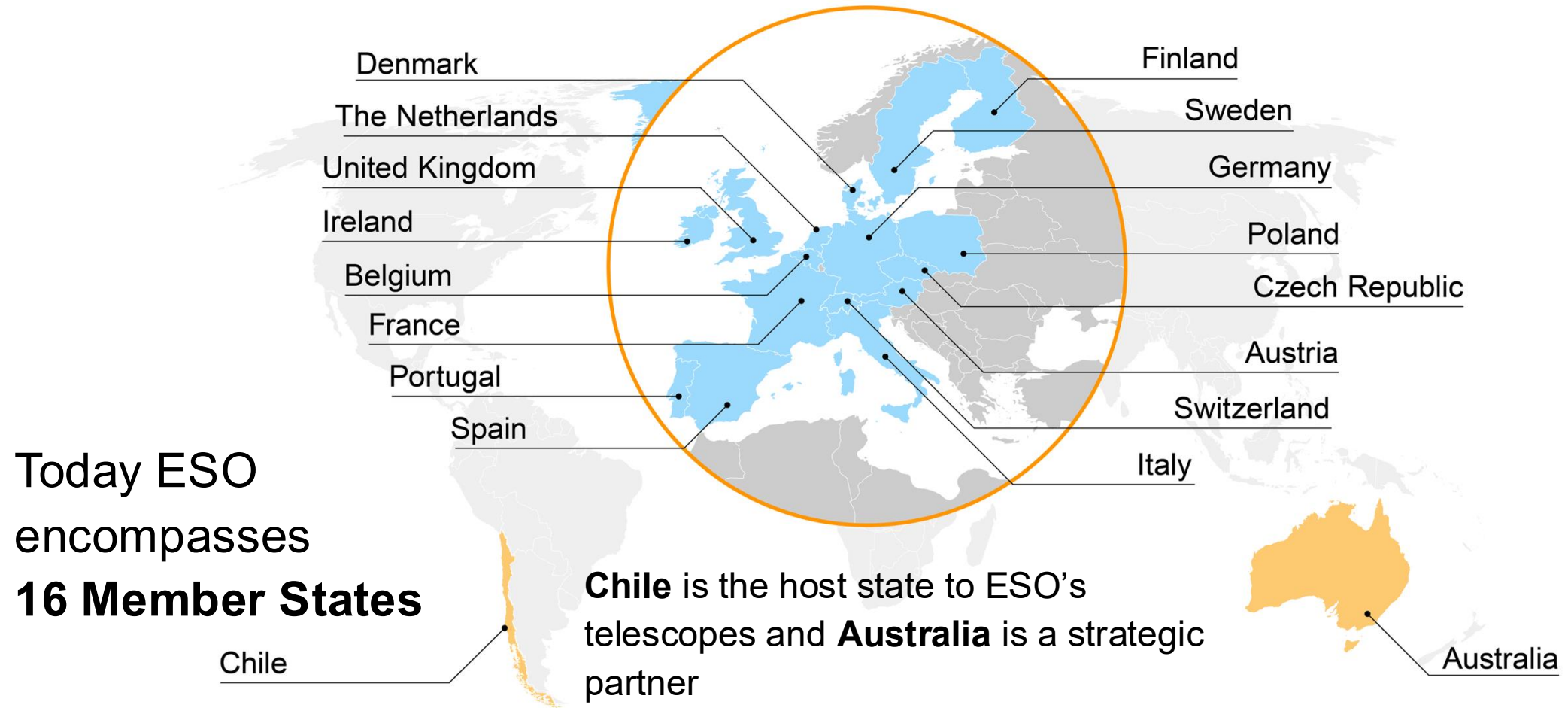
In a nutshell

Founding Member States



Intergovernmental Treaty
Organisation, **founded in 1962**
by five Member States

Member States and Partners





Our Mission

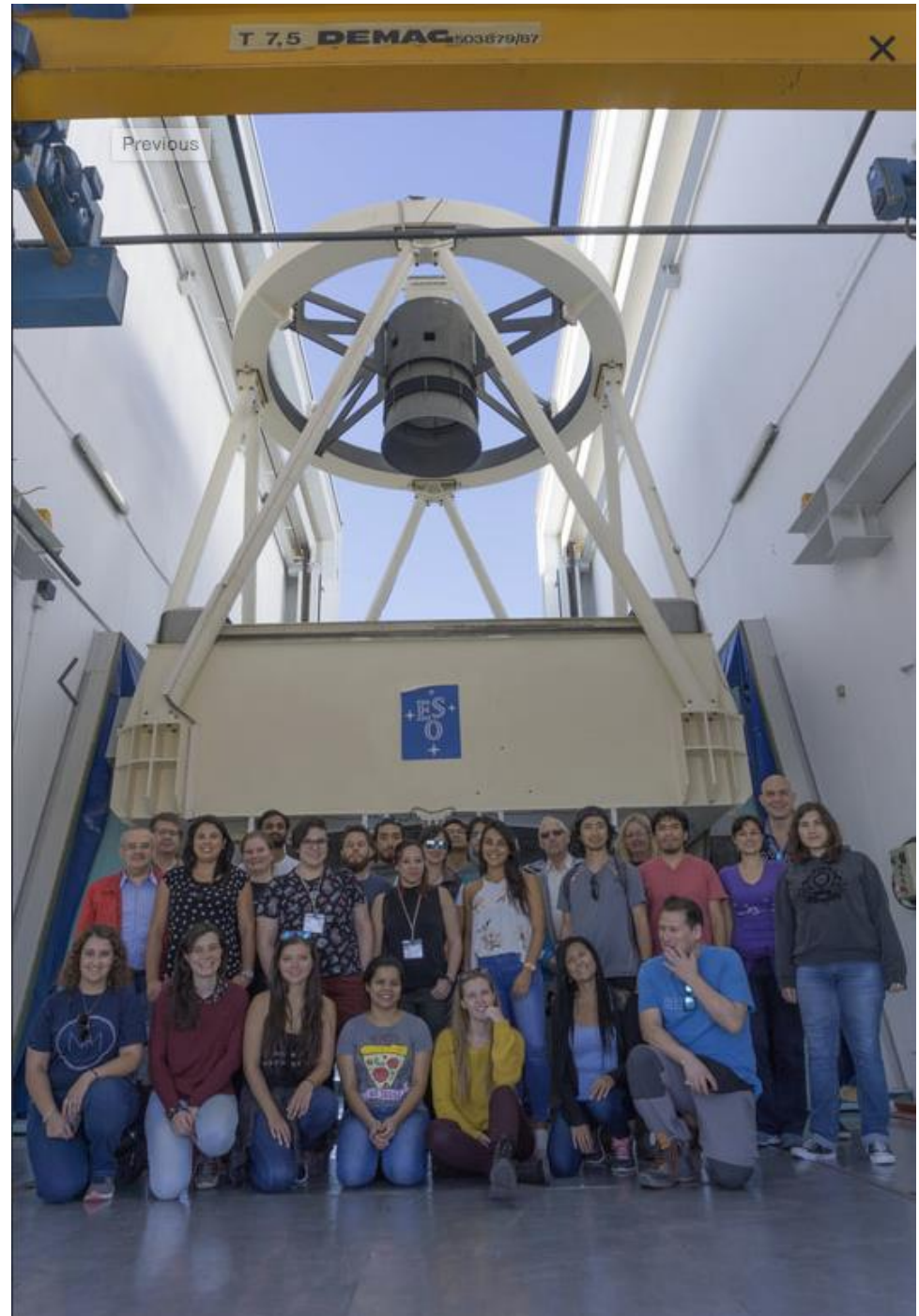
*We design, build, and
operate advanced
ground-based
observatories*



*We foster international
collaboration
for astronomy*

ESO Science Programmes

- Studentships/Fellowships/Internships
- A broad range of science & technical areas
 - From the Solar system to high-z galaxies
 - Instrumentation, optics, engineering, ...
- Training, Outreach
- Workshops & Schools
- Science Visitor Programme
 - Senior and Early Career scientists

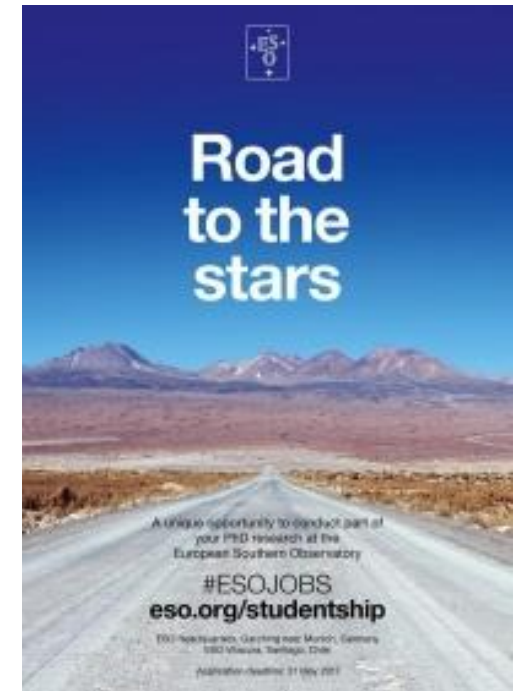


ESO Studentship

“Come to ESO to work on your doctoral project under the co-supervision of an ESO staff astronomer”



- **Who?** Students enrolled in a PhD programme in astronomy or related fields
- **Where and how long?**
 - ESO's headquarters in Garching (Germany), for 1 yr up to 2 years
 - ESO's offices in Santiago (Chile), for 6 months up to 2 years
- **How?** Contact ESO supervisor & coordinate your research project jointly with your home institute supervisor → then prepare application material
- **Application deadlines:** on April 20th and October 20th



IMPRS PhD studentship

“Conduct your full PhD at ESO and on the Garching campus”



The International Max Planck Research School on Astrophysics



- **Who?** Students from all countries in the world with a 5-year Master's degree in physics or astrophysics
- **Where and how long?** @ESO's headquarters in Garching, for 3+ years
- **How?** Look for an ESO IMPRS PhD project of your interest → apply through the IMPRS application form, mentioning the ESO PhD topic
- **Application deadline:** November 1st



[IMPRS website](#)

[ESO IMPRS website](#)

Fellowships in Germany or Chile

Here you can find all the information related to the ESO Fellowship Programme and the recruitment process.

The application deadline is every year on 15 October.

If you are interested in applying for the ESO Fellowship in Germany or Chile, please read carefully the [instructions for applicants](#).

For a general overview of the ESO Fellowship Programme please download the [ESO Fellowship brochure](#) and click on the topics below for further details.

What makes it unique

Mission and Vision

How we support you

Duration and Frame of the
Programme

Fellows' Research

Fellows and ESO Projects

Development Programme

Recruitment Process

Remuneration and
Benefits

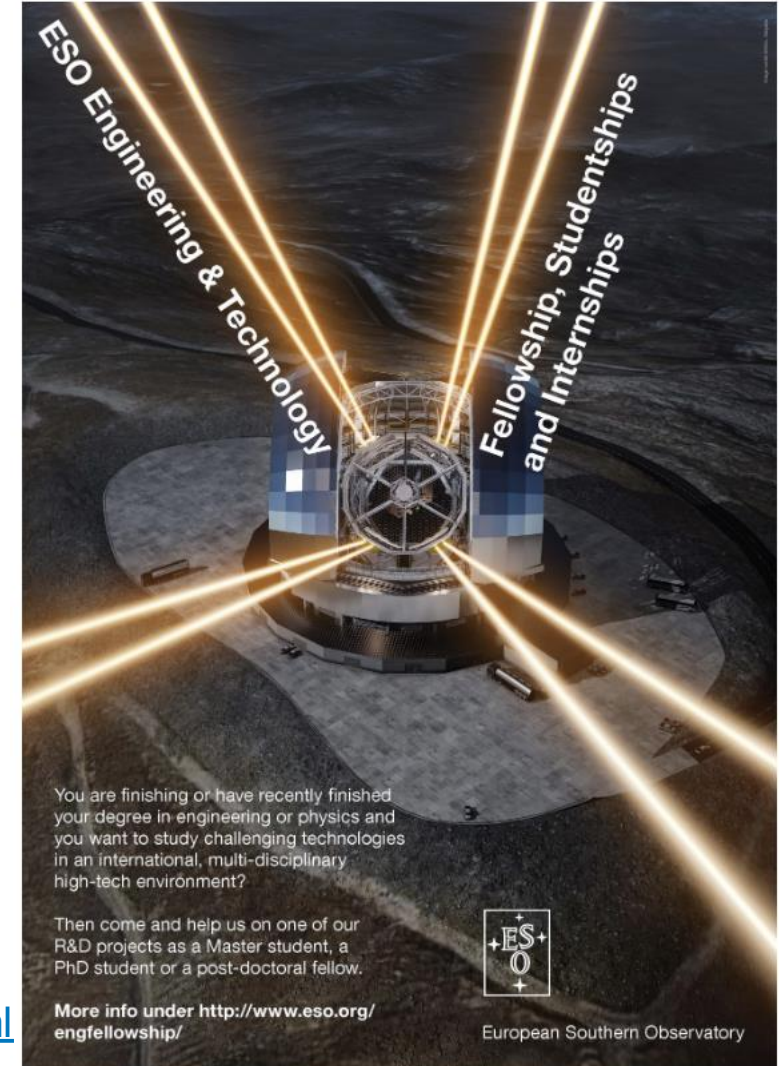
Engineering Fellowships & Studentships

Take active part in ESO R&D Projects

Examples of past & current research & development topics:

- Advanced visible & infra-red detectors
- Sub-mm receivers for ALMA
- Adaptive optics
- Laser guide stars
- Interferometry
- Optics & photonics technologies
- Mechanical, control software, systems engineering

<https://www.eso.org/sci/activities/fellowships-and-studentships/engstudentfellow.html>



ESO Engineering & Technology Fellowship, Studentships and Internships

You are finishing or have recently finished your degree in engineering or physics and you want to study challenging technologies in an international, multi-disciplinary high-tech environment?

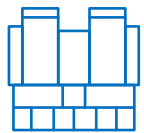
Then come and help us on one of our R&D projects as a Master student, a PhD student or a post-doctoral fellow.

More info under <http://www.eso.org/engfellowship/>

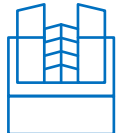
 European Southern Observatory

ESO telescopes

Paranal



VLT
VLT-I

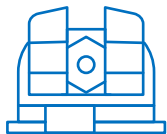


VISTA



CTA
South*

Armazones



ELT**

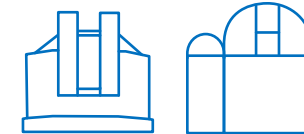
* in preparatory phase
** under construction

Chajnantor

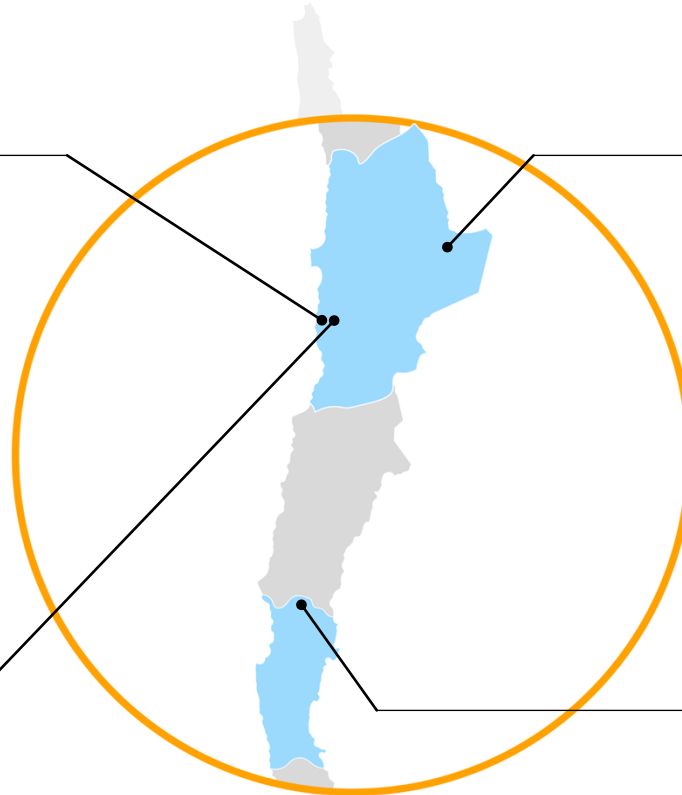


ALMA

La Silla



Telescopes at La Silla



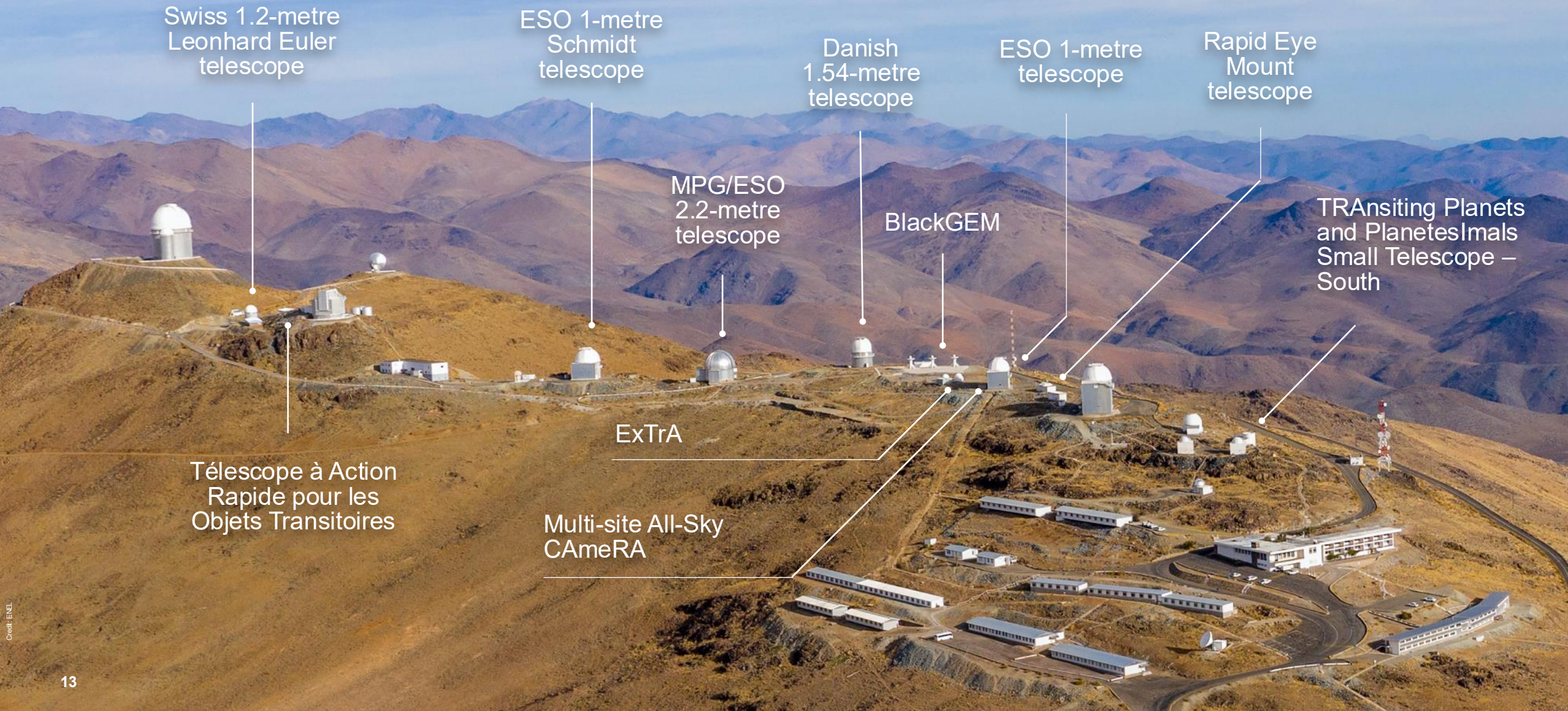
Telescopes currently operated by ESO

New Technology Telescope (NTT)

ESO 3.6-metre telescope



Hosted telescopes



Paranal – home of the Very Large Telescope





UT1
Antu

UT2
Kueyen

UT3
Melipal

UT4
Yepun

VISTA

VST

4 Unit Telescopes

Each primary mirror:
8.2-metre diameter,
17.5 cm thick,
weighing 23 tonnes

**Control
building**

Auxiliary Telescopes

4 movable AT's,
1.8-metre mirror

The **ALMA** telescope is a global partnership between the scientific communities of **East Asia**, **ESO** and **North America** together with **Chile**

Array Operations Site in Chajnantor (5050 m):
66 movable antennas, over a 16-km plateau,
receivers, back-end and correlator



Operations:

Support Facility at 3000 m, near San Pedro de Atacama
Regional Support Centres in Europe, North America and East Asia



European
Southern
Observatory

THE EXTREMELY LARGE TELESCOPE

The World's Biggest Eye on the Sky

elt.eso.org

[ELT HOME](#)

[ABOUT](#)

[TELESCOPE](#)

[INSTRUMENTS](#)

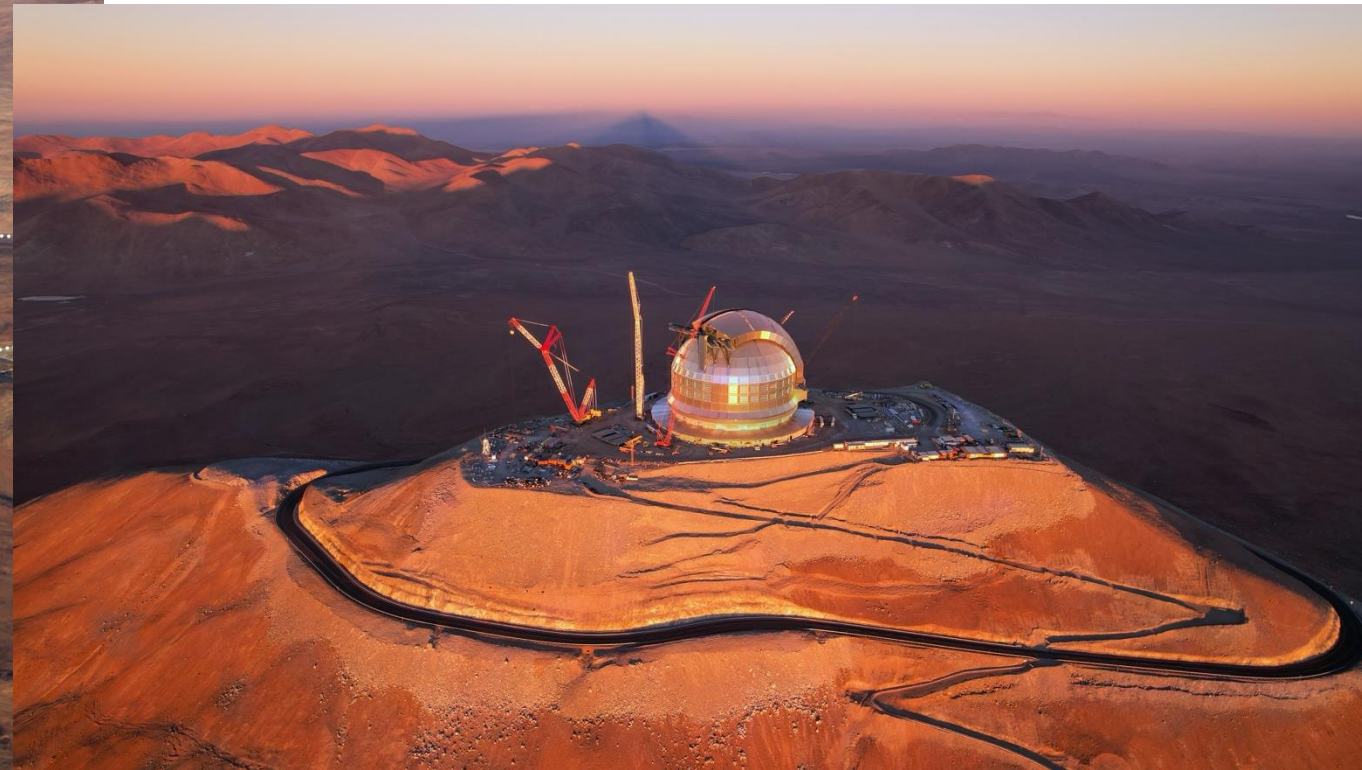
[SCIENCE](#)

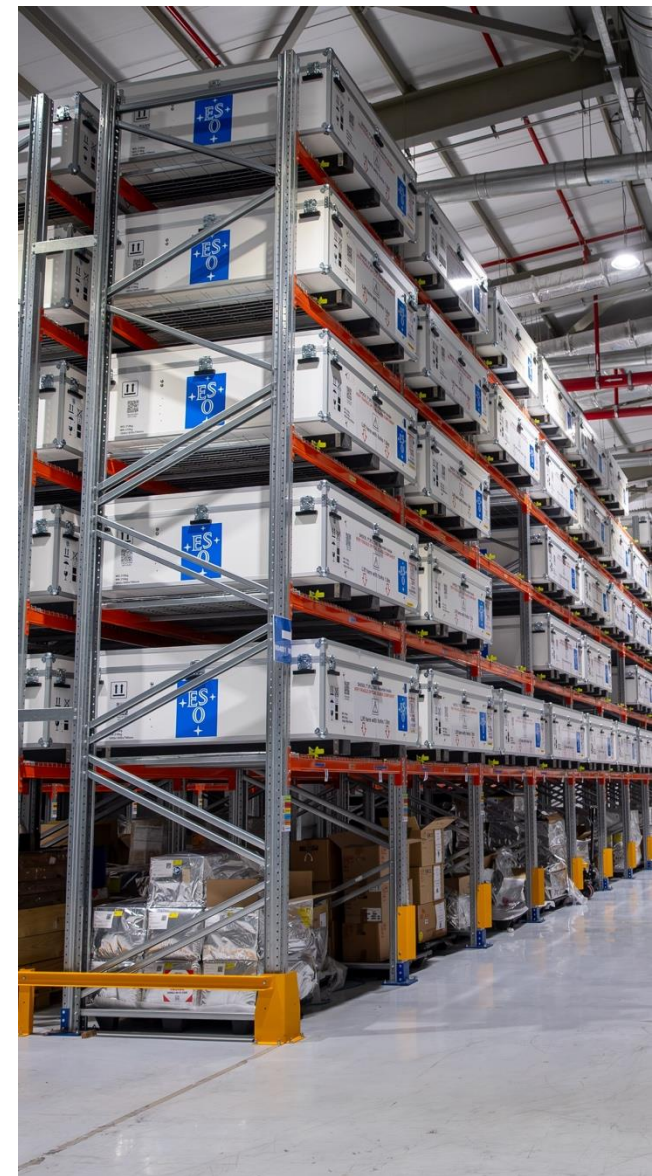
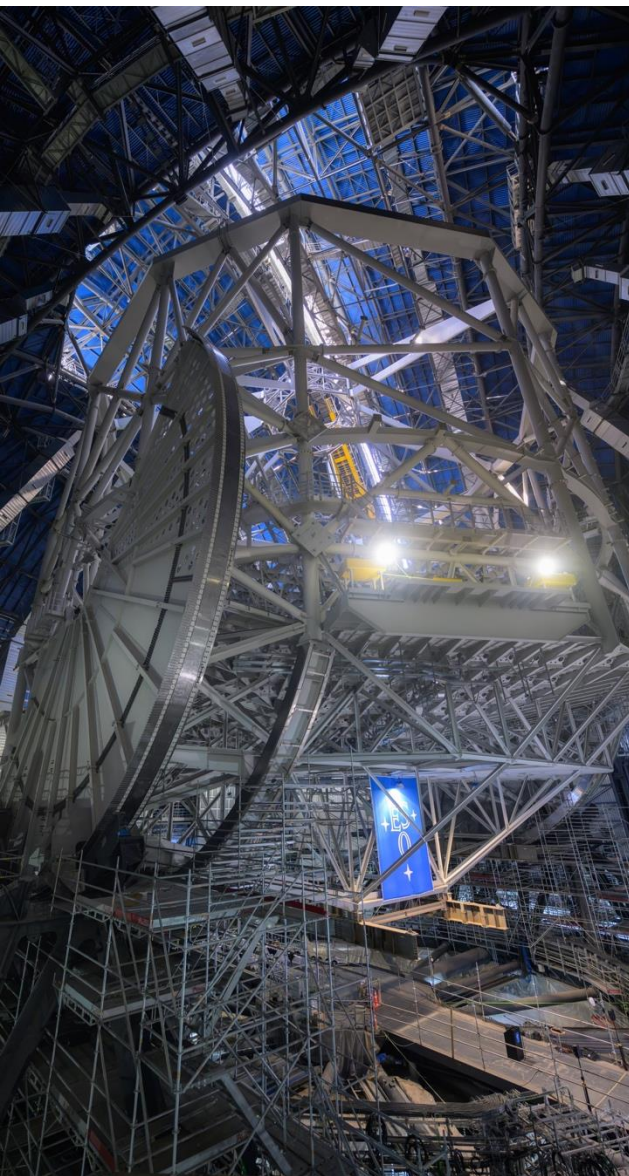
[NEWS & MULTIMEDIA](#)

[SUCCESS STORIES](#)

The ELT

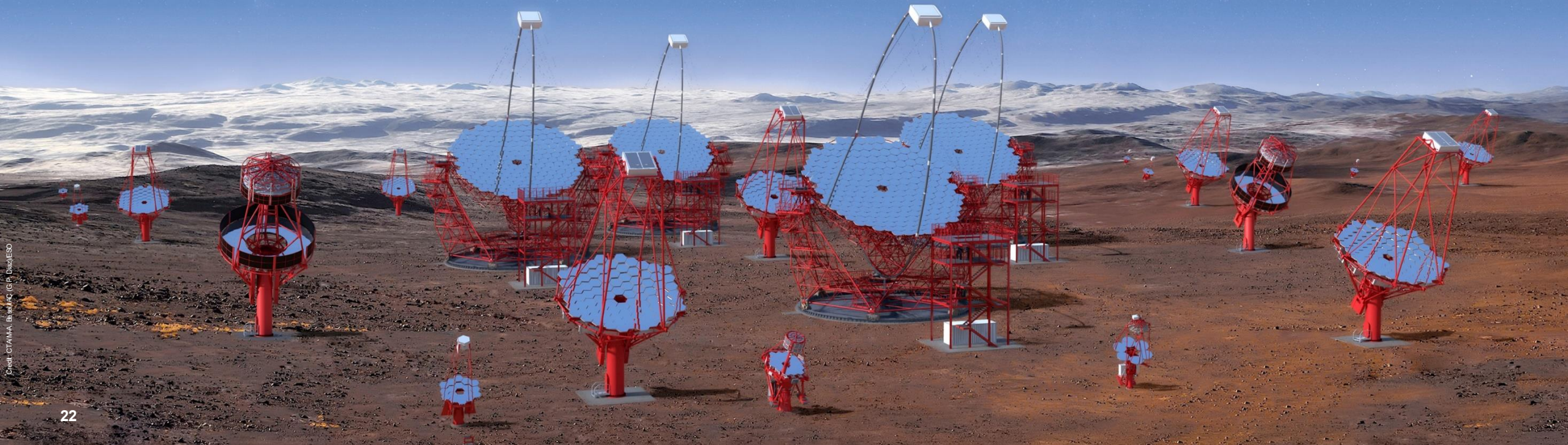
- In construction on Cerro Armazones at 3046 metres altitude, 23 km from Paranal
- 39-metre segmented (798) primary mirror
- Adaptive optics





Cherenkov Telescope Array – South (CTA-S)

The CTA is a **Cherenkov-light telescope** that will enable us to observe the most energetic phenomena in the Universe





Cerro Armazones
ESO' ELT

Cherenkov Telescope Array Site



It will be hosted and operated by ESO,
an 8% partner in the CTA Observatory.

Cerro Paranal
Very Large Telescope

The Southern site, CTA-S,
will be located in the vicinity of
ESO's Paranal Observatory



European
Southern
Observatory



[Home](#)

[Timeline](#)

[Upcoming Activities](#)

[White Papers](#)

[Senior Science Committee](#)

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Expanding Horizons

next.eso.org

Transforming Astronomy in the 2040s



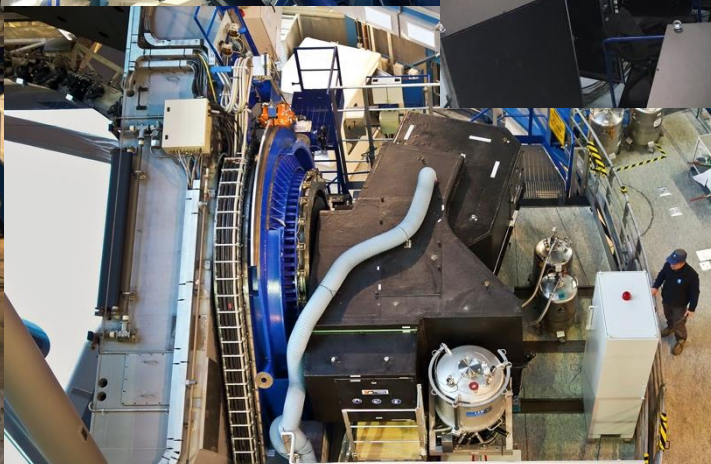
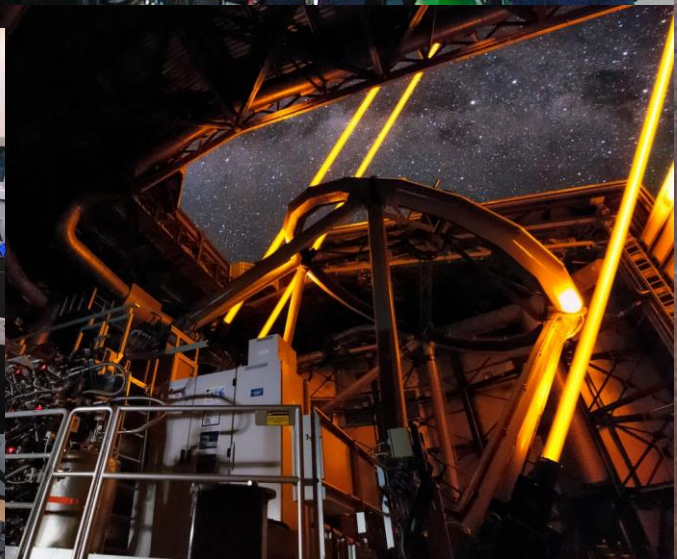
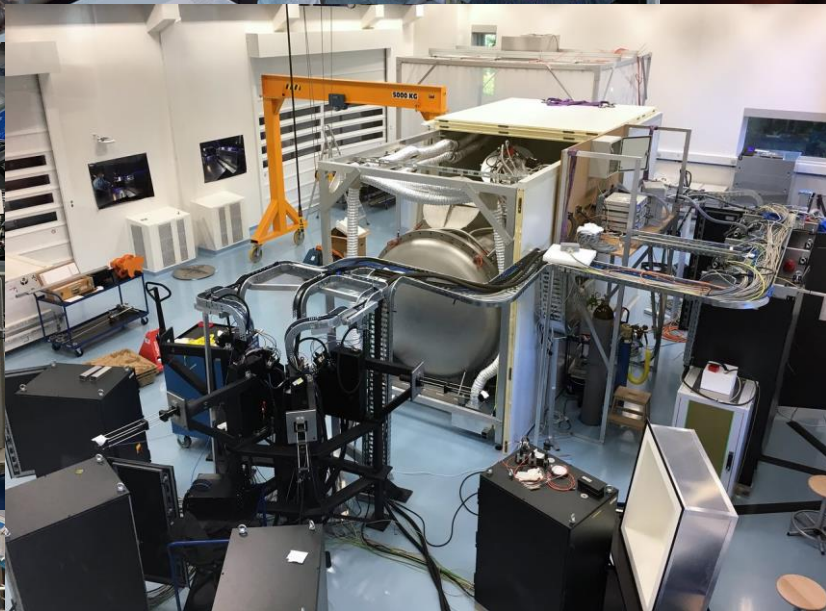
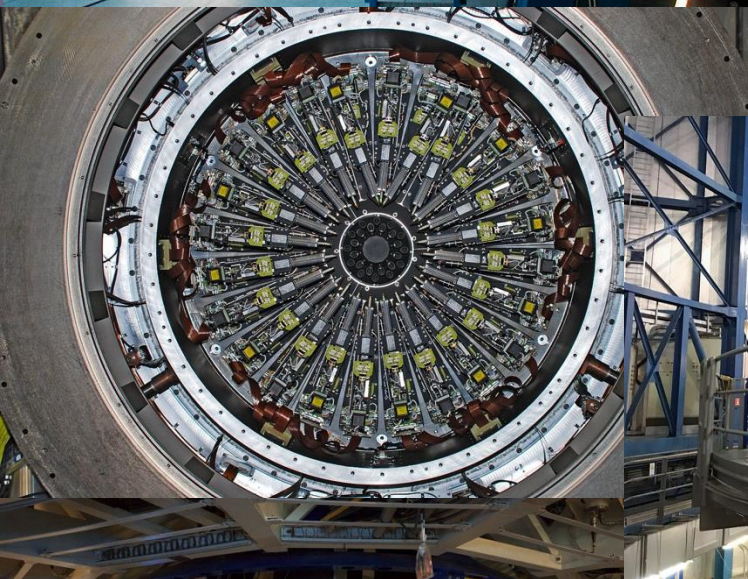
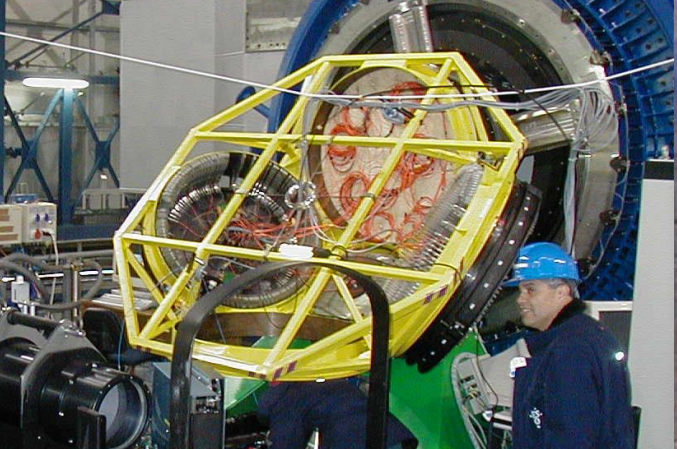
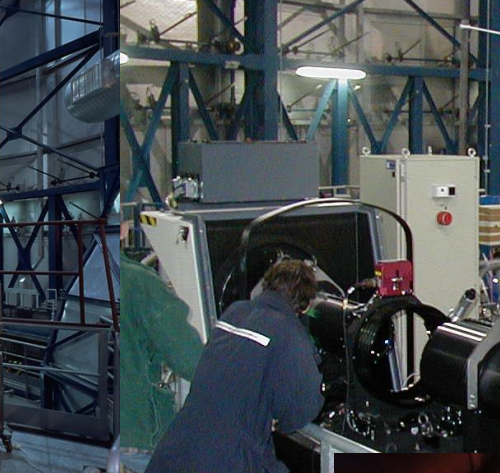
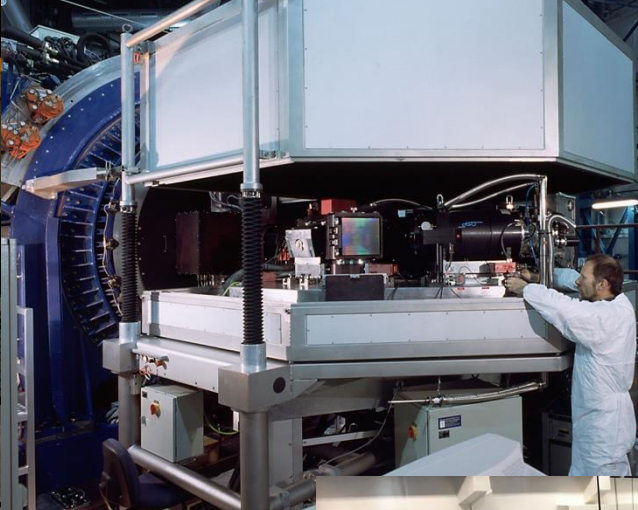
LPO: La Silla Paranal Observatory

ESO La Silla Paranal Observatory

- **Observatory Sites**
 - **La Silla** (1969)
 - NTT, EFOSC2 → SOXS (ULTRACAM) (transients)
 - 3.6m, NIRPS + HARPS (exoplanets)
 - **Paranal** (1999)
 - VLT: 4x 8.2m Unit Telescopes, 4x3 = 12 instruments
 - VLT Interferometer: 4 UTs or 4 ATs, 3 instruments
 - Incoherent Combined Coudé Focus:
1 UT (any) or 4 UTs, 1 instrument
 - VISTA
 - **Armazones** (~2029)
 - ELT: 39m, 5 instruments

11 telescopes, 25 instruments, many instr. modes





LPO: Instruments & Facilities in operation today

<https://www.eso.org/sci/facilities/lpo/cfp/cfp118/instruments.html>

La Silla Paranal Observatory: Instrumentation and Facilities offered

The following instruments are offered in this period. Their main functionalities can be found in the [Instruments Summary Table](#).

At La Silla

Telescope	Focus			
	Nasmyth A	Cassegrain	Nasmyth B	Fibre fed from Cassegrain
3.6m	n/a	n/a	n/a	HARPS (1) NIRPS
NTT	SOXS	n/a	ULTRACAM	n/a

1) HARPS and NIRPS can be operated simultaneously.

At Paranal

Telescope	Focus				
	Nasmyth A	Cassegrain	Nasmyth B	Incoherent Combined Coudé	Interferometric
UT1 (Antu)		FORS2	KMOS	ESPRESSO	GRAVITY
UT2 (Kueyen)	FLAMES		UVES		MATISSE
UT3 (Melipal)	SPHERE	XSHOOTER	CRIRES		Visitor focus
UT4 (Yepun)	HAWK-I	ERIS	MUSE		

AT1					GRAVITY
AT2					MATISSE
AT3					PIONIER
AT4					Visitor focus



Instruments Summary Table

https://www.eso.org/sci/facilities/lpo/cfp/cfp118/instrument_summary.html

La Silla Instruments Summary Table

Instrument	Spectral Coverage	Observing Mode	Spectral Resolution	Multiplex	Note
HARPS	optical 378-691nm	echelle, polarimetry	120,000	no	2 fibres, high accuracy; 2 fibers, high efficiency
NIRPS	near-IR 971-1854nm	echelle	84,000	no	fibre-fed. HARPS and NIRPS can be operated simultaneously.
ULTRACAM	optical: u',g',r' or u',g',i' or u',g',z'	3-channel, high-speed CCD camera	-	no	frame rate up to 300Hz; field-of-view of 6 arcmin

VLTI

GRAVITY	near-IR 2.05 - 2.45 μm	spectro-interferometry	R ~ 20, 500, & 4000	no	4 beam combiner - delivers spectrally dispersed visibilities, differential and closure phases	VLTI - ATs VLTI - UTs
MATISSE	mid-IR 2.8 - 4.1 μm 4.5 - 5 μm 8 - 13 μm	spectro-interferometry	R ~ 30 (covers L&M-band) R ~ 506, 959, 3666 (L or M band) R ~ 30, 218 (N band)	no	4 beam combiner - delivers spectrally dispersed visibilities, differential and closure phases	VLTI - ATs VLTI - UTs
PIONIER	near-IR 1.65 μm	spectro - interferometry	R ~ 5 or 40	no	4 beam combiner - delivers spectrally dispersed visibilities and closure phases	VLTI - ATs

Paranal Instruments Summary Table

Instrument	Spectral Coverage	Observing Mode	Spectral Resolution	Multiplex	Note	Telescope
FORS2	optical 330 - 1100 nm	imaging (incl. configurable occulting bars), long slit and multi-object spectroscopy, spectropolarimetry, imaging polarimetry	260 - 2600	yes	Spectroscopy with ~7" long slit, ~20" multi-slit, and laser-cut slit masks; multiple object spectroscopy; RRM	VLT UT1
KMOS	near-IR 0.8 - 2.5 μm	multi-object integral field spectroscopy (24 arms)	1800 - 4000	yes	24-arms Integral Field Spectroscopy; 2.8x2.8", 0.2" sampling IFU over a 7.2' field;	VLT UT1
FLAMES	optical 370 - 950 nm	multi-fibre echelle, integral field spectroscopy	6000 - 47000	yes	132 Medusa fibres; 15 deployable IFUs, one large IFU; GIRAFFE: single echelle order; 8 fibres to UVES	VLT UT2
UVES	optical 300 - 1100 nm	echelle, image slicer, slit spectroscopy	up to 80,000 (blue arm) / 110,000 (red arm)	no	long slit capability in single order; iodine cell; RRM	VLT UT2
SPHERE	optical: 500 - 900 nm near-IR: 0.95 - 2.32 μm	high-contrast imaging, dual-band imaging, integral field spectroscopy, differential-polarimetric imaging with or without classical, apodized pupil Lyot coronagraphs, sparse aperture mask	~30, 50, 400	no	extreme AO with optical wave-front sensor; fast star hopping; RRM	VLT UT3
X-SHOOTER	UV-optical-NIR 300 - 2500 nm	echelle, slit	~5000-17000	no	full spectral coverage with one pointing; slit; RRM	VLT UT3
CRILES	near-IR 0.95- 5.3 μm	echelle, slit spectroscopy, spectro-polarimetry	~40,000-80,000	no	AO assisted, 29 wavelength settings, 0.2"x10" and 0.4"x10" slits, gas cells for precision RV measurements, linear and circular polarimetry below 2500 nm.	VLT UT3
HAWK-I	near-IR 0.85- 2.5 μm	broad and narrow band imaging, fast photometry	-	-	pixel size of 0.106"; field: 7.5"x7.5", subwindow readout capability; GLAO; RRM	VLT UT4
ERIS	near-IR 1-5 μm	imaging, coronagraphy: apodizing phase plate (K/L-band only) and focal plane coronagraphy (L/M-band only), sparse aperture mmask interferometry, integral field spectroscopy (JHK), long-slit spectroscopy (L-band only)	5000-11200 (IFS), 900 (NIX long-slit spectroscopy)	no	AO modes: NGS, LGS, LGS-SE, noAO	VLT UT4
MUSE	optical 465 - 930 nm	integral field spectroscopy	1770 @ 480nm 3590 @ 930nm	no	IFU size on sky 60"x60" with spaxel size 0.2" (WFM) or 7.5"x7.5" with spaxel size 0.025" (NFM); GLAO, LTAO, no AO; RRM.	VLT UT4
ESPRESSO	optical 380 - 788 nm	fibre-fed échelle spectroscopy	140,000, 190,000, or 70,000 (median)	no	2 fibres (1 object, 1 sky or simultaneous reference); RV precision < 1 m/s (with the ultimate goal of reaching 10 cm/s); 1-UT and 4-UT modes	VLT UT1, VLT UT2, VLT UT3, or/and VLT UT4

Instruments documentation

<https://www.eso.org/sci/facilities/paranal/instruments/muse.html>

[Science Users Information](#) >
[Observing Facilities](#) >
[Paranal Facilities](#) >
[Paranal Instrumentation](#) >
[MUSE](#)

26 May 2026

Paranal Facilities

Contact Information

Paranal Science Operations

Quality Control

Call for Proposals

Paranal Telescopes

Paranal Instrumentation

VISIR

4MOST

CRIRES

ERIS

ESPRESSO

FLAMES

FORS

HAWK-I

KMOS

MUSE

Overview

News

Instrument Description

Manuals

Tools

Instrument Operation Team

Visitor Instructions

Science

SPHERE

UVES

X-SHOOTER

Visitor Focus

VLTI GRAVITY

MUSE - Multi-Unit Spectroscopic Explorer

Work based on **MUSE** observations should cite the paper [E-Bacon et al., SPIE 7735, 7 \(2010\)](#).

Work using the **Adaptive Optics Facility (AOF)** should cite the papers: [E-Strobele et al. \(2012\)](#), and [E-Arsenault et al. \(2008\)](#).

Summary

The following items are available on all the MUSE pages, using the bar on the left.

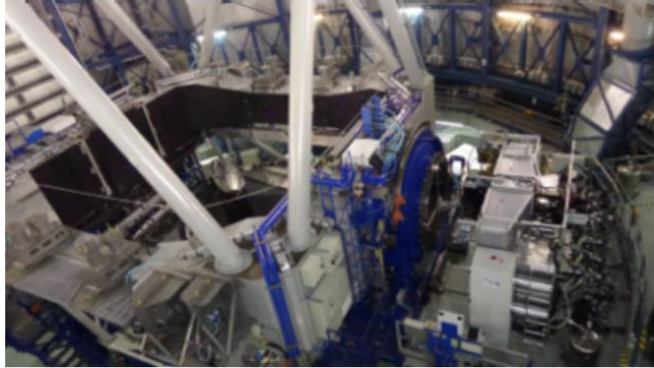
- Overview:** a short description of the instrument
- News:** list of changes affecting the instrument and/or its pages.
- Instrument Description:** all the important parameters of the instrument.
- Manuals:** links to all the documents related to MUSE.
- Tools:** a collection of useful tools and informations for preparing and analyzing the MUSE observations.
- Instrument Operations Team**
- Visitor Instructions:** Instrument specific instructions for Visiting Astronomers
- Science:** Science done with MUSE, incl. during Science Verification

Contact Information

- Questions related to proposal preparation, service mode, and visitor mode observations** should be addressed via the contact form at [ESO Operations Helpdesk](#).
- Please, send us your general feedback, comments, suggestions, or report errors and inaccurate statements in the web pages and manuals also via this contact form.

MUSE Consortium

Collaborating institutes	Logo	Collaborating institutes
Leibniz-Institut für Astrophysik Potsdam		Development of the Calibration Unit, testing of the preassembled spectrograph -- detector units, data reduction software.



Top view of UT4 with MUSE sitting in the right at the Nasmyth platform. Photo Jean-Louis Lizon

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M. Re

Exposure Time Calculator

Is my science idea feasible?

<https://www.eso.org/observing/etc/>




News and Notes
February 2, 2026
P117 Phase 2, see the [ETC2.0 change log](#)


Documentation and Tools

- Support: <https://support.eso.org>
- [Frequently Asked Questions](#)
- [Formula Book](#)
- [Database](#) of efficiency profiles
- Deprecated ETCs select...
- [SkyCalc](#) Sky Model Calculator
 - with advanced Almanac
 - command-line interface [skycalc_cli](#)

	Facility
La Silla	
Paranal UT1	
Paranal UT2	
Paranal UT3	SPH
Paranal UT4	
Paranal ICCF	
Paranal VLT1	
Paranal VISTA	
Paranal VST	
ELT	

v. 117.2.0ParanalLa SillaIn DevelopmentX-SHOOTER

TargetSkySeeing & IQInstrumentExp.time & S/NPlotsETC Results

IP version117.07Instrument ConfigNodding

UVB Arm

UVB Slit1.0x11UVB readout mode100k/1pt/hg

Orders $[\lambda_{\min} - \lambda_{\max}] / \text{nm}$

Deselect all

☒ 24 [307.97 - 316.43]

☒ 23 [319.93 - 330.07]

☒ 22 [334.19 - 345.41]

☒ 21 [350.03 - 362.17]

☒ 20 [366.81 - 380.19]

☒ 19 [385.55 - 400.85]

☒ 18 [406.05 - 422.96]

☒ 17 [429.54 - 448.06]

☒ 16 [455.79 - 477.00]

☒ 15 [484.96 - 508.63]

☒ 14 [518.12 - 543.87]

☒ 13 [549.13 - 562.88]

VIS Arm

VIS Slit0.9x11VIS readout mode100k/1pt/hg

Orders $[\lambda_{\min} - \lambda_{\max}] / \text{nm}$

Deselect all

☒ 30 [545.70 - 555.31]

☒ 29 [562.59 - 573.42]

☒ 28 [577.94 - 593.85]

☒ 27 [599.01 - 616.38]

☒ 26 [620.05 - 638.95]

☒ 25 [643.70 - 663.91]

☒ 24 [670.84 - 693.35]

☒ 23 [699.67 - 722.73]

☒ 22 [730.03 - 755.17]

☒ 21 [763.89 - 791.32]

☒ 20 [799.93 - 831.67]

☒ 19 [842.40 - 877.99]

☒ 18 [886.05 - 922.56]

☒ 17 [942.39 - 972.21]

☒ 16 [985.34 - 1017.86]

NIR Arm

NIR Slit0.9x11

Orders $[\lambda_{\min} - \lambda_{\max}] / \text{nm}$

Deselect all

☒ 26 [990.90 - 1020.65]

☒ 25 [1029.92 - 1062.08]

☒ 24 [1072.14 - 1107.03]

☒ 23 [1117.96 - 1155.96]

☒ 22 [1167.87 - 1209.42]

☒ 21 [1222.45 - 1268.04]

☒ 20 [1282.36 - 1332.64]

☒ 19 [1348.46 - 1404.17]

☒ 18 [1421.73 - 1483.83]

☒ 17 [1503.43 - 1573.03]

☒ 16 [1595.08 - 1673.67]

☒ 15 [1698.63 - 1788.06]

☒ 14 [1816.50 - 1919.21]

☒ 13 [1951.97 - 2071.09]

☒ 12 [2109.25 - 2249.10]

☒ 11 [2294.05 - 2460.51]

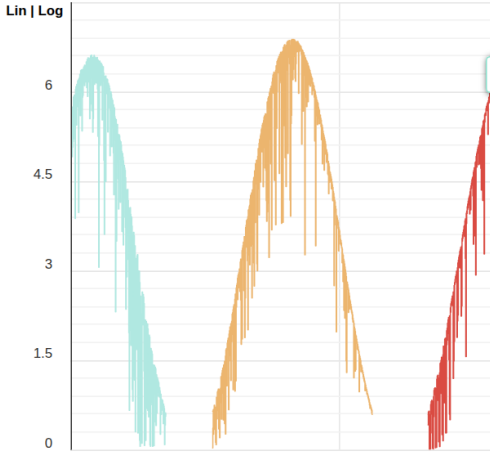
ComputeReset

Dynamic S/N FormulaInput form data

ShowDownloadUploadCopy to clipboard

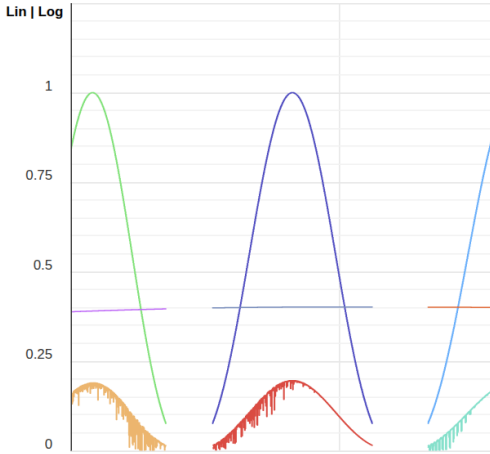
Signal-to-Noise Ratio

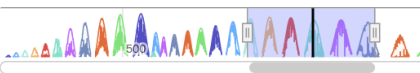
Lin | Log



Throughput

Lin | Log





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M. Rejkuba, INAF - Teramo, 24 Sep 2026

Instrumentation Programme

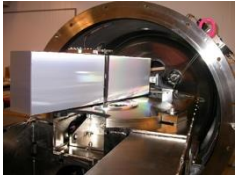
La Silla



SOXS



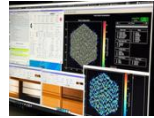
HARPS



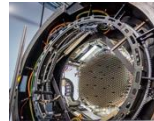
VLT



4MOST



MOONS



FORS-up



**Workshop in January 2026 “VLT beyond 2030” to
rebuild the future roadmap for VLT/VLTI**

https://www.eso.org/sci/meetings/2026/VLT_beyond_2030.html

MAVIS



2DGSM



BlueMUSE



VLTI



GRAVITY+

ELT



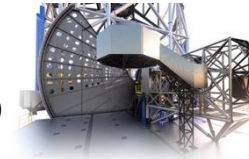
MICADO



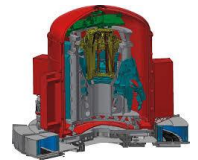
METIS



MORFEO



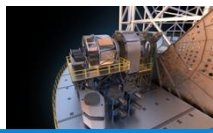
HARMONI



ANDES



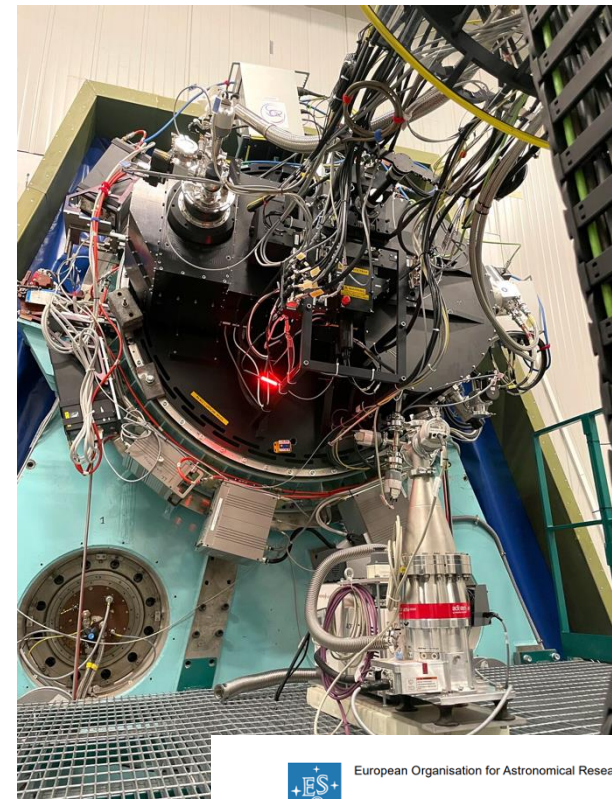
MOSAIC



SOXS – Son of X-SHOOTER at NTT

<https://soxs.inaf.it/>

- First light: Dec 2025, Commissioning 2026, offered in P118
- SOXS GTO: 50% of the time (900 nights over 5yr)
- Medium resolution, high efficiency, wide band spectrograph
 - UV-VIS, wavelength range 350-850 nm
 - NIR, wavelength range 795-2040 nm
- SOXS is nearly fully operated by the consortium that built the instrument
- Main science case: transients
 - Requires Target of Opportunity mode & Service Mode (like) operations
 - La Silla only supports Visitor Mode – new way of operating



European Organisation for Astronomical Research in the Southern Hemisphere

Programme: Instrumentation Programme (INS)

Project: SoXS

NTT/SOXS Operation Policies

Document Number: ESO-641350

Document Version: 1

Document Type: Policy (POL)

Released On: 2026-01-09

Document Classification: Public

4MOST



P.I. Roelof de Jong (AIP) → From October 1st, Jakob Walcher (AIP)

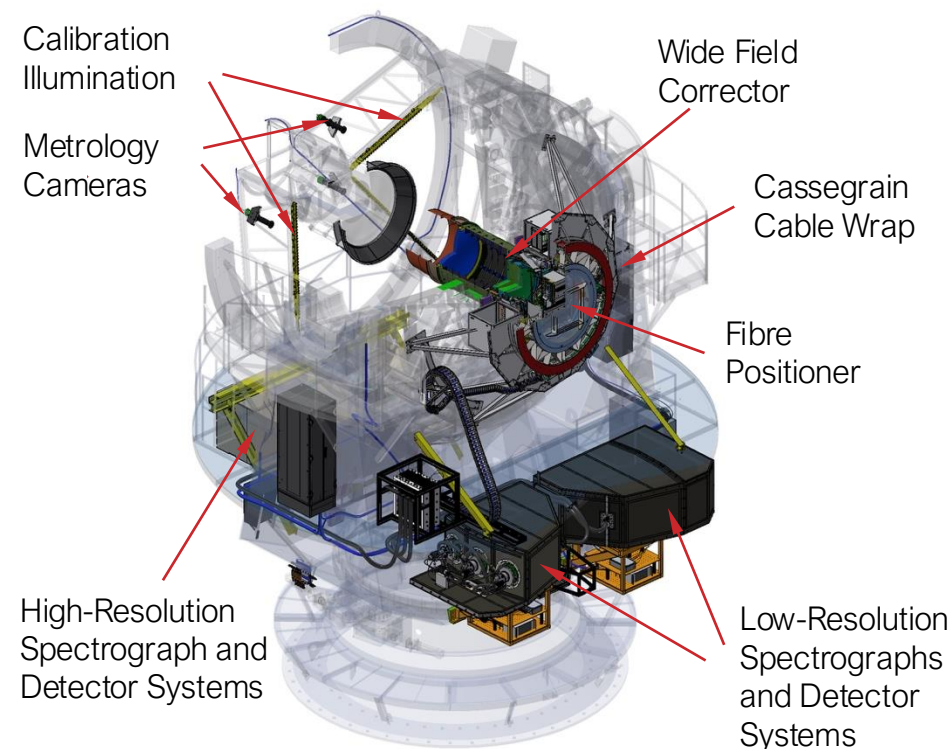
www.4most.eu

■ Timeline

- VISTA recommissioning: December 2024
- PAE: June 2025
- Commissioning: Q4 2025
- Operational rehearsals: Q1-Q2 2026
- Start of 5-years survey programme: Q3 2026 (October)

■ 2436 Fibres, 2xLR + HR spectrograph

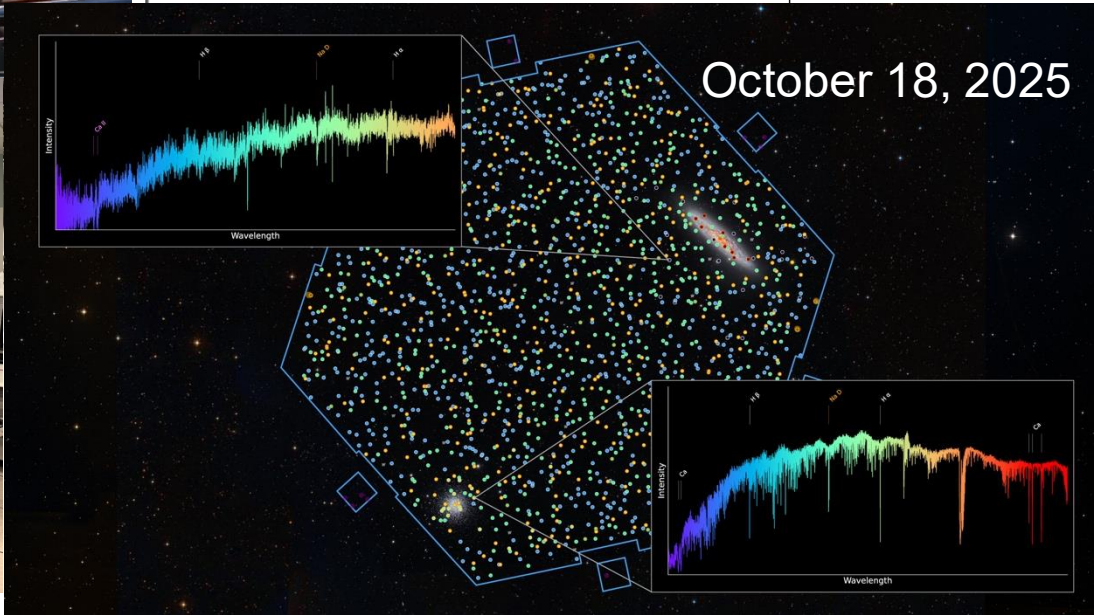
- Shared focal plane



4MOST at VISTA



Requirement	Baseline Specification
Field-of-View in hexagon	4.1 degree ²
Fibre multiplex per pointing	2436
Smallest target separation	<17"
Low-Resolution Spectrographs (LRS)	
Fibre multiplex	1624
Spectral resolution	R>4000–7800
Wavelength coverage	370–950 nm
High-Resolution Spectrographs (HRS)	
Fibre multiplex	812
Spectral resolution	R>18,500

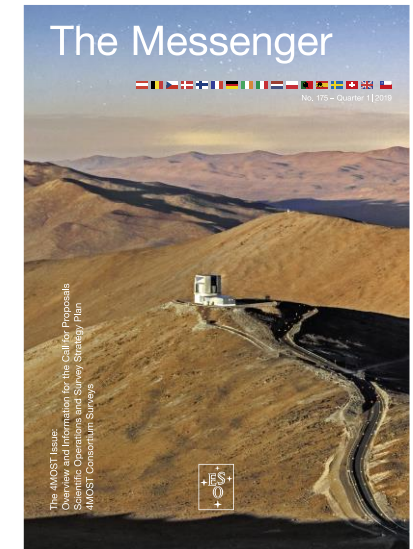


4MOST surveys (2026-2031)

- Maximize the scientific return has been the motivation for sharing the focal plane between multiple surveys.
- A long process to inform the community, select the surveys and merge them.
- Lessons learned from this first 5-years survey process should be useful for the next 5-years and/or other instrument/facilities at ESO.



Approved surveys: 10 Consortium surveys + 15 Community surveys

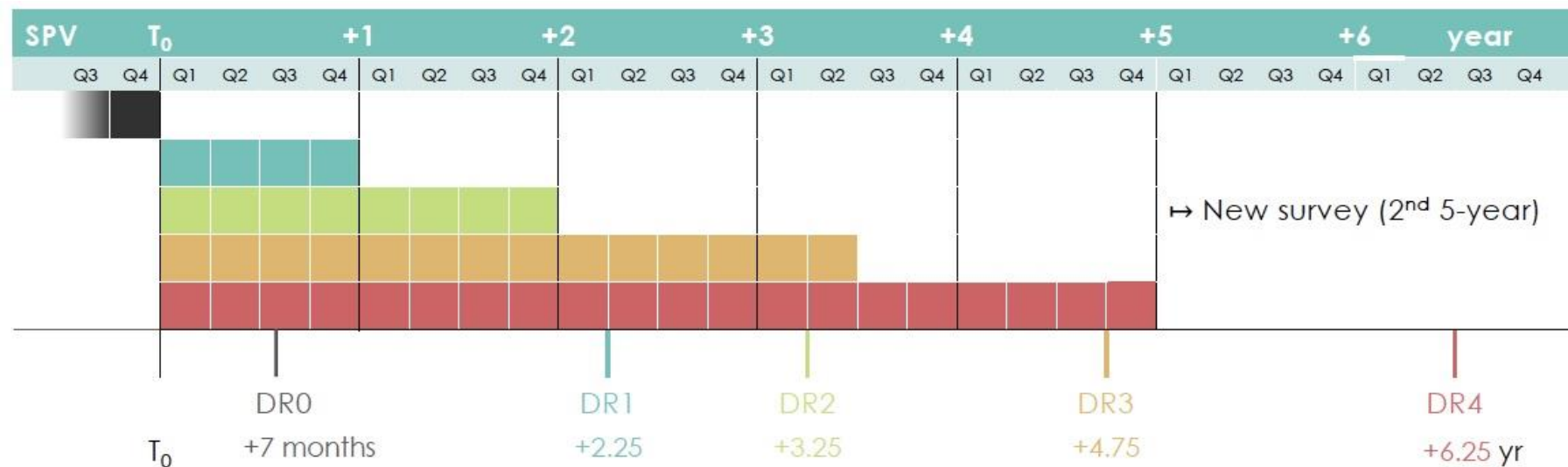


4MOST Science Themes



4MOST legacy: public data releases

- 4MOST will significantly increase the numbers of files and products in your archive:
 - 1 year worth of observations (DR1) : ~70 million spectra [**~85 million files in the all ESO archive now**]
 - 5 years survey (DR4): ~350 million spectra [**~4 million products in the ESO archive now**]
- ESO is entering thanks to 4MOST in the domain of large spectroscopic surveys.



MOS instruments at the VLT:

- **FLAMES** (optical, 130 fibers)
- **FORS2** (optical, low-res)
- **KMOS** (near-IR, 34 IFUs, low-res)
- **MOONS** (optical and near-IR, 1000 fibers, low and high-res)



Field of view: 500 sq. arcmin at the 8.2m VLT

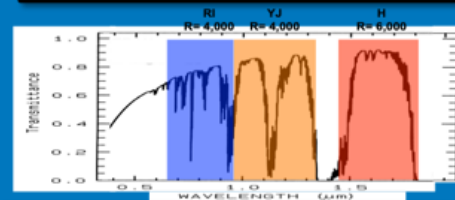
Multiplex: 1000 fibers, with the possibility to deploy them in pairs

Fibers: Aperture on sky = 1.1arcsec; Close pair = 10arcsec; Max 7 fibers within 2 arcmin

Medium resolution:

Simultaneously 0.64 μ m-1.8 μ m

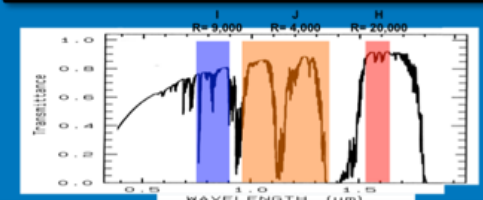
- 0.64-0.95 μ m at R=4,000
- 0.95-1.35 μ m at R=4,000
- 1.42-1.81 μ m at R=6,600



High resolution:

Simultaneously 3 bands:

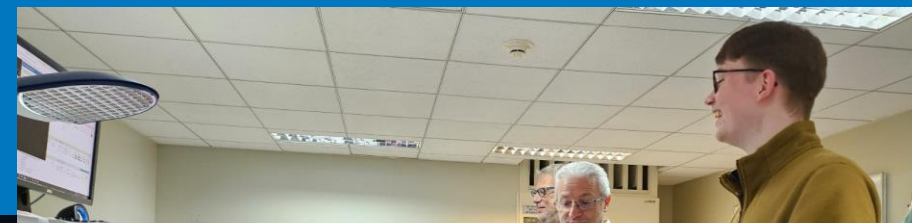
- 0.76-0.90 μ m at R = 9,000
- 0.95-1.35 μ m at R=4,000
- 1.52-1.63 μ m at R=20,000



The “last stretch” of a long journey: MOONS@UT1

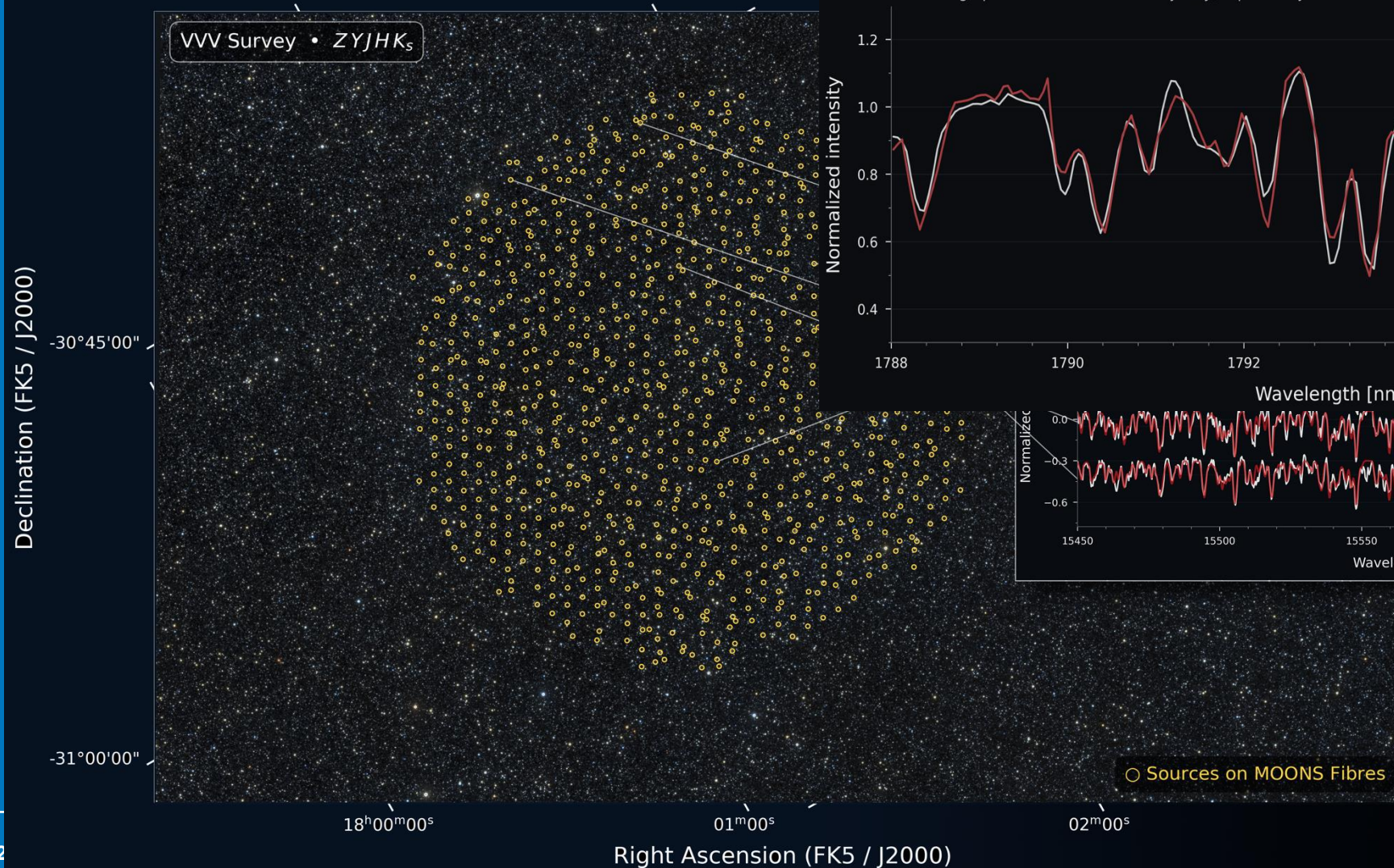
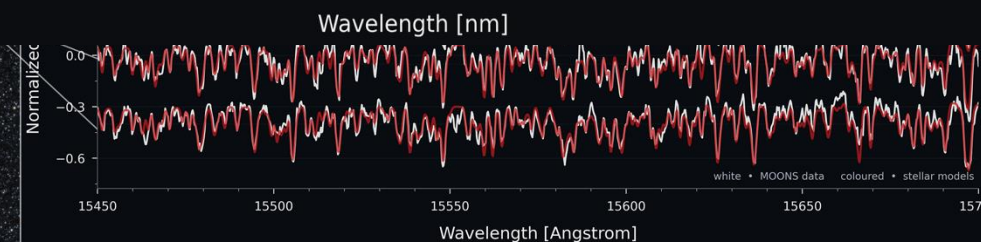


MOONS First Light!

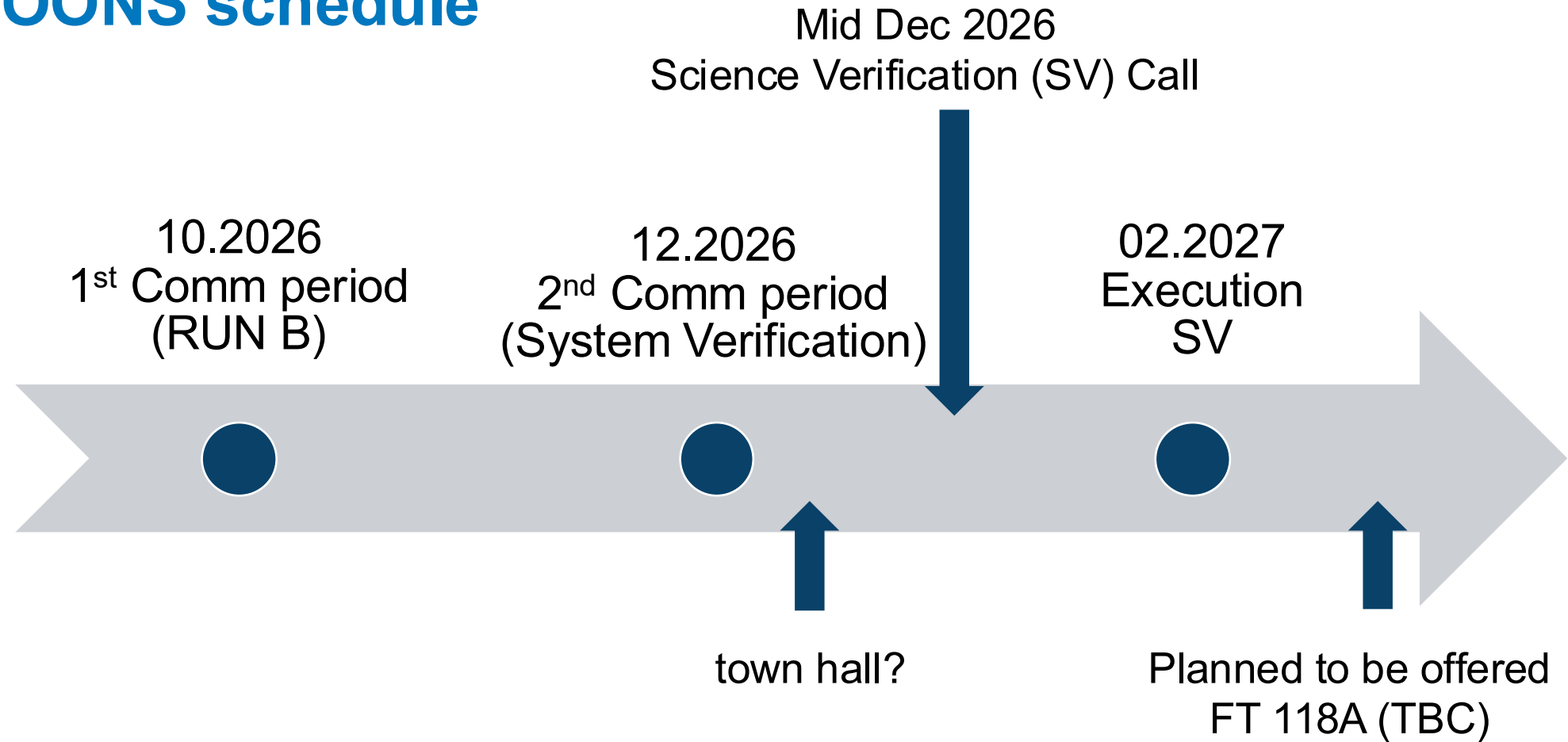


MOONS First Light

Stellar fingerprints of the obscured Milky Way, captured by MOONS



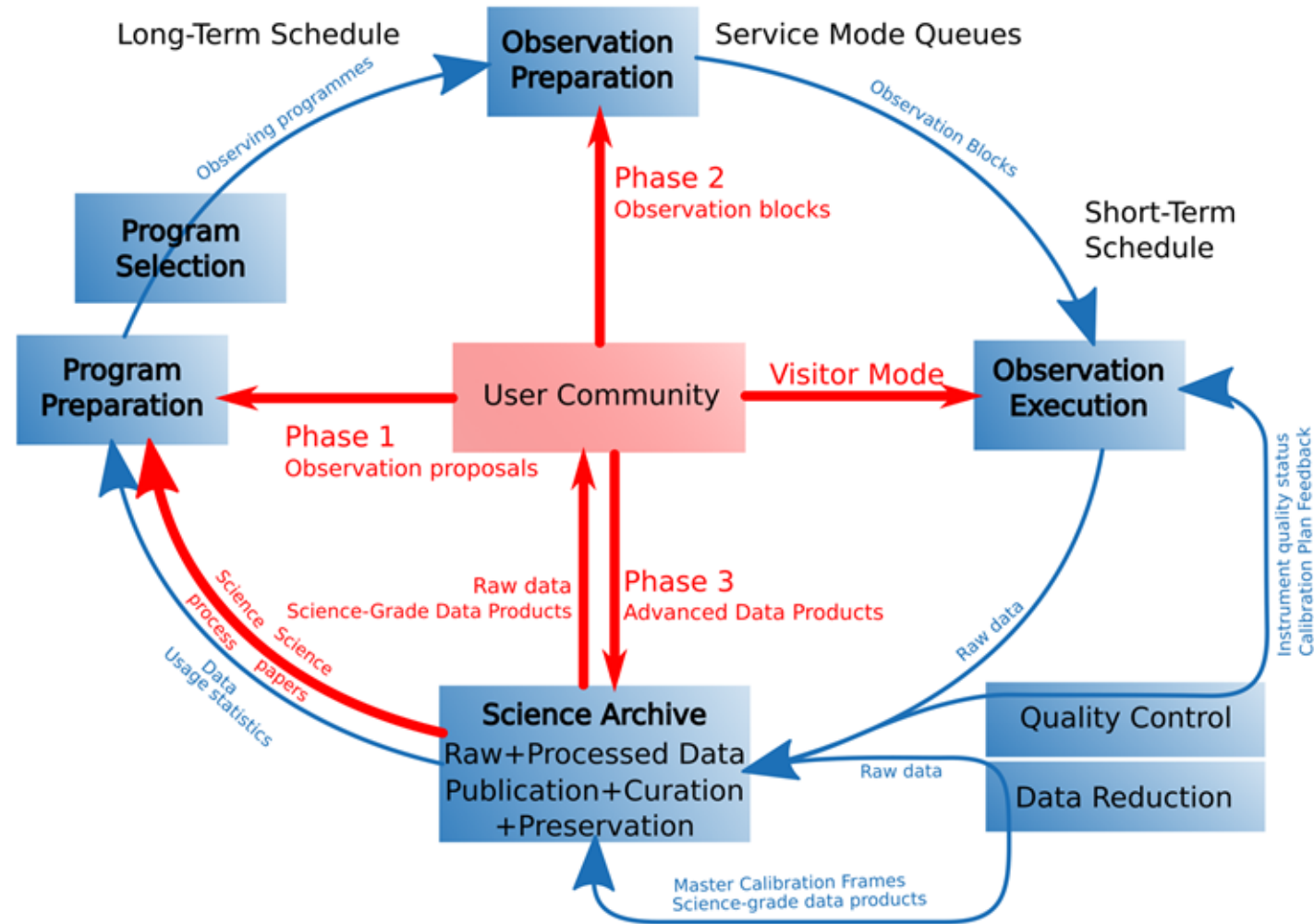
MOONS schedule





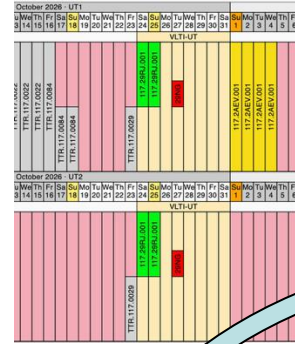
VLT/I end-to-end operations model tools, services and support

Integrated end-to-end operations

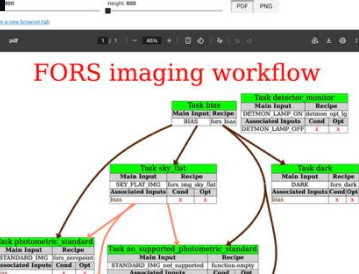
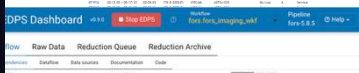
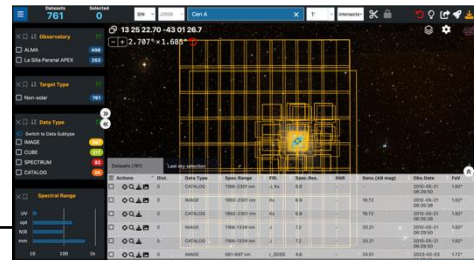
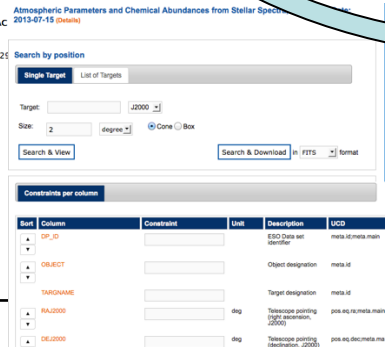
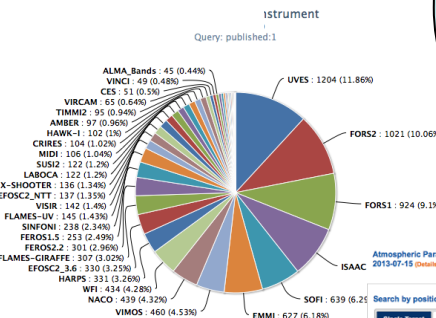
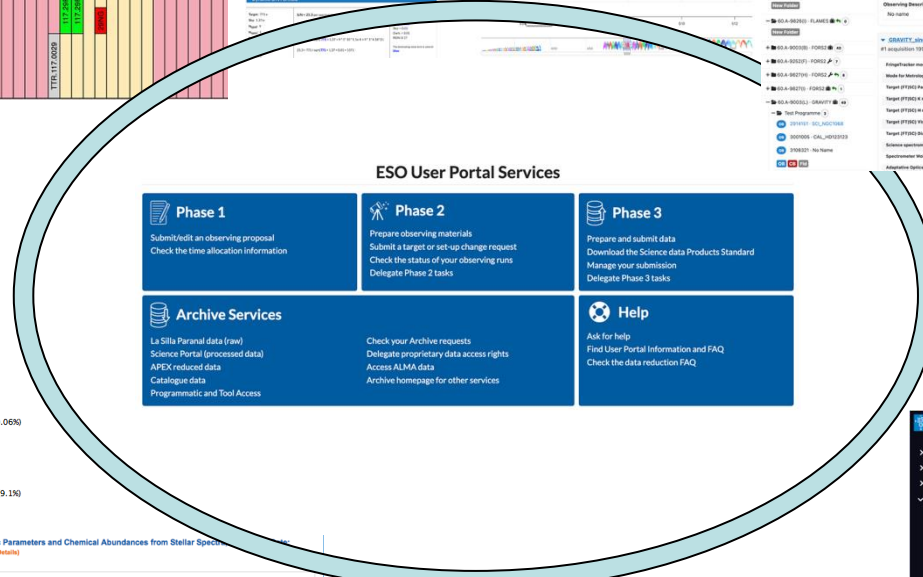
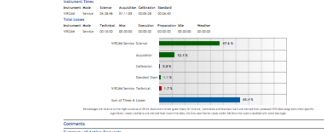
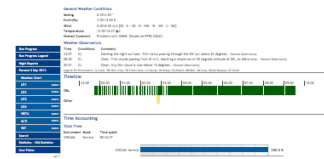
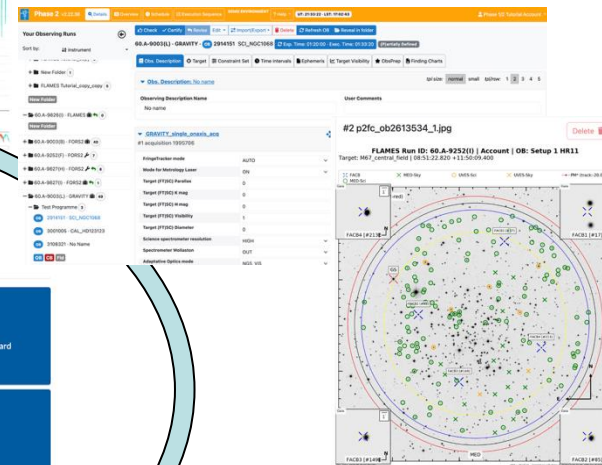


Data flow end-to-end tools

Proposals handling & Long-term scheduling



Observation preparation, execution & reporting



Science return: Data Products & Publications

Post-observation: archive, quality control, data reduction pipelines

User Support Department

support@eso.org

Interface between the astronomers/users and the Observatory

- Scientific and technical support in proposal and observation preparation, post-observation
- Long Term Telescope Schedule preparation and maintenance
- Up-to-date status information services
- observing queues, observation progress and programme management, execution problems follow-up, operations metrics (<https://www.eso.org/sci/observing/observatory-statistics.html>)
- Observation preparation tools, User Portal, **helpdesk**, user satisfaction surveys
- Visiting Astronomers travel
- ESO Users' Committee

Call for Proposals

<https://www.eso.org/sci/observing/phase1.html>

Regular Call for Proposals: bulk of the time allocation (~85-90%)

- Call open ~Jul-Sep every year for observations starting next year
- ESO P117 – the first yearly cycle (1 May 2026 – 1 May 2027)
- ESO P118 – second yearly cycle (1 May 2027 – 1 May 2028)



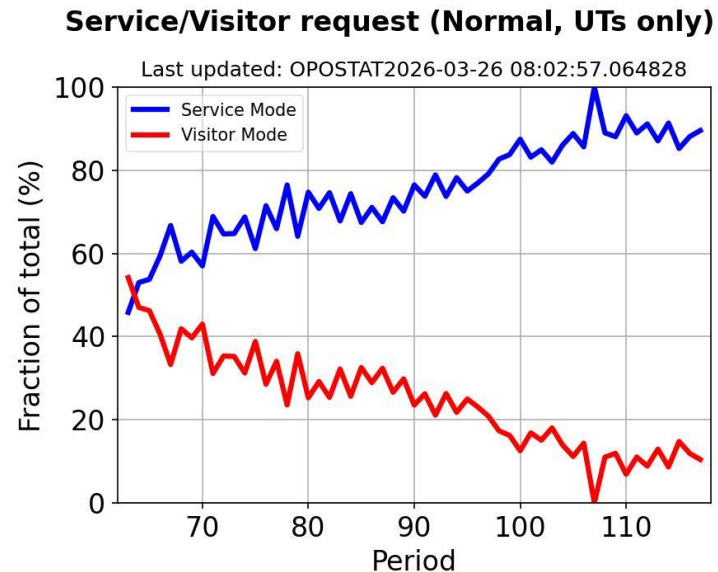
Cannot wait for the next year?

- Fast Track Call (FTC): Novel scientific idea and targets observable in the next ~4 months
- Director Discretionary Time (DDT): Urgent, highly competitive sci. topic, breakthrough, risky (pilot)
https://www.eso.org/sci/observing/policies/ddt_policy.html

Observing Modes

Observing Modes

- Visitor Mode (Classical)
- designated Visitor Mode (Remote)
- Service Mode (Queue)



Should I stay, or should I go? Service and Visitor Mode at ESO's Paranal Observatory

Rejkuba, M.  ; Tacconi-Garman, L. E.  ; Mieske, S. ; Anderson, J.  ; Gadotti, D.  ; Marteau, S. ; Patat, F.  [show details](#)

Article



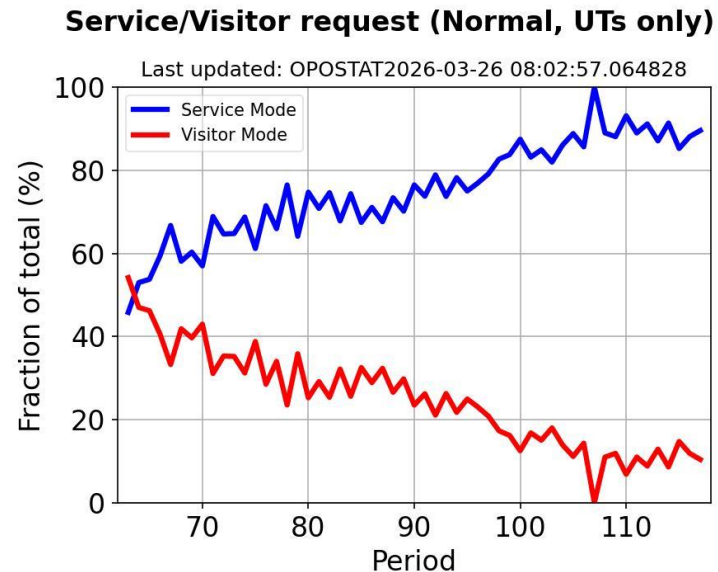
Since the beginning of Very Large Telescope (VLT) operations in 1998, ESO has been offering time in both Visitor Mode (VM) and Service Mode (SM). In this article we discuss the advantages and limitations of these two observing modes, explain the rationale behind the one-hour observation rule in SM, and provide some statistics comparing the usage in each mode. Community demand has been steadily growing for SM observations and is now above 80% for normal programmes (i.e., not Large or Guaranteed Time Observation programmes). Here, we highlight the benefits of VM and promote its usage to the community. We also emphasise the low demand for SM for observations in the most demanding seeing conditions.

Publication	The Messenger, vol. 173, p. 2-6 
Publication Date	September 2018
DOI	10.18727/0722-6691/5090  
Bibcode	2018Msng.173....2R 

Observing Modes & Programme Types

Observing Modes

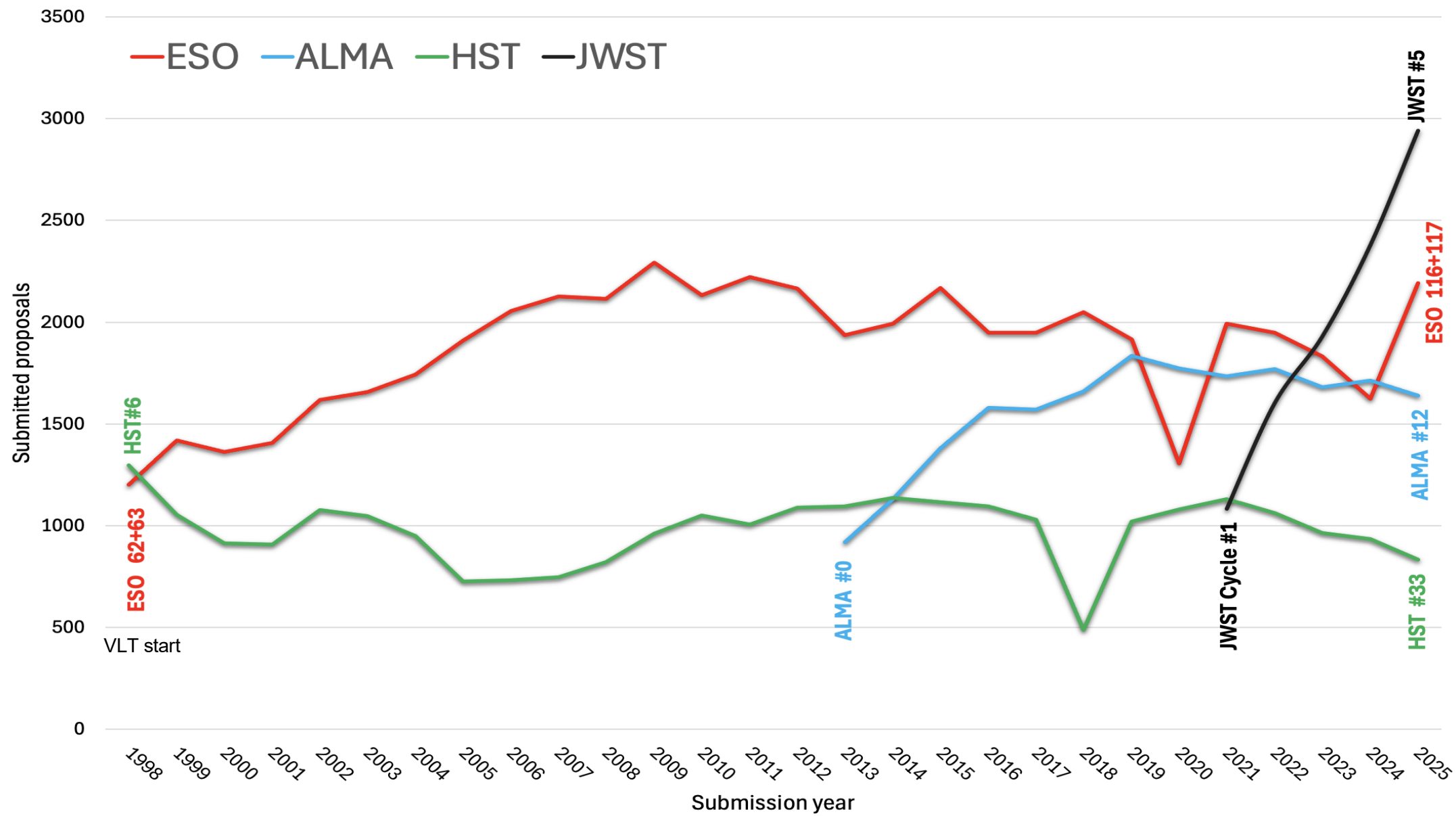
- Visitor Mode (Classical)
- designated Visitor Mode (Remote)
- Service Mode (Queue)



Observing Programme Types

- SM/VM • Normal – high priority, medium, filler type
- SM • Monitoring Programme – long time
- SM • Target of Opportunity, Rapid Response Mode
- SM/VM • Large Programme – 200h or longer
- SM/VM • Joint proposals with XMM and ALMA
- SM/VM • Calibration Programme
- VM • Guaranteed Time Observations
- Public Surveys – special/dedicated calls

Proposal Submission History



ESO Time Allocation

- **What:**

- Telescopes: Paranal (4 UTs, VLTI), La Silla (NTT, 3P6), Armazones (ELT) = **20 instruments**

- **Runs:**

- **Science Proposals**

- New proposals (**>1280 per year**) + on-going proposals
 - Normal, Large, Guaranteed Time, Monitoring, Calibration, Target of Opportunity, Rapid Response...

- **Technical time requests** – affecting instrument/telescope/subsystem

- **How:**

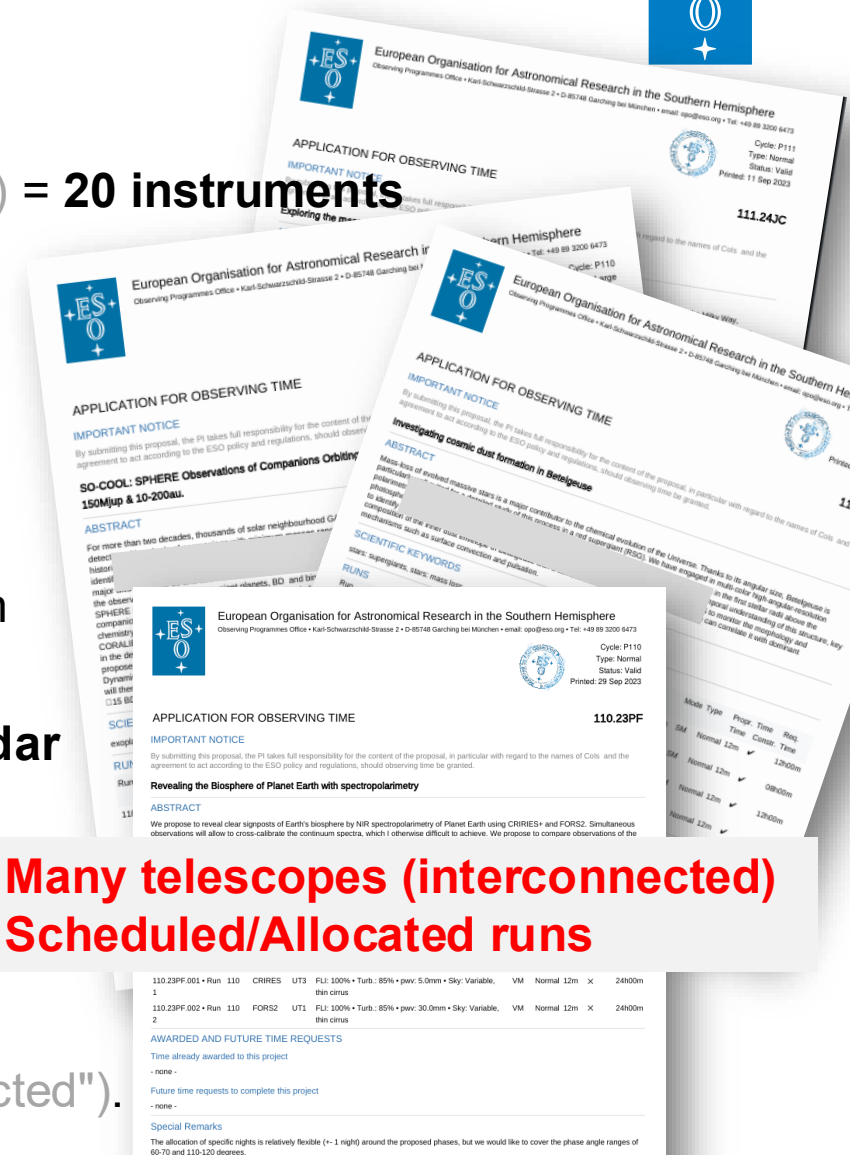
- **Scheduled:** [Visitor](#), delegated, Service with time constraints → **on calendar**
- **Allocation:** [Service](#) (queue) → **sidereal time allocation**

- **When:**

- yearly cycles + fast track channel (~2-3 per year)
- DDTs (any time)

- **OPC/Distributed review:** grade the proposals: 1 (must do) ... 3 ... 5 ("rejected").

- **Many telescopes (interconnected)**
- **Scheduled/Allocated runs**

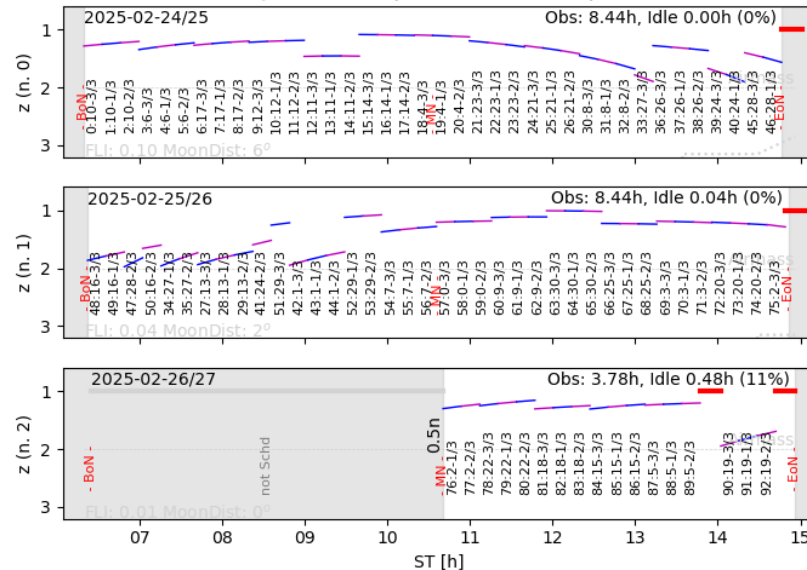


ESO Time Allocation & Scheduling Process

Collect → **pre-process** → **curate** → schedule → analyse → review → publish

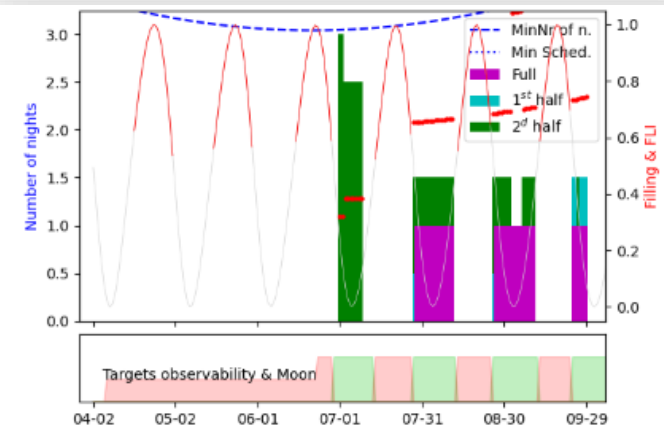
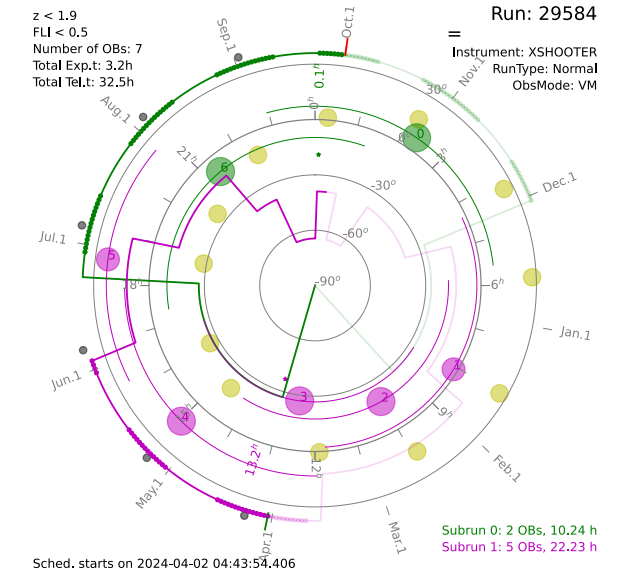
Pre-process:

- Astronomical calculations (airmass, moon, VLT visibility, ...) for all observations
- Assemble Visitor Mode runs (possibly splitting in sub-runs)
- Translate constraints to abstraction for scheduler



Curate:

- Detect and fix issues with proposal (targets not observable, too strong constraints...)
- Identify high priority conflicts
 - Time critical, VLT-UT, ESPRESSO, GTO
- ESPRESSO 1-UT: assign telescope
- VLT Imaging Slots

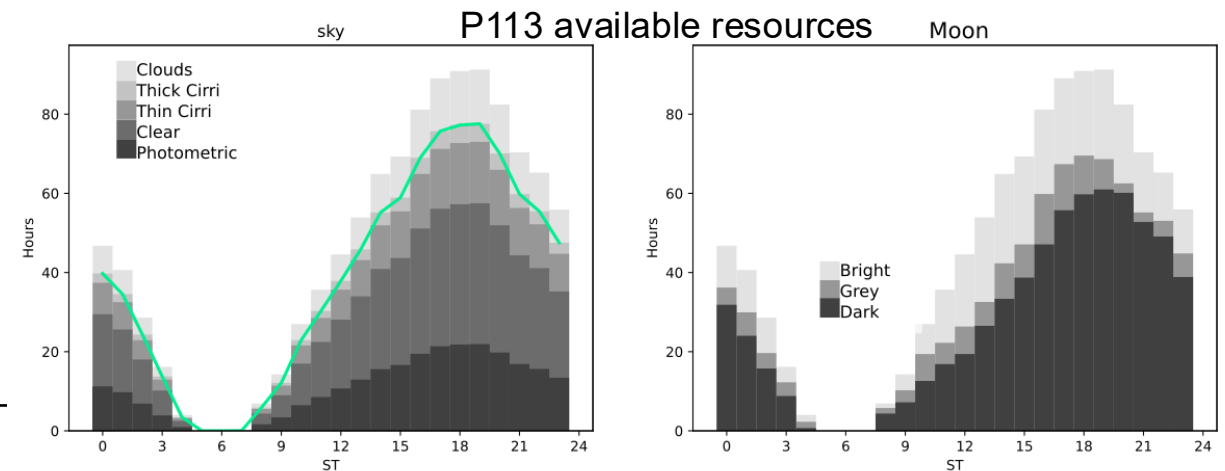


ESO Time Allocation & Scheduling Process

Collect → pre-process → curate → **schedule** → analyse → review → publish

Scheduling and Time Allocation:

- Compute available resources in ST bins
 - Allocated run: Service Mode
 - Look for a solution that includes ALL previously allocated runs + new run
Matching ST constraints for all observations & matching constraints (Turb., Sky, Moon, PWV, time)
 - Scheduled run: Visitor Mode (or dVM) on calendar
 - Look for a solution with all previously scheduled + new run
 - Success
 - Remove resources from ST bins
 - Failure
 - Reject the run
 - Iterate ...





LPO Telescopes Schedule

<https://www.eso.org/LPOschedule/public>



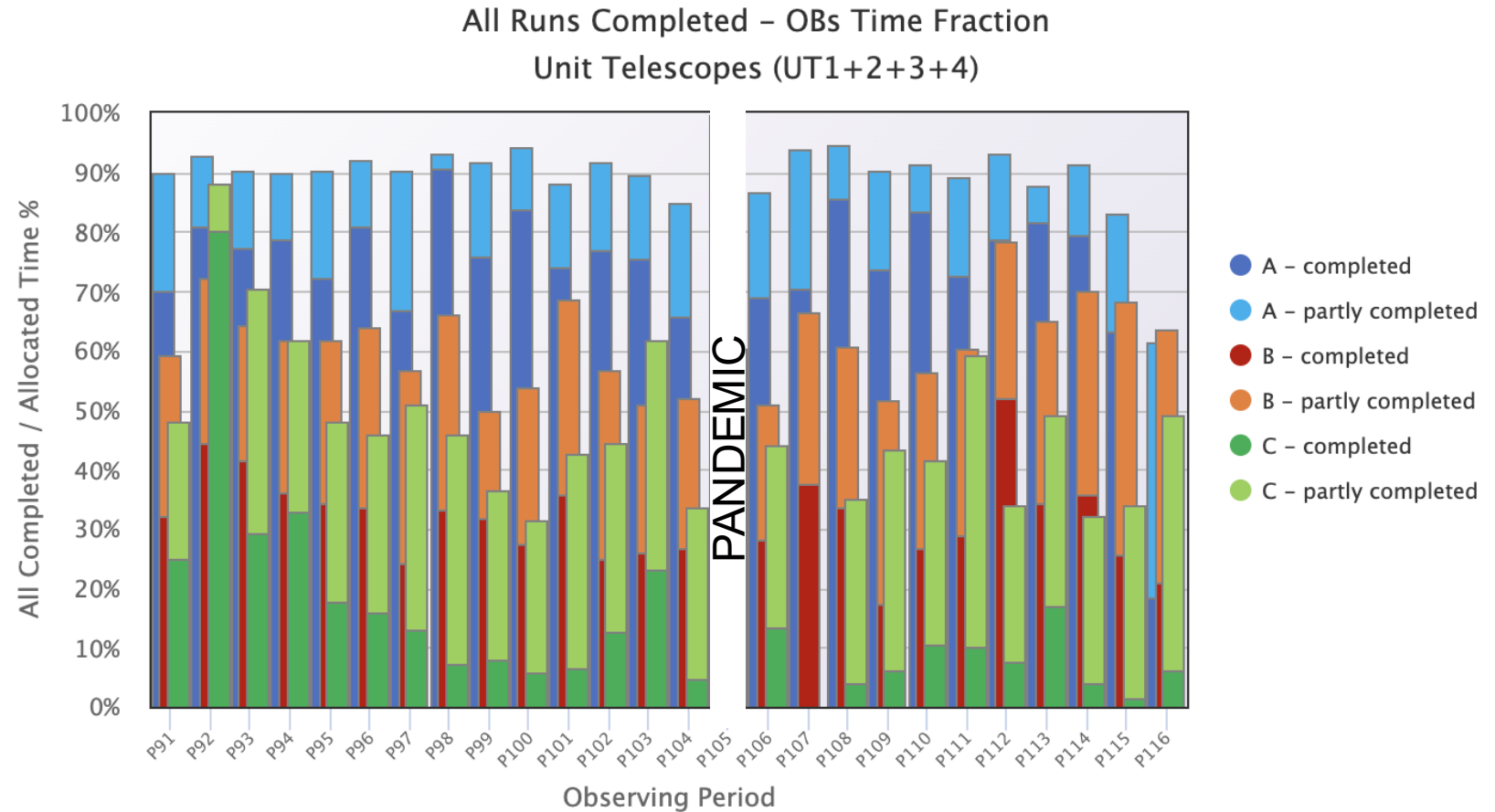
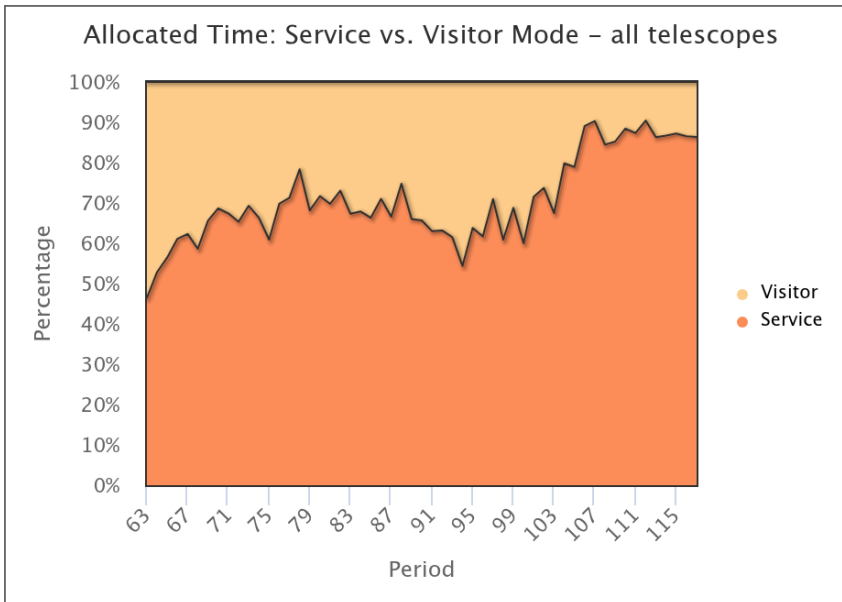
Service Mode & Short Term Scheduling @VLT/I

When will my observations be done?

- **Step 0: Observations preparation** → OBs, README, Finding Charts, Ephemeris
- **Step 1: Observations Filtering** → Observable vs Non-observable OBs
 - Constraints: airmass, sky transparency, moon, PWV, GL fraction, t0, IQ(z, l)
 - wind, availability of laser, inst. configuration
 - sidereal time, absolute time (include long-term schedule)
- **Step 2: Observations Ranking** → ranked list + rank justification
 - scientific ranking of the programme
 - combined probability of the realization of observing constraints
 - time critical score + setting target score
 - user priority, group score, group contribution

Allocated & Completed Time

~90% of SM A-rank observations completed – similar to VM



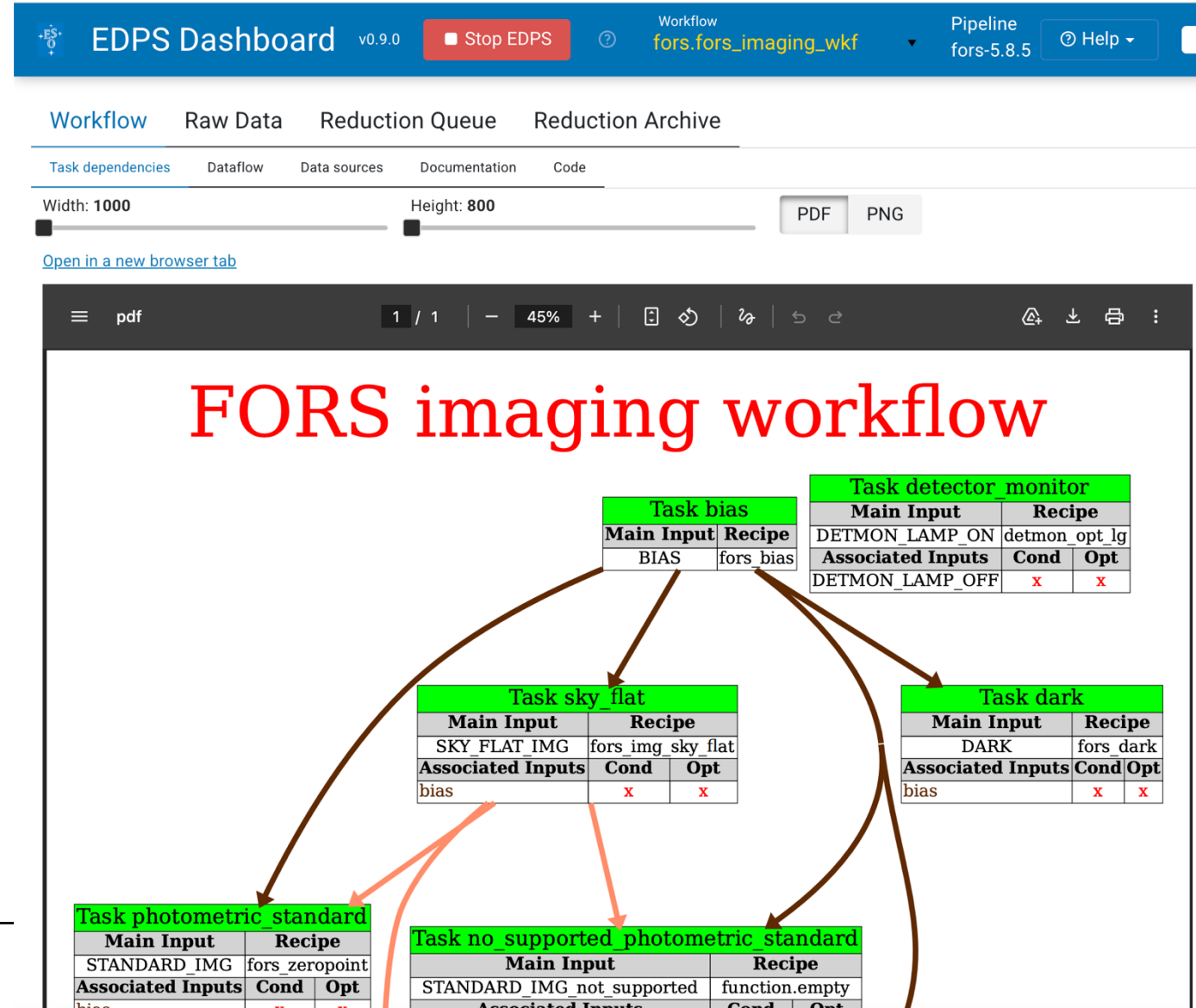


ESO Data Processing System (EDPS)

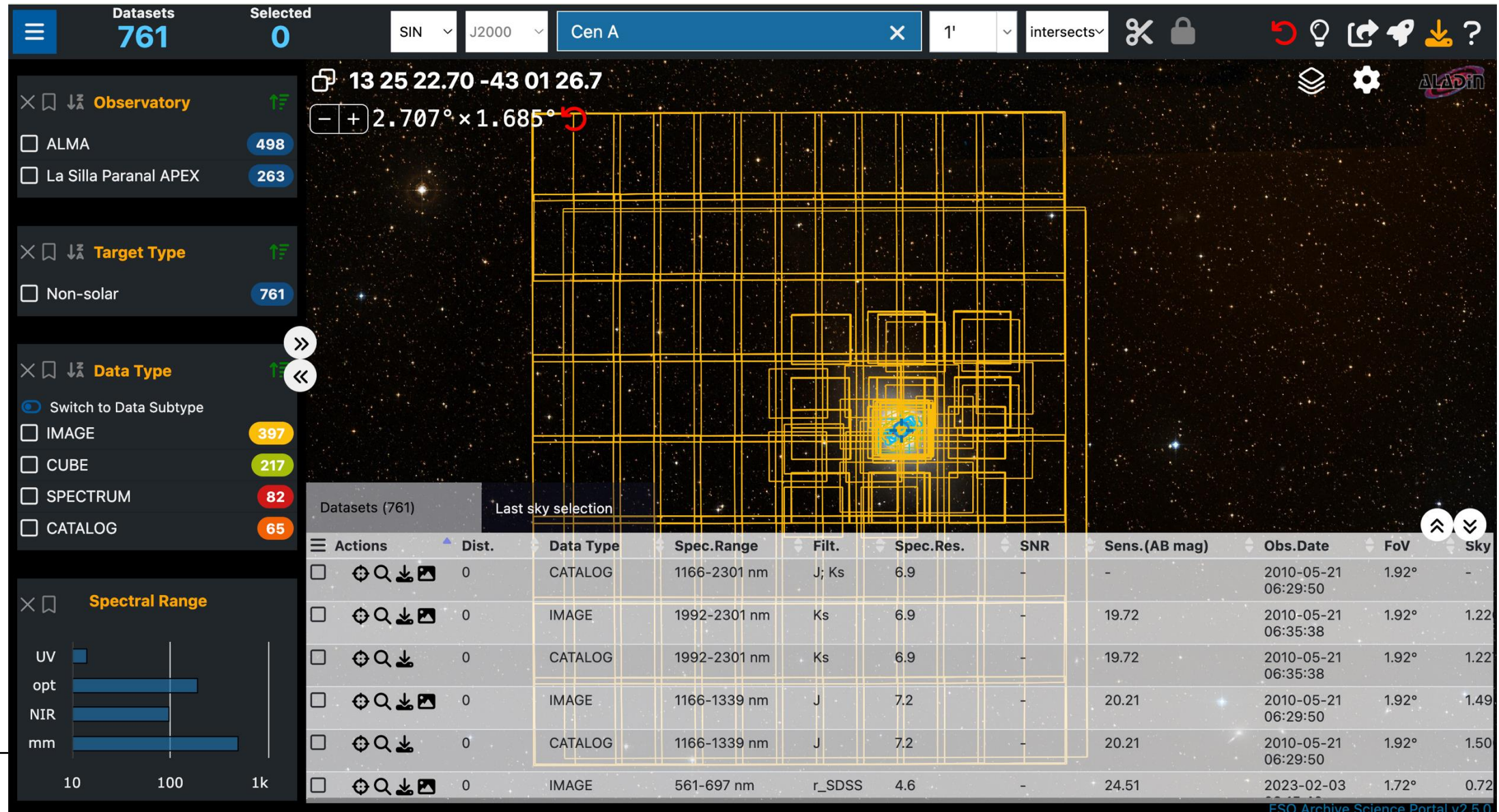
<https://www.eso.org/sci/software/edps.html>

Front-end pipeline execution

- unifies all ESO use cases
- written in Python
- includes data organisation
- orchestration of CPL/pyCPL recipes
- instrument-specific data processing
- web-based GUIs for QC
- compatible with science/cloud platforms (EOSC-EU Node, ESA Datalabs...)



ESO Science Archive



ESO Science Archive (archive.eso.org)



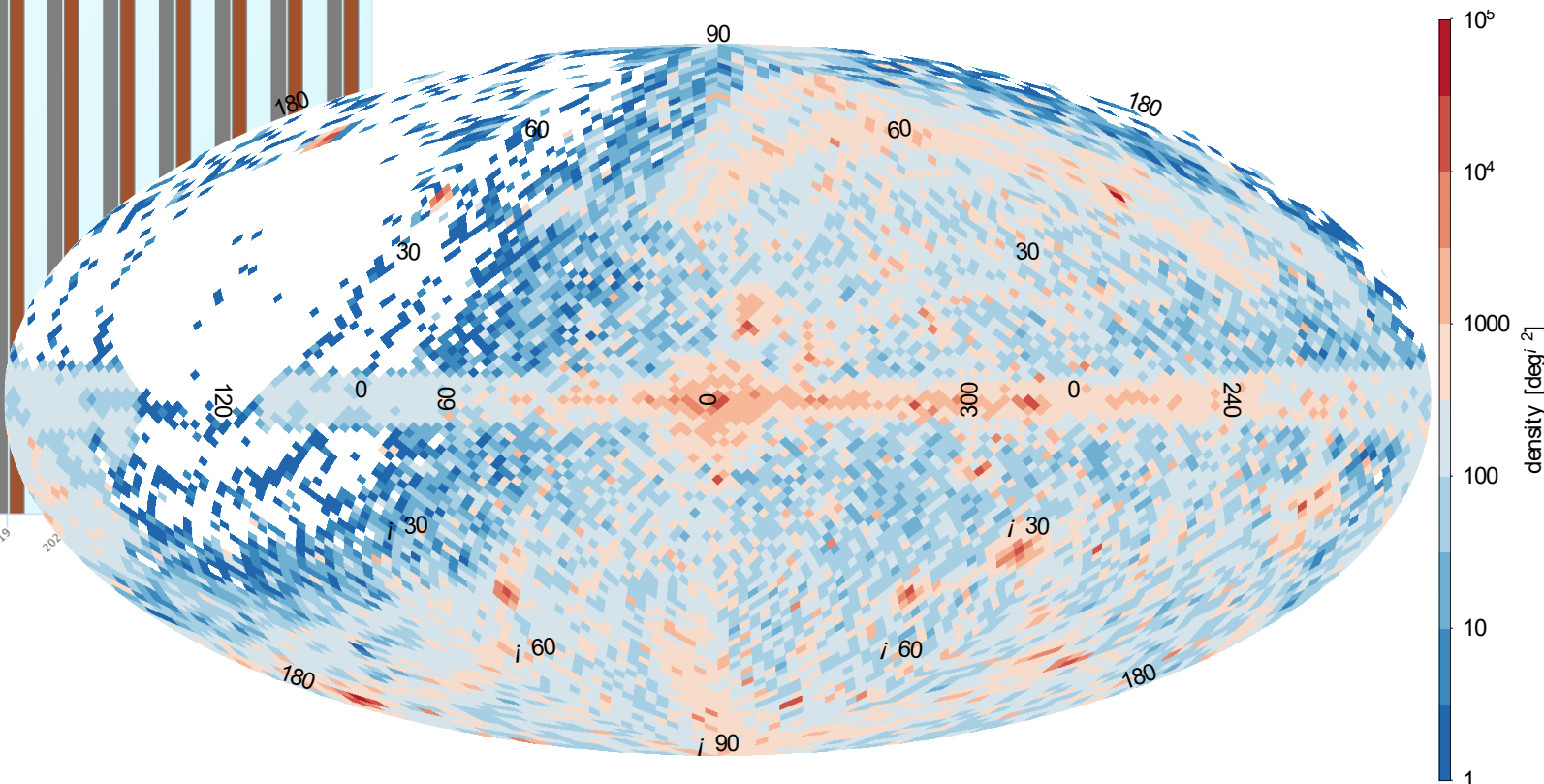
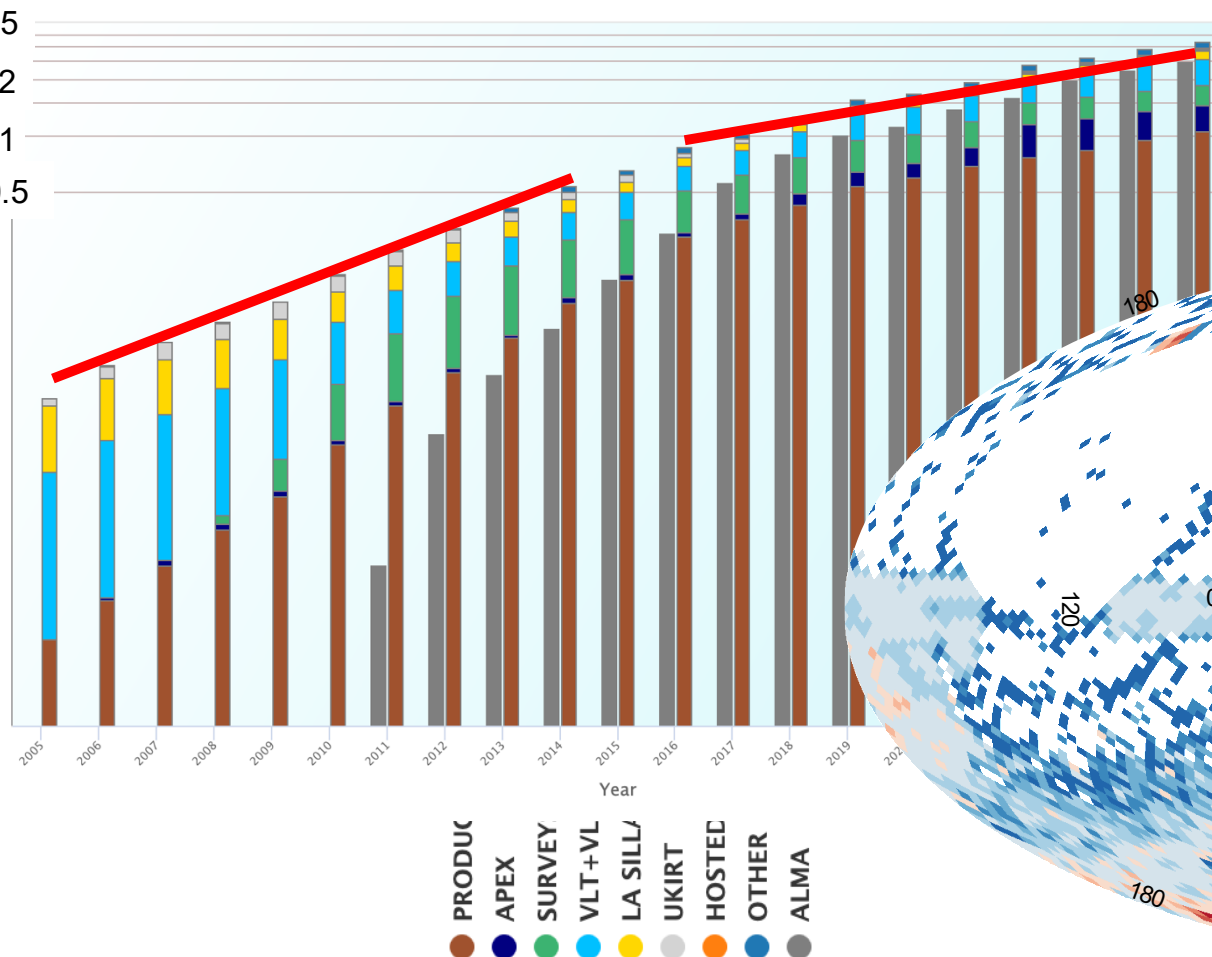
Data volume doubling time: 4-5 years; ~65 billion metadata items

- Great demand for processed data
- Steady, but “slow”, growth of data volume

ESO Archive Assets

Raw data *and* quick-look
Products (QC0) available within
less than 10 minutes

Content data volume [PB]



Telbib – ESO Telescope Bibliography

https://www.eso.org/sci/libraries/telbib_info.html

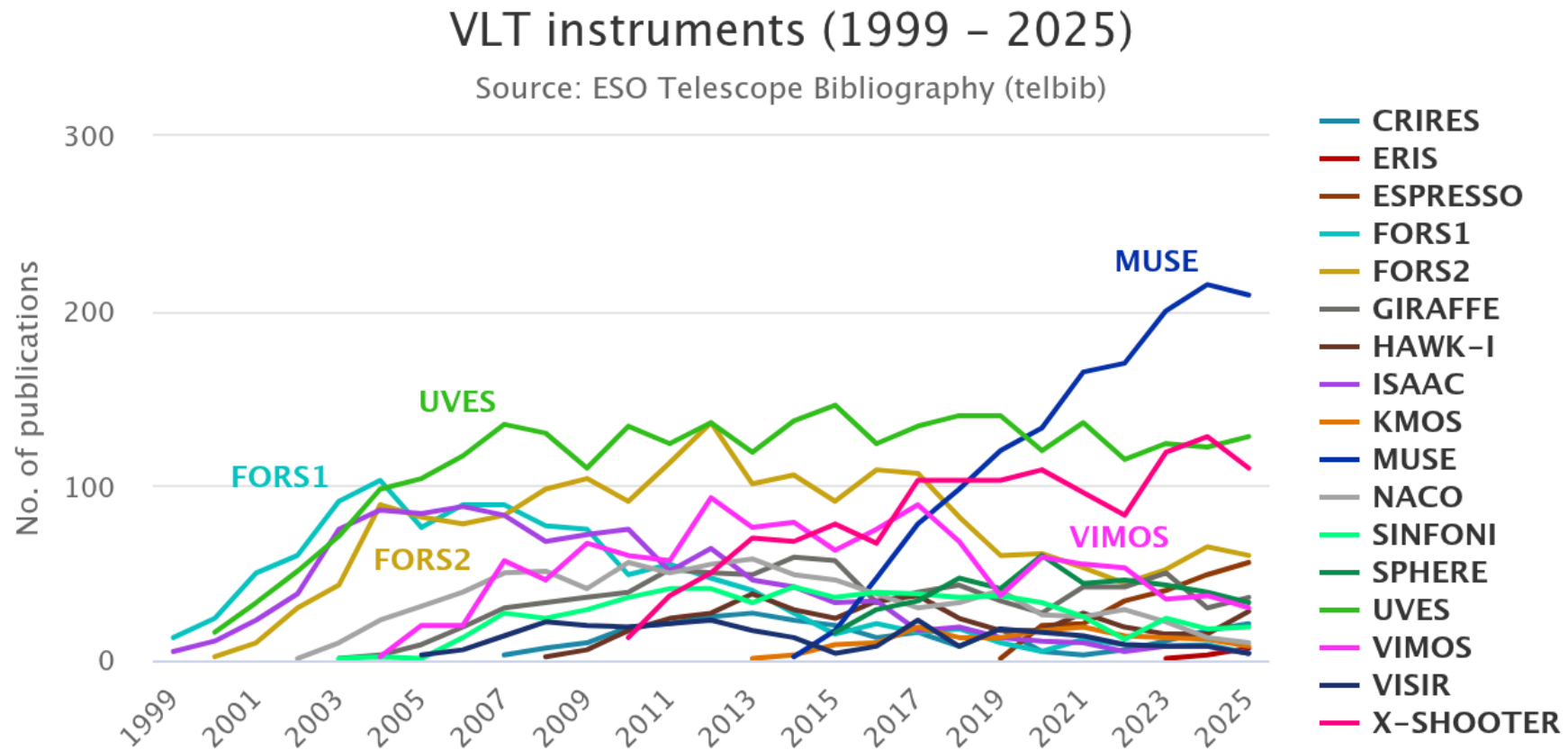


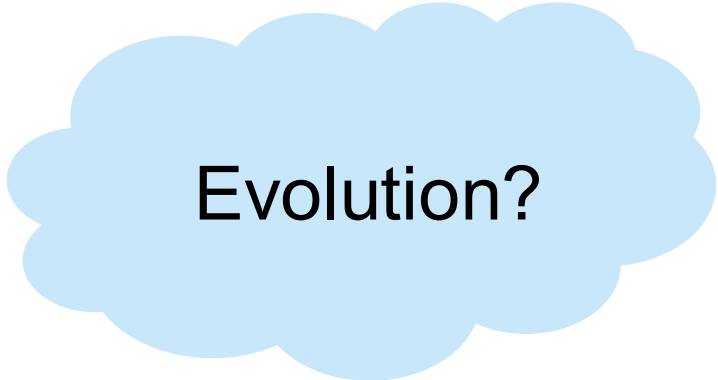
Fig. 4: Refereed publications using data from VLT instruments

provided by the ESO Library & Information Centre, realized with Highcharts.com

Scientific productivity (refereed publications)

Quantity, quality and evolution

- What is the average (time integrated) number of publications per observing program?
 - Program can have 0, 1, 2, ... publications
 - Publication can be based on 1 or more programs that contribute data
- What is the average (time integrated) number of publications per unit time (1 night ~ 9h)?
- How long does it take to publish?
 - First paper and all publications
- What is the fraction of programs with $N \geq 1$ publication?
- Which program types are more productive?
- What role does the ESO Science Archive play?



Evolution?

Methodology

Same method as in Sterzik et al., 2016 SPIE paper

🏠 / Proceedings / Volume 9910 / Article

15 Jul 2016 | Conference Proceedings

The impact of science operations on science return at the Very Large Telescope

M. Sterzik, U. Grothkopf, A. Kaufer, B. Leibundgut, S. Mieske, F. Patat, M. Rejkuba, M. Romaniello, L. E. Tacconi-Garman | [Author Affiliations](#)

Proceedings Volume 9910, <https://doi.org/10.1117/12.2232521> | [Event Info](#) ▾

ESO Operational databases (curated since the start of VLT operations): unique prog ID

- Phase 1 (proposals submission and time allocation) + Phase 2 (observations)
 - Telescope, instrument, observing mode, allocated time (nights for VM, hours for SM)

Science return increases with time

- Performance indicators integrated over the 25 years lifespan of the Observatory (1999-2025)
13,798 programmes, 29,284 publications: 1.09 publications/night
- ('11-'25) numbers: programs starting in 2011 directly comparable with the 2015 results
 - Publication can have 1 or more programs: all programs contribute equally
 - Archival publications consistently identified: paper co-authors do not include proposal PI/co-Is

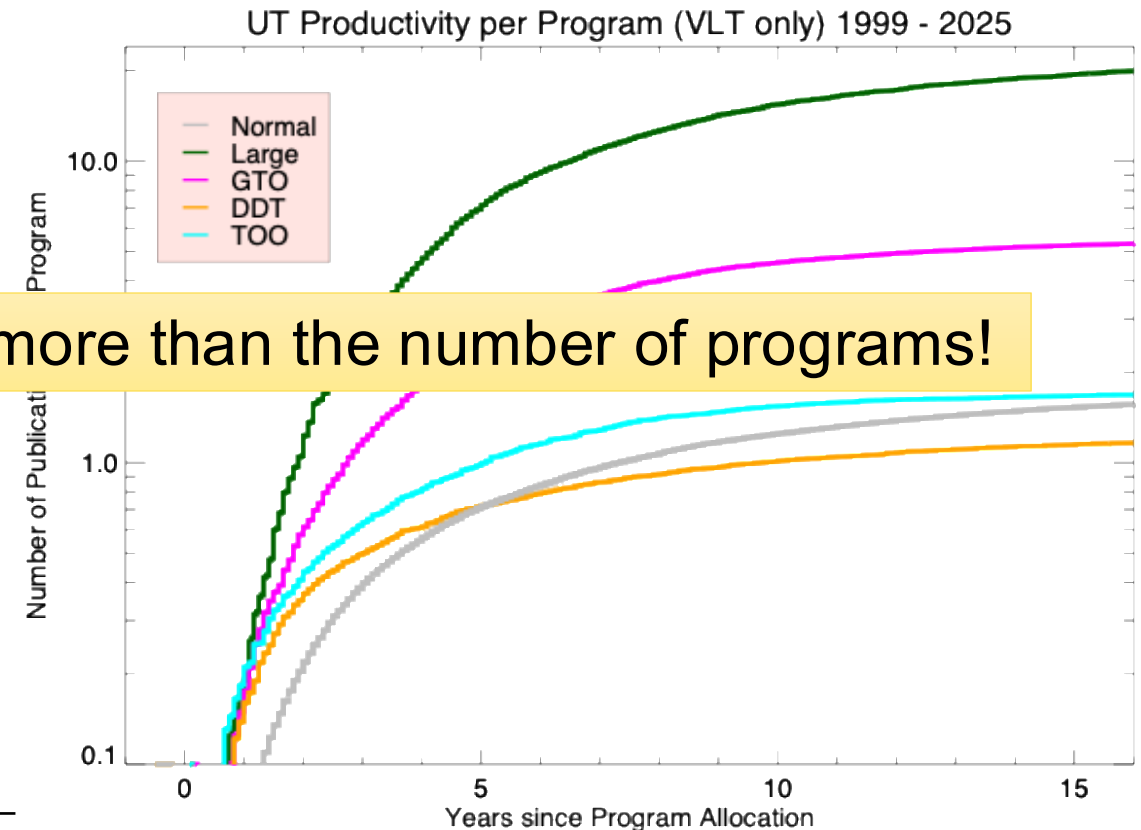
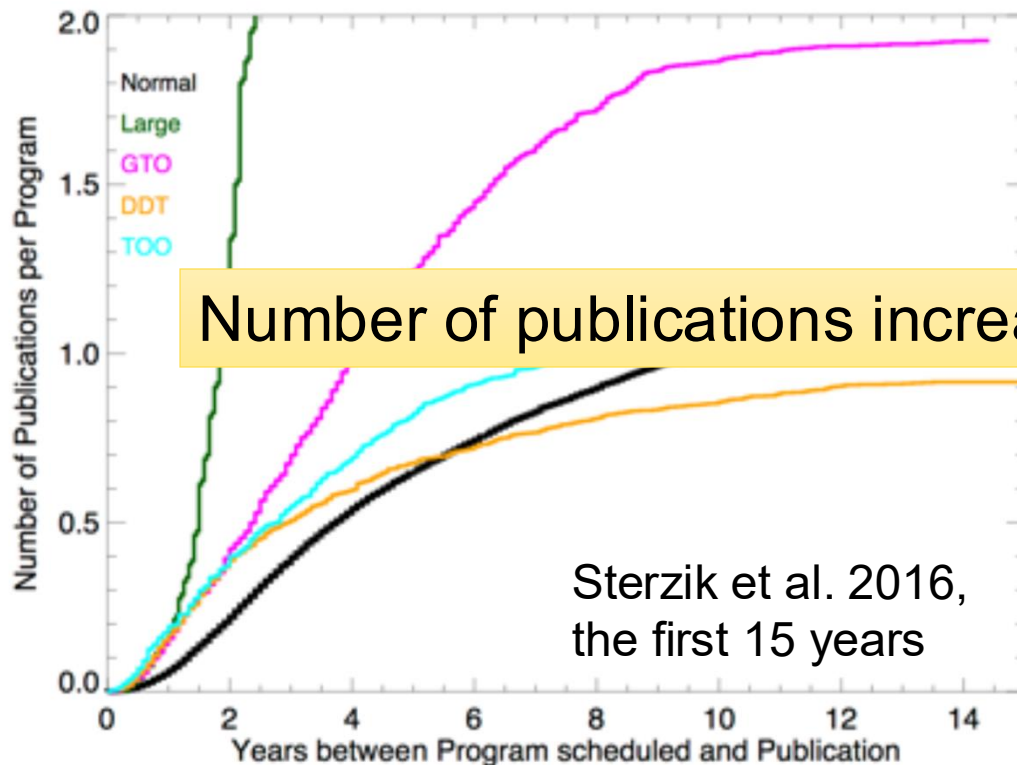
Citations drawn from the ADS for publications in telbib

Productivity – # of publications per program

publications vs publication time delay

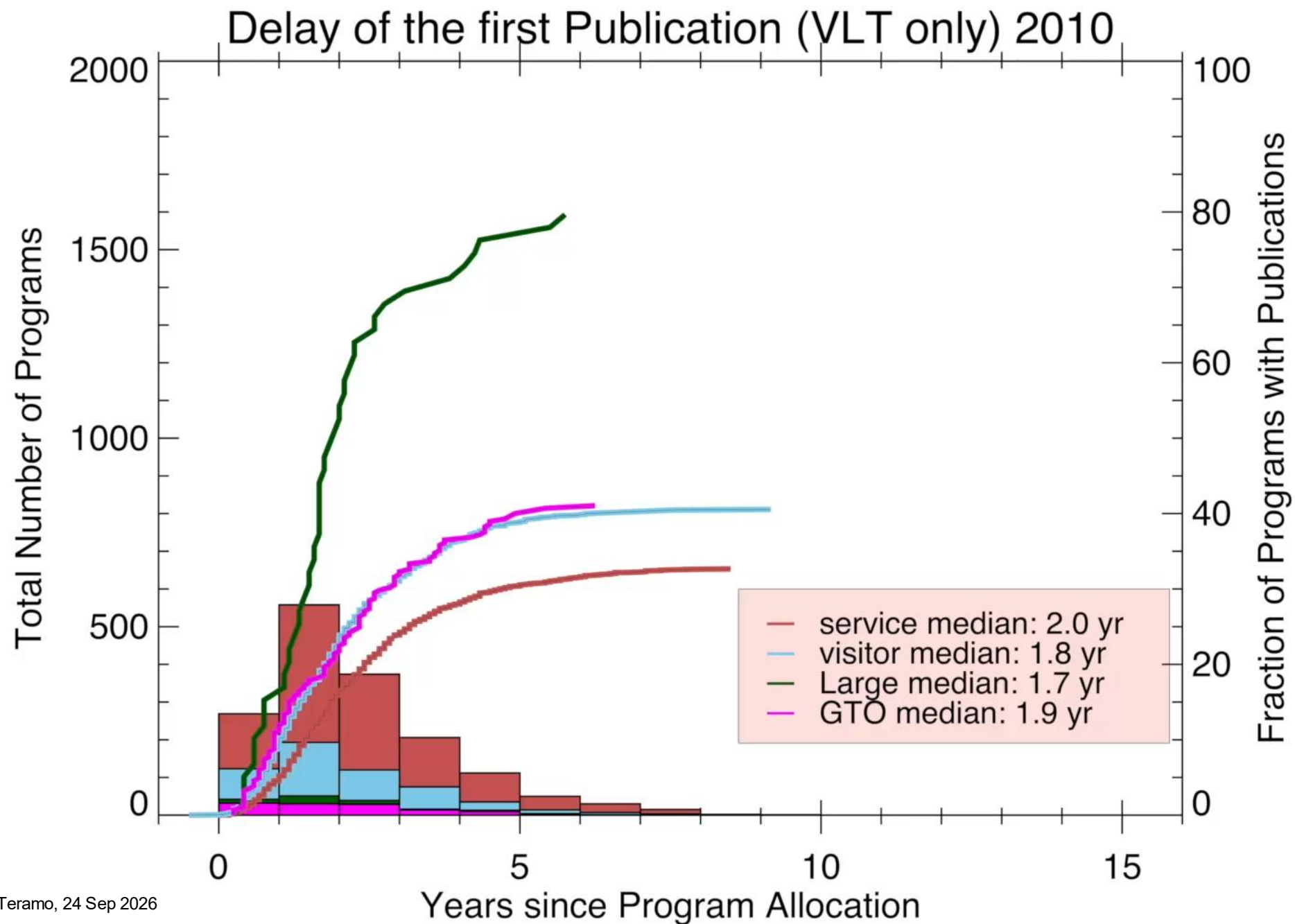
Total number of publications 2.5 x higher in 2025 (29284 papers; time window 1999-2015)
compared to 2015 (11291 papers; time window 1999-2025)

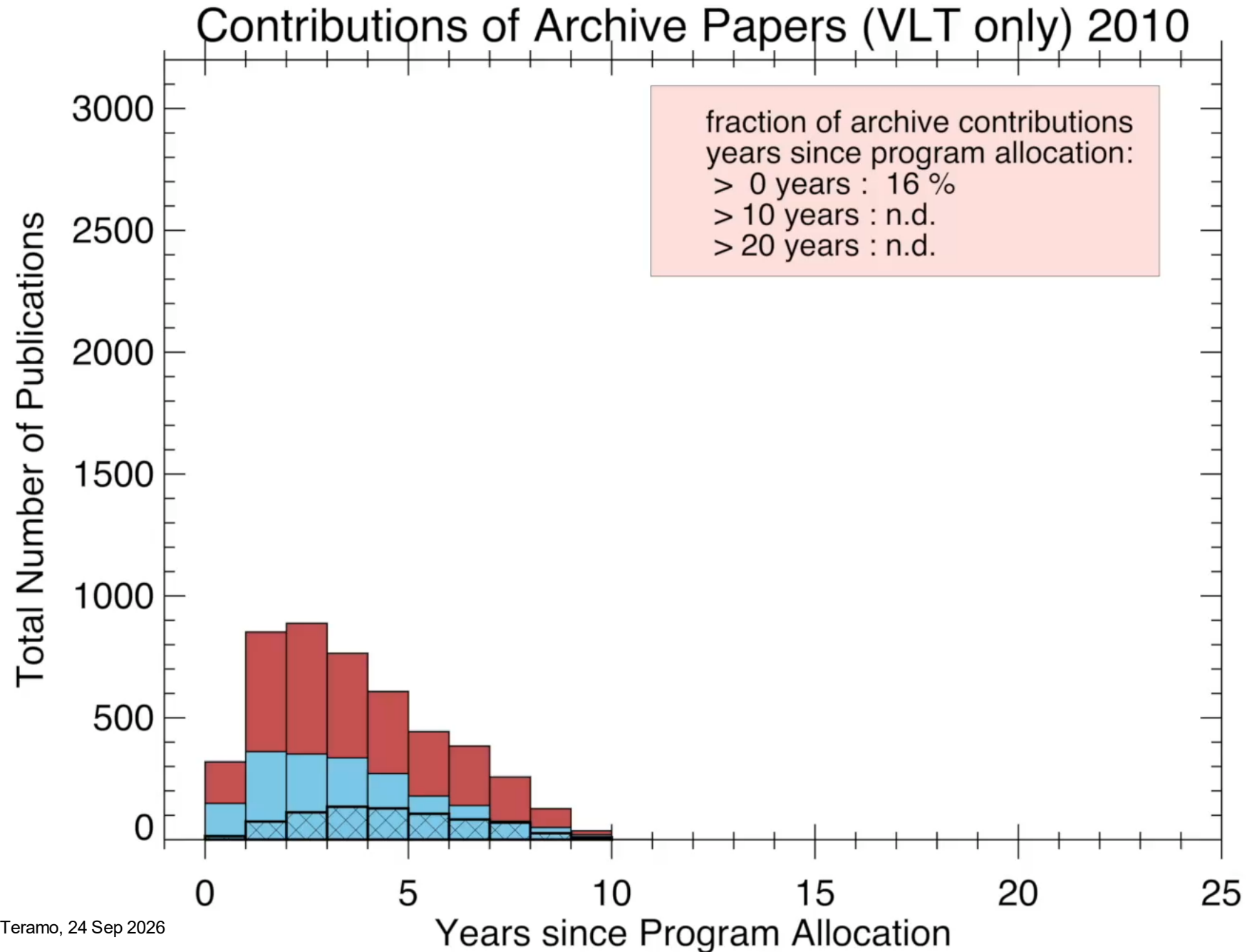
Total number of programs 1.6 x higher: 8414 in 2015 and 13789 in 2025



Number of publications increases more than the number of programs!

Evolution of the “Publication Delay” for first publications after program allocation





25 years science return of the Very Large Telescope

M. F. Sterzik, J. Brinchmann, J. Grave, U. Grothkopf, O. R. Hainaut, M. Hilker, A. Kaufer, T. Klein, S. Meakins, A. Merand, S. Mieske, F. Patat, C. Peroux, M. Rejkuba, M. Romaniello^a

^aEuropean Southern Observatory, Karl-Schwarzschild-Str 2, 85748 Garching, Germany

ABSTRACT

The scientific performance of an observatory depends on how observing programs are implemented and executed. After more than 25 years of continuous and stable operations of the VLT, the Paranal Observatory provides a uniquely rich dataset to quantify the long-term effects of the implementations of science policy strategies on scientific return. We use bibliometric indicators to evaluate program productivity and to characterize how different program types (Normal, Large, Guaranteed Time Observations, Director Discretionary Time, Target of Opportunity) and observing modes (aka Visitor and Service) translate into scientific publications. The long operational baseline of the VLT enables us to identify trends in scientific return, its connection to evolving operational strategies, and the contribution of specific program classes to high-impact publications. In particular, we highlight the increasing contributions of ESO's science archive to the publication statistics, as well as the effectiveness of Large and GTO programs. The insights gained offer a data-driven assessment of the strengths and limitations of the current operational model and guide the design of integrated VLT and ELT science operations for the coming decade.

Keywords: Observatory operations, Very Large Telescope, science return, bibliometrics, productivity, evolution

<http://dx.doi.org/10.1117/12.3102923>



Thank you!

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