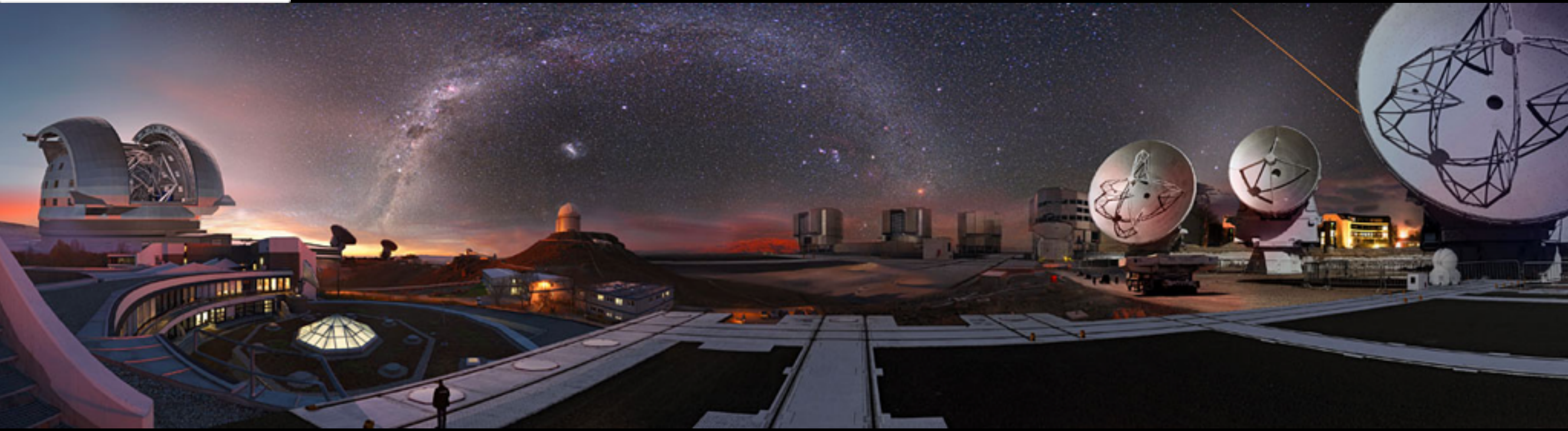
What the European Southern Observatory has to offer and how you can use it



Daniel Asmus

ESO, Chile & University of Southampton

European Southern Observatory

“ESO is the pre-eminent intergovernmental science and technology organisation in astronomy. It carries out an ambitious programme focused on the design, construction and operation of powerful ground-based observing facilities for astronomy to enable important scientific discoveries.”

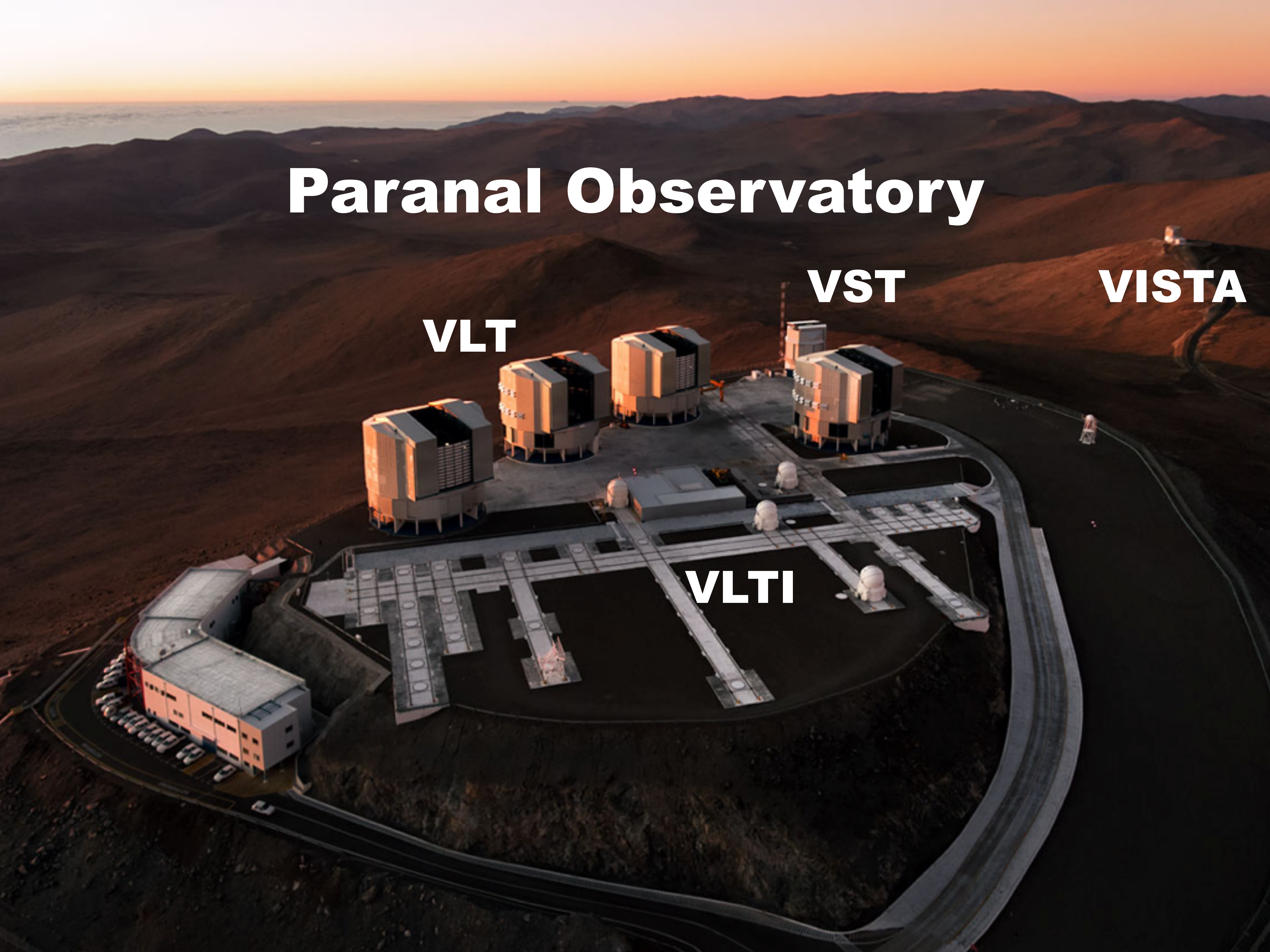
Astronomical Observatory Map

Credit: K. Reardon


Iquique
Bolivia
since 2005
since 1998
Chajnantor (ALMA/APEX)
Antofagasta
Paranal (VLT)
since 2011
2024?
since 1966
Argentina
La Silla
La Serena
Santiago (400km)
200 km

Iquique
Bolivia
since 2005
since 1998
Antofagasta
Chajnantor (ALMA/APEX)
Paranal (VLT)
Armazones (ELT)
since 2011
2024?
since 1966
La Silla
Argentina
La Serena
Santiago (400km)
200 km


ALMA
ATACAMA LARGE MILLIMETER ARRAY
ESO
NRAO
NAOJ
• 66 antenna interferometer
• 0.32 to 3.6 mm,
• 0.018” to 3.4” angular resolution
“Users of any professional background, nationality or affiliation may submit an ALMA proposal (call yearly, deadline in April)”
See separate call


Paranal Observatory
VST
VISTA
VLT
VLTI

VLT/I Instruments


NaCo
FORS
KMOS
UVES
X-SHOOTER
FLAMES
MUSE
SINFONI
HAWKI
VIMOS
VISIR
SPHERE
AMBER
PIONIER
GRAVITY

NaCo
UVES
X-SHOOTER
FLAMES
FORS
KMOS
AOF
MUSE
espresso
CRIRES+
SINFONI
VISIR
AMBER
PIONIER
GRAVITY
AWKI
SPHERE
MATISSE

NaCo
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KMOS
UVES
X-SHOOTER
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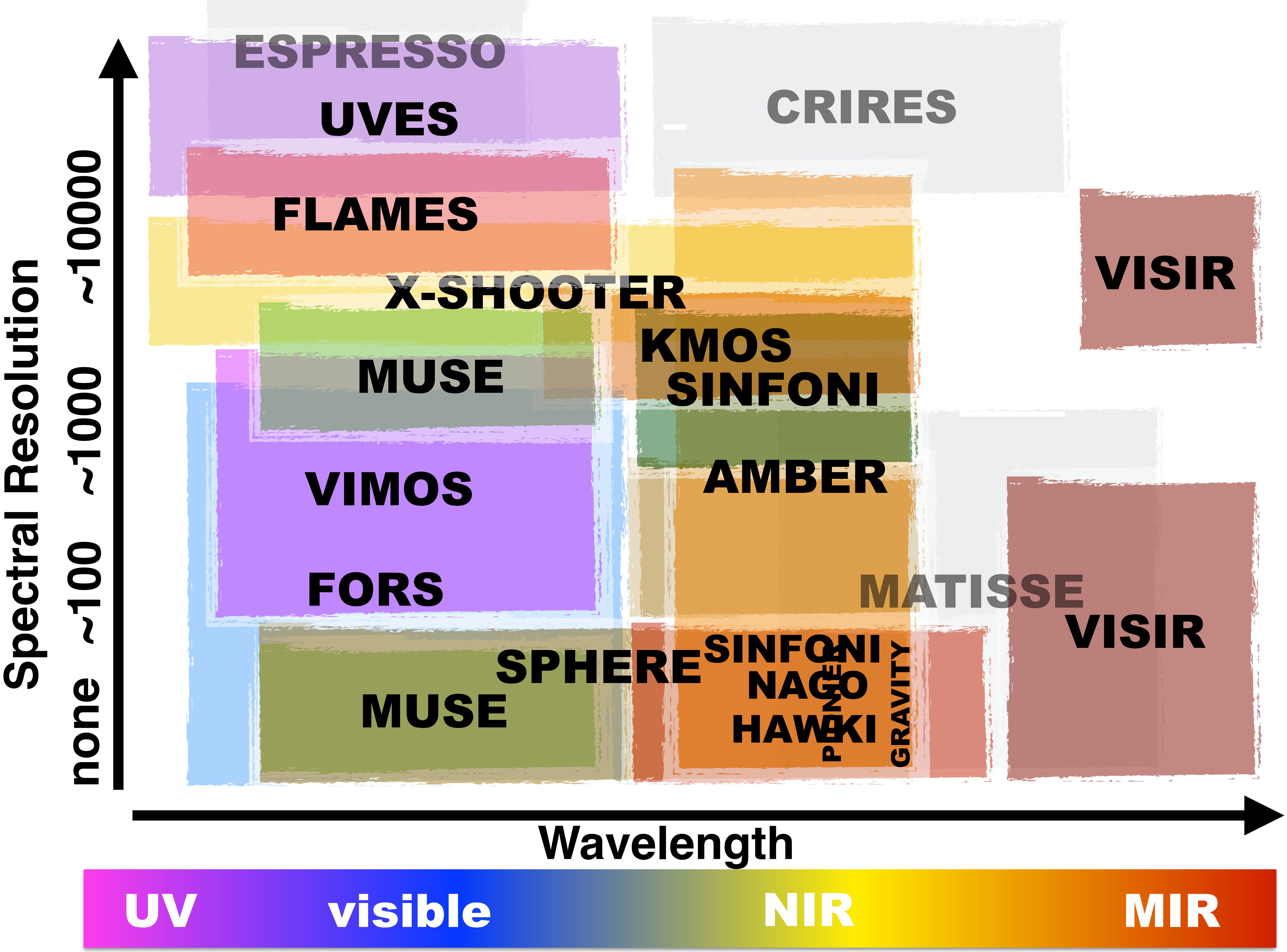
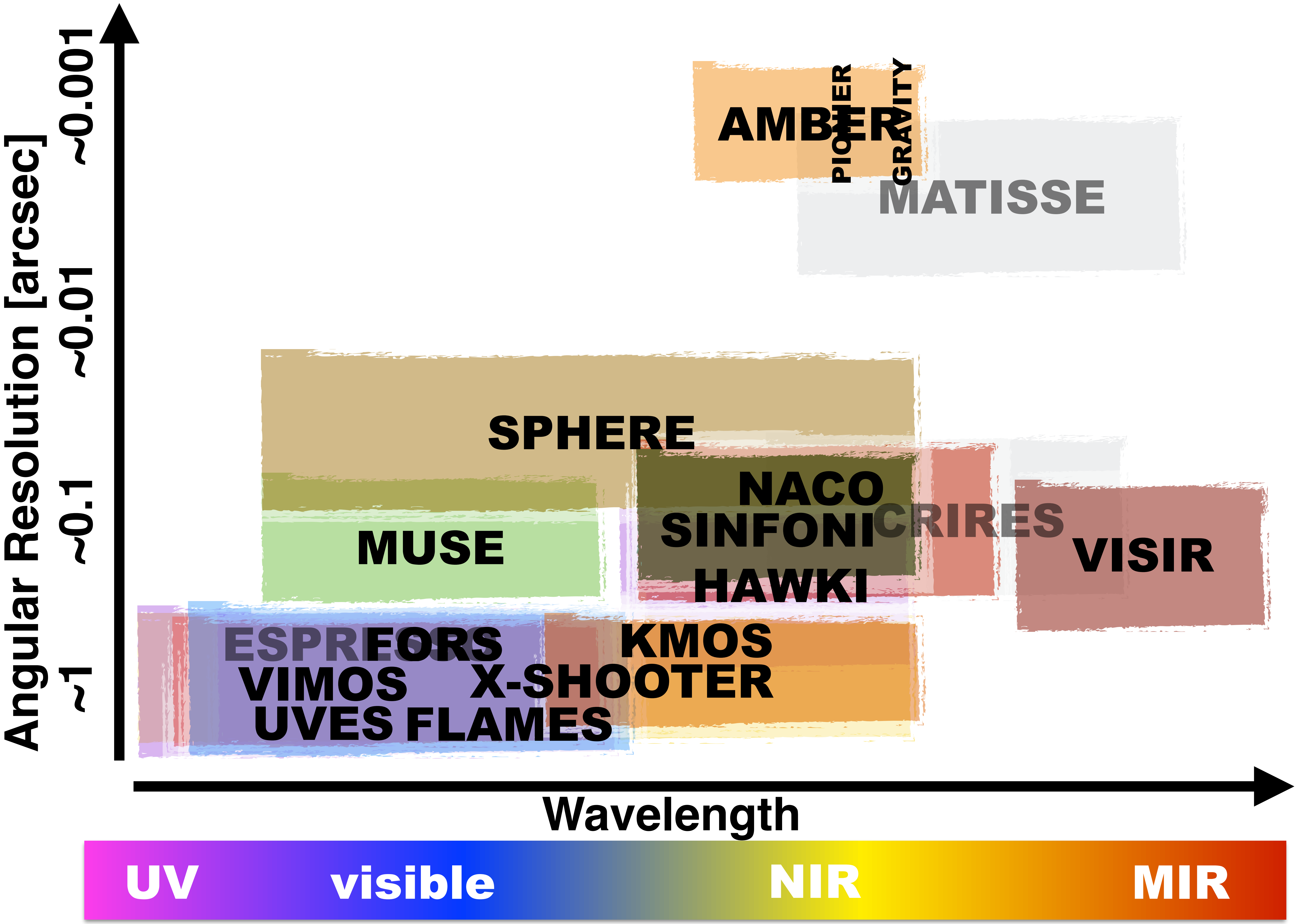
AWKI
MATISSE



ESPRESSO
UVES
CRIRES
FLAMES
VISIR
X-SHOOTER
KMOS
SINFONI
MUSE
AMBER
VIMOS
MATISSE
FORS
VISIR
SINFONI
SPHERE
NACO
HAWKI
GRAVITY
MUSE
Spectral Resolution
none
~100
~1000
~10000
Wavelength
UV
visible
NIR
MIR


Angular Resolution [arcsec]
~0.001
~0.01
~0.1
~1
AMBER
PIONIER
GRAVITY
MATISSE
SPHERE
NACO
SINFONI
CRIRES
VISIR
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UVES FLAMES
Wavelength
UV
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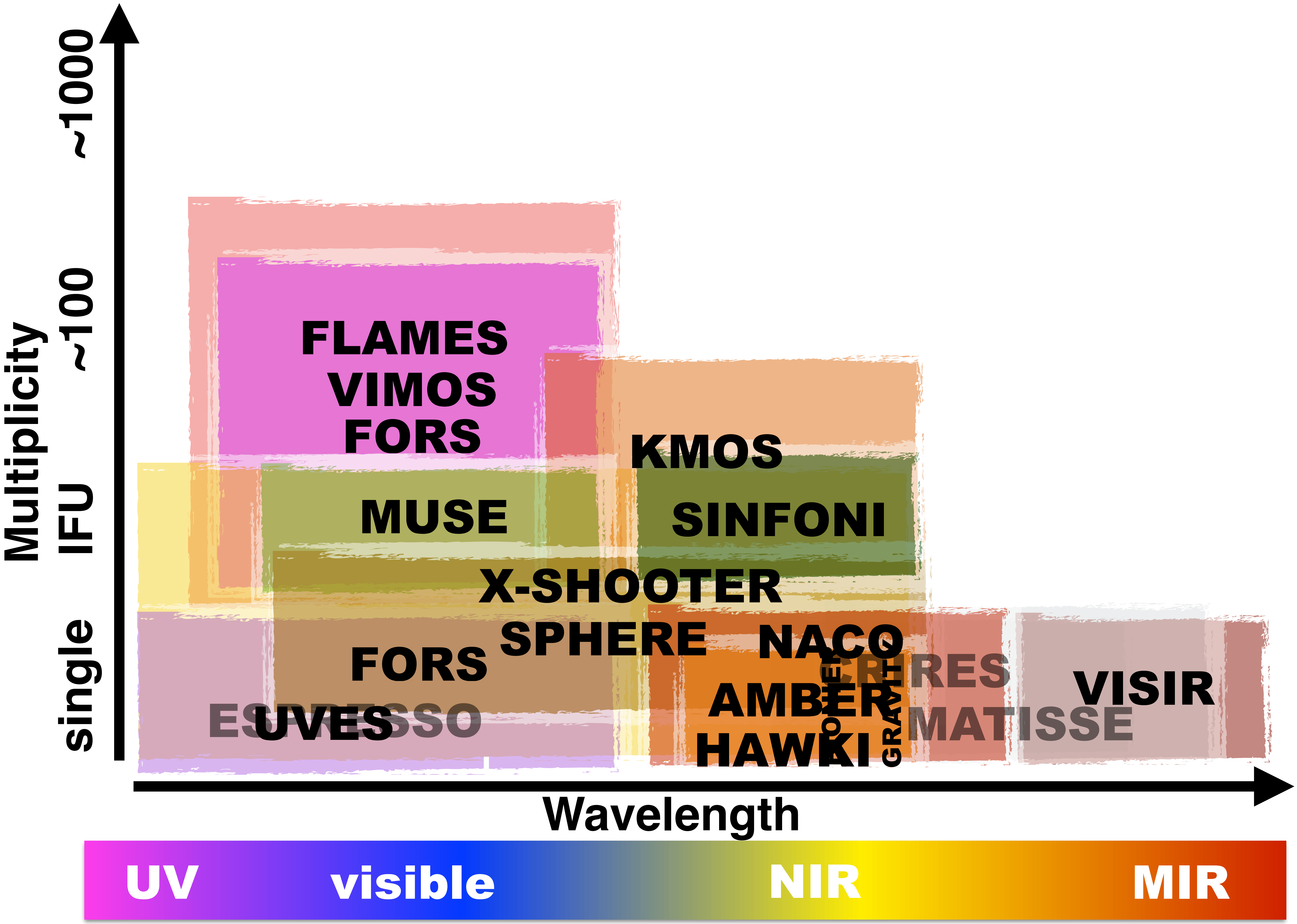
MIR


~1000
~100
Multiplicity
IFU
single
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KMOS
MUSE
SINFONI
X-SHOOTER
SPHERE
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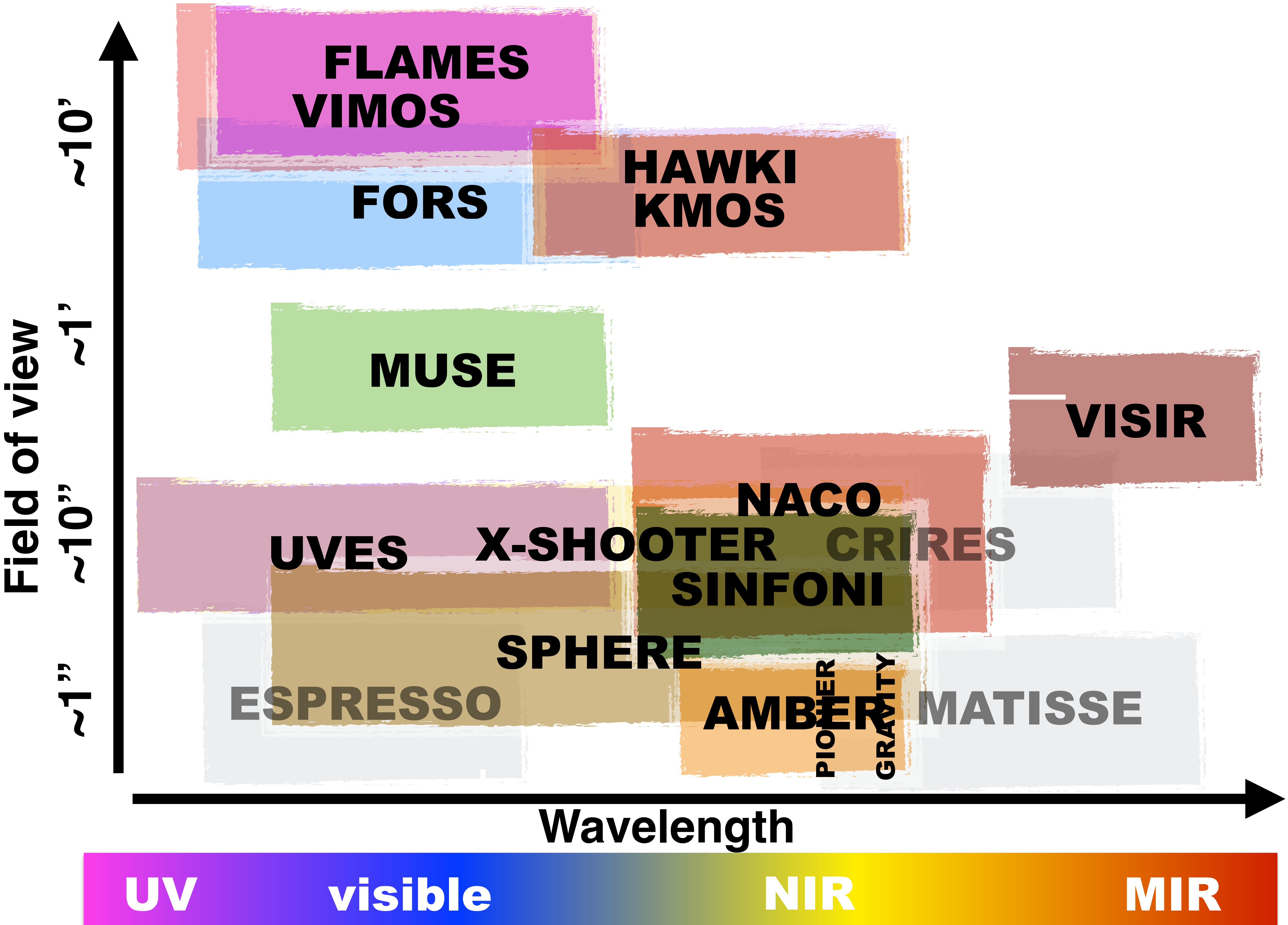
FORS
CRIRES
AMBER
GRAVITY
HAWKI
VISIR
UVES
MATISSE
Wavelength
UV
visible
NIR
MIR



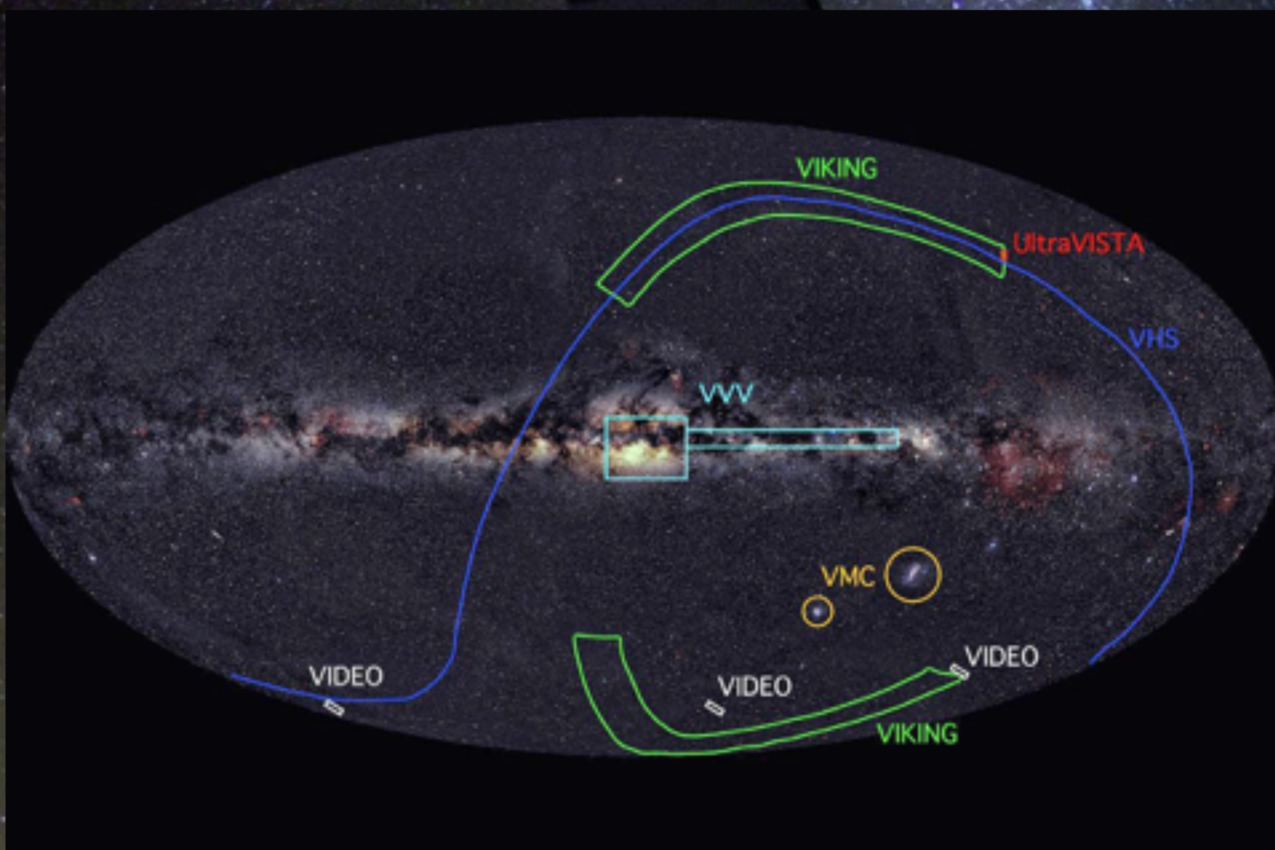
FLAMES
VIMOS
HAWKI
KMOS
FORS
MUSE
VISIR
NACO
X-SHOOTER
CRIRES
UVES
SINFONI
SPHERE
ESPRESSO
AMBER
PIONIER
GRAVITY
MATISSE
~10'
~1'
~10"
~1"
Field of view
Wavelength
UV
visible
NIR
MIR


VISTA
(Visible and Infrared
Survey Telescope for Astronomy)
VIRCAM
(VISTA InfraRed CAMera)


VST
(VLT Survey Telescope)
OmegaCAM
Credit: M. Claro/ESO

VISTA

(Visible and Infrared Survey Telescope for Astronomy)

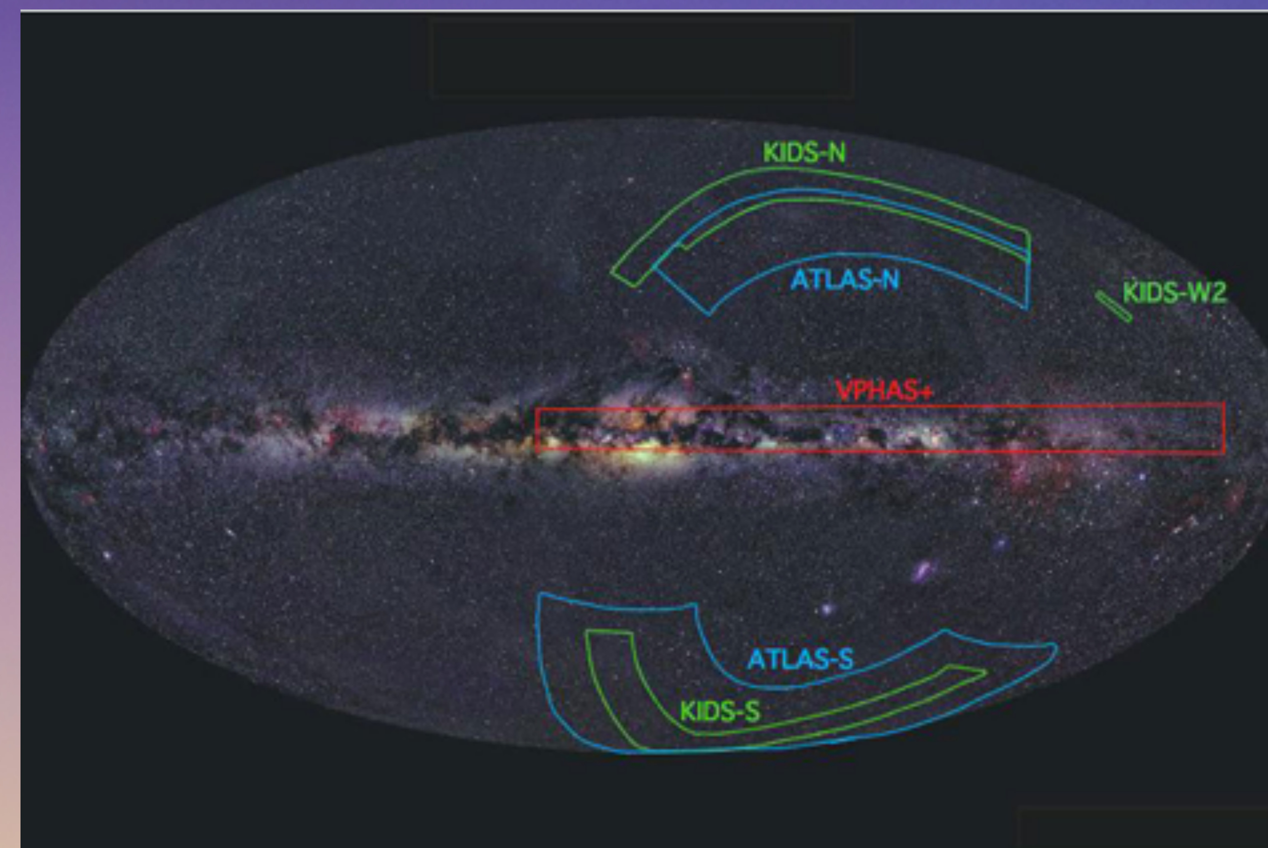


VIRCAM

(VISTA InfraRed CAMera)

VST

(VLT Survey Telescope)



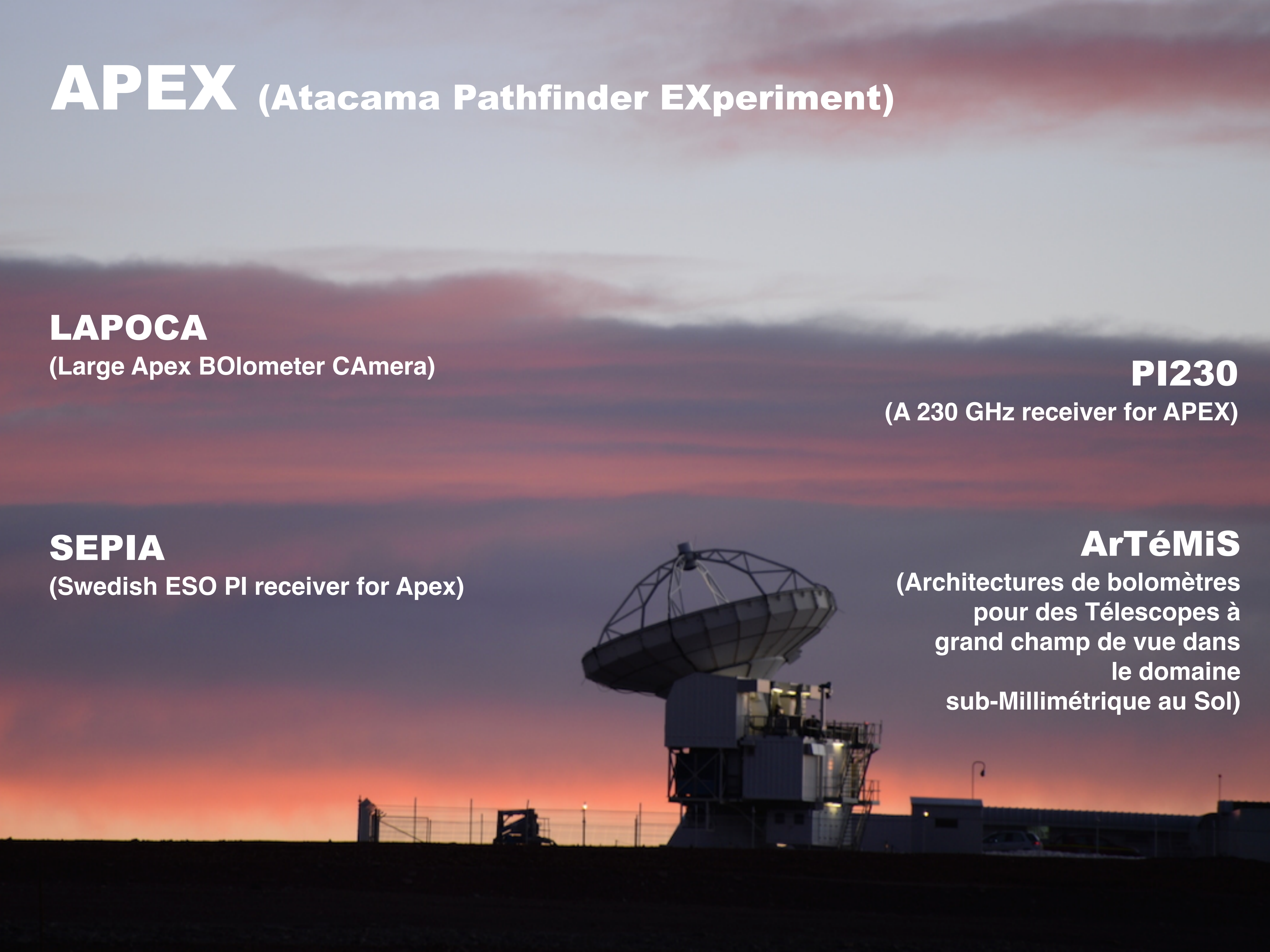
OmegaCAM

Credit: M. Claro/ESO

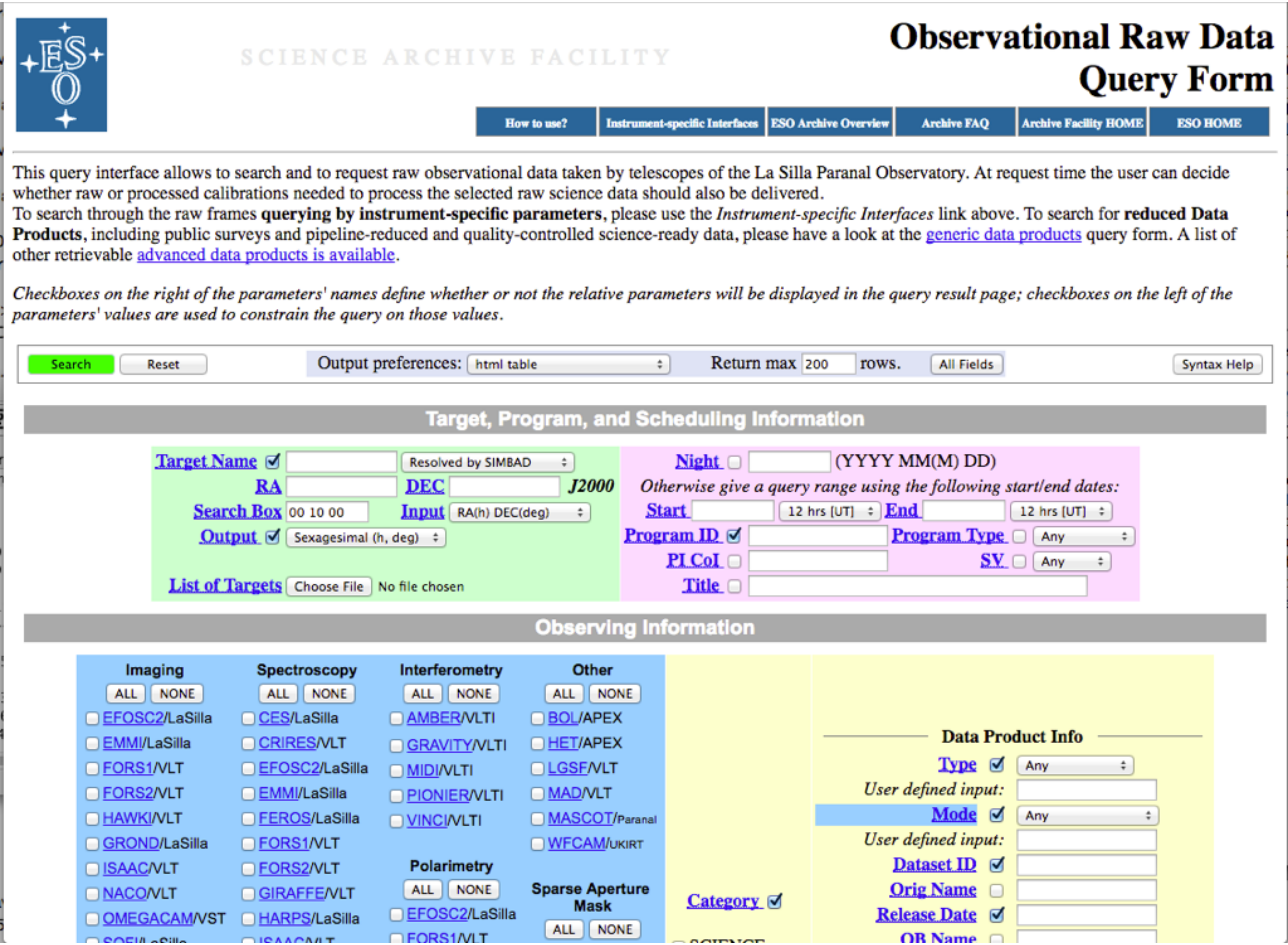

La Silla Observatory
3.6m
NTT


3.6-metre telescope
HARPS
(High Accuracy Radial velocity Planet Searcher)


NTT
(New Technology Telescope)
EFOSC2
(ESO Faint Object SpeCtrograph 2)
SOFI
(Son OF Isaac)
ULTRACAM


APEX (Atacama Pathfinder EXperiment)
LAPOCA
(Large Apex BOlometer CAmera)
PI230
(A 230 GHz receiver for APEX)
SEPIA
(Swedish ESO PI receiver for Apex)
ArTéMiS
(Architectures de bolomètres pour des Télescopes à grand champ de vue dans le domaine sub-Millimétrique au Sol)

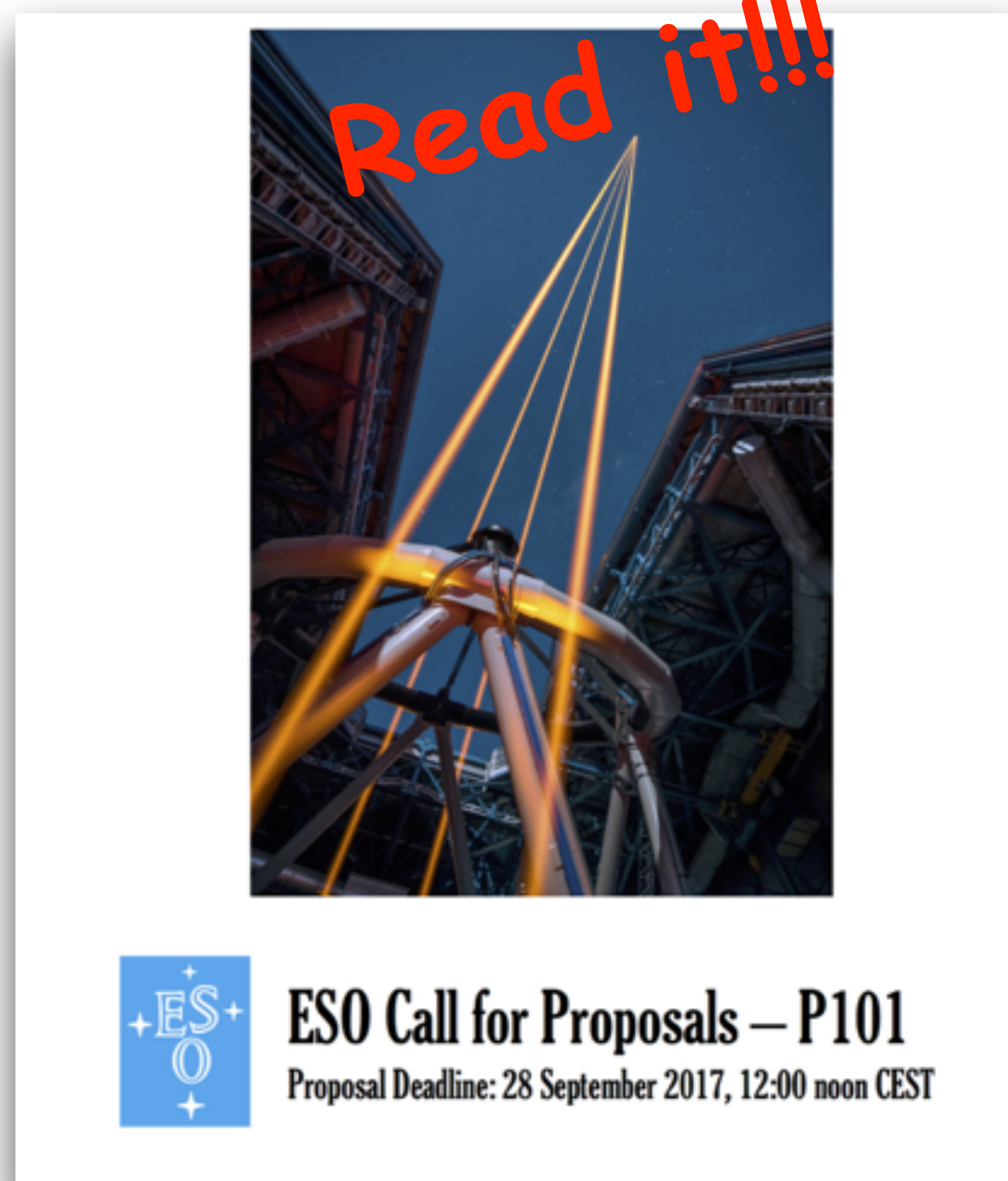
How to make use of ESO?


SCIENCE ARCHIVE FACILITY
Observational Raw Data Query Form
How to use?
Instrument-specific Interfaces
ESO Archive Overview
Archive FAQ
Archive Facility HOME
ESO HOME
This query interface allows to search and to request raw observational data taken by telescopes of the La Silla Paranal Observatory. At request time the user can decide whether raw or processed calibrations needed to process the selected raw science data should also be delivered.
To search through the raw frames querying by instrument-specific parameters, please use the Instrument-specific Interfaces link above. To search for reduced Data Products, including public surveys and pipeline-reduced and quality-controlled science-ready data, please have a look at the generic data products query form. A list of other retrievable advanced data products is available.
Checkboxes on the right of the parameters' names define whether or not the relative parameters will be displayed in the query result page; checkboxes on the left of the parameters' values are used to constrain the query on those values.
Search
Reset
Output preferences: html table
Return max 200 rows.
All Fields
Syntax Help
Target, Program, and Scheduling Information
Target Name
Resolved by SIMBAD
RA
DEC
J2000
Search Box 00 10 00
Input RA(h) DEC(deg)
Output Sexagesimal (h, deg)
List of Targets Choose File No file chosen
Night (YYYY MM(M) DD)
Otherwise give a query range using the following start/end dates:
Start 12 hrs [UT] End 12 hrs [UT]
Program ID
Program Type Any
PI CoI
SV Any
Title
Observing Information
Imaging ALL NONE
EFOSC2/LaSilla
EMMI/LaSilla
FORS1/VLT
FORS2/VLT
HAWKI/VLT
GROND/LaSilla
ISAAC/VLT
NACO/VLT
OMEGACAM/VST
Spectroscopy ALL NONE
CES/LaSilla
CRIRES/VLT
EFOSC2/LaSilla
EMMI/LaSilla
FEROS/LaSilla
FORS1/VLT
FORS2/VLT
GIRAFFE/VLT
HARPS/LaSilla
Interferometry ALL NONE
AMBER/VLTI
GRAVITY/VLTI
MIDI/VLTI
PIONIER/VLTI
VINCI/VLTI
Polarimetry ALL NONE
EFOSC2/LaSilla
Other ALL NONE
BOL/APEX
HET/APEX
LGSF/VLT
MAD/VLT
MASCOT/Paranal
WFCAM/UKIRT
Sparse Aperture Mask ALL NONE
Category
Data Product Info
Type Any
User defined input:
Mode Any
User defined input:
Dataset ID
Orig Name
Release Date


Observing Proposals
Credit: G. Hüdepohl/ESO

Call for proposal twice per year
(deadlines end of March & September)

- Document with all relevant info appears ~< 1month before
- Everyone can apply
- Service mode or Visitor mode for Paranal; La Silla only visitor mode (3+ nights minimum); APEX only service mode
- Travel support but only for member state affiliated



Top Tip: Start at least 1 month in advance with the preparation

What telescope/instrument do I need for my science goal?

What can I learn with telescope/instrument X for my science?

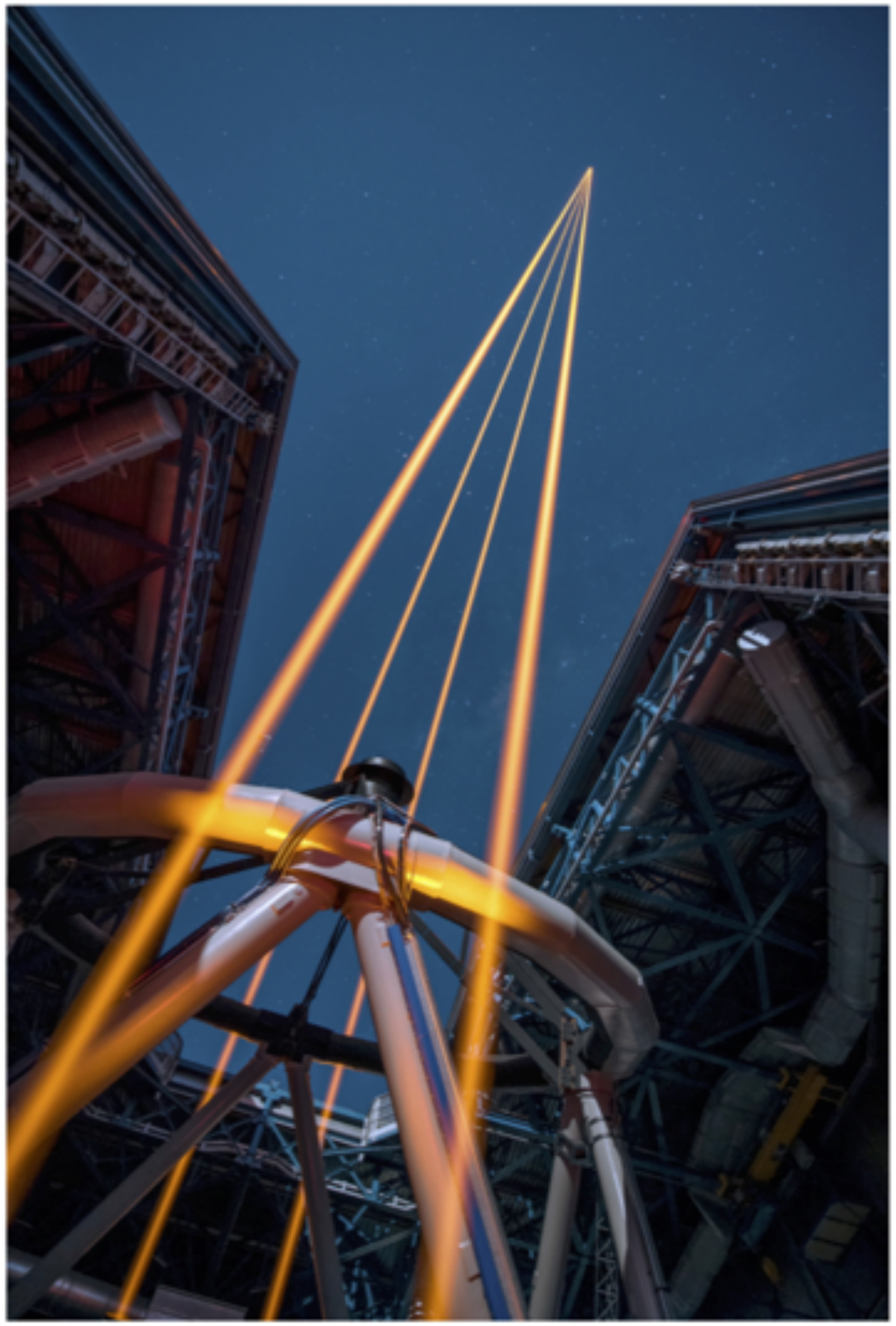
Is it feasible???

Has something similar been done before?

Who can help me?

What kind of proposal do I need to write?

What is needed?



ESO Call for Proposals – P101

Proposal Deadline: 28 September 2017, 12:00 noon CEST

I Phase 1 Instructions

1 ESO Proposals Invited

1.1 Important recent changes (since Periods 99 and 100) . . . .

1.2 Important reminders . . . .

1.3 Foreseen changes in the upcoming Periods . . . .

2 Getting Started

2.1 Exposure Time Calculators . . . .

2.2 The ESOFORM proposal package . . . .

2.2.1 ESOFORM: Important notes . . . .

2.3 Proposal Submission . . . .

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2.2.1 ESOFORM: Important notes . . . .
2.3 Proposal Submission . . . .

4 Proposal Types

4.1 Normal Programmes . . . .
4.2 Monitoring Programmes . . . .
4.3 Large Programmes . . . .
4.4 Target of Opportunity . . . .
4.4.1 ToO using the Rapid Response Mode (RRM) system .
4.5 Guaranteed Time Observations . . . .
4.6 Proposals for Calibration Programmes . . . .
4.7 Director's Discretionary Time . . . .
4.8 Host State Proposals . . . .
4.9 Non-Member State Proposals . . . .
4.10 VLT-XMM proposals . . . .

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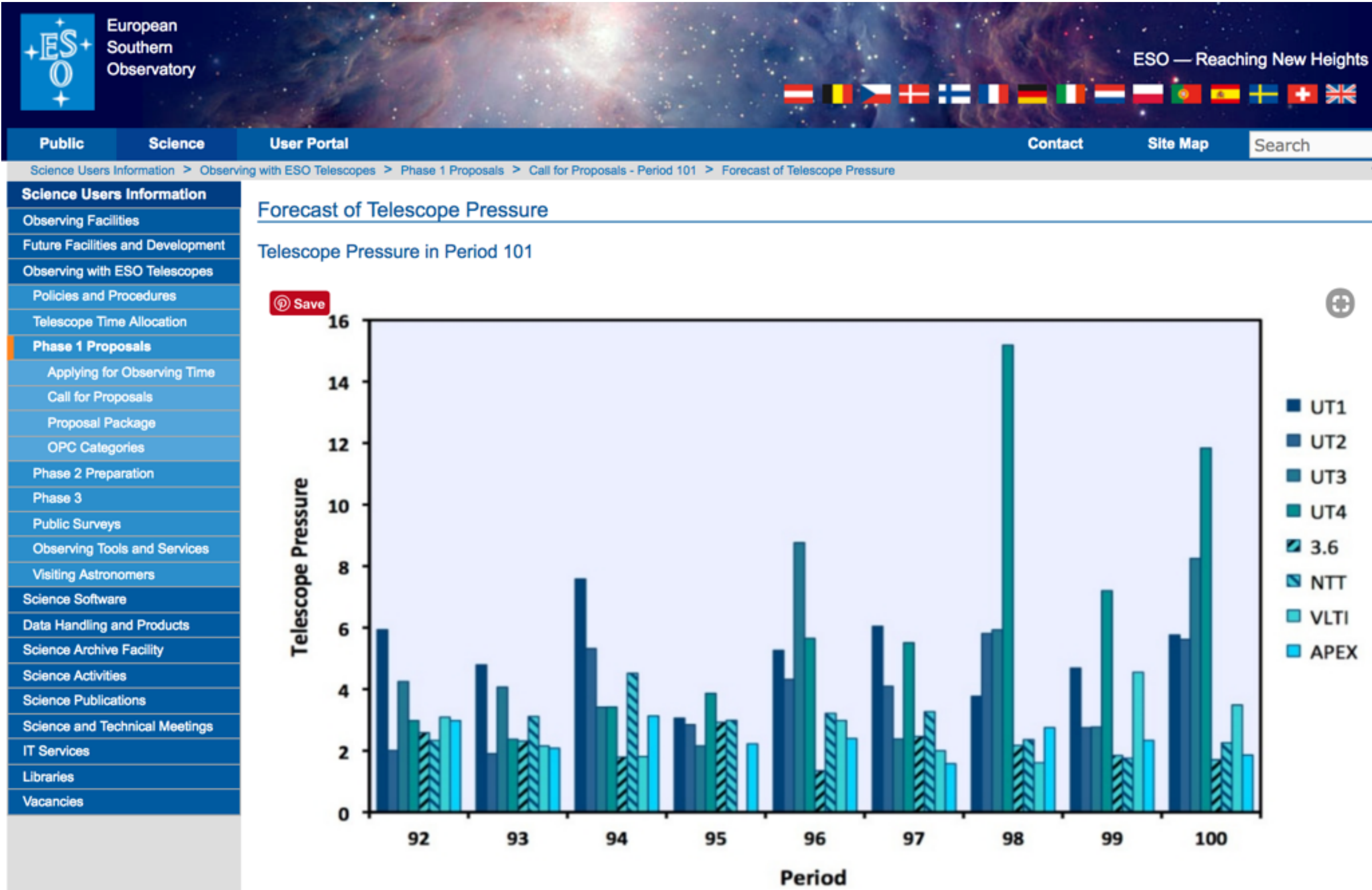
4.8 Host State Proposals . . . .
4.9 Non-Member State Proposals . . . .
4.10 VLT-XMM proposals . . . .

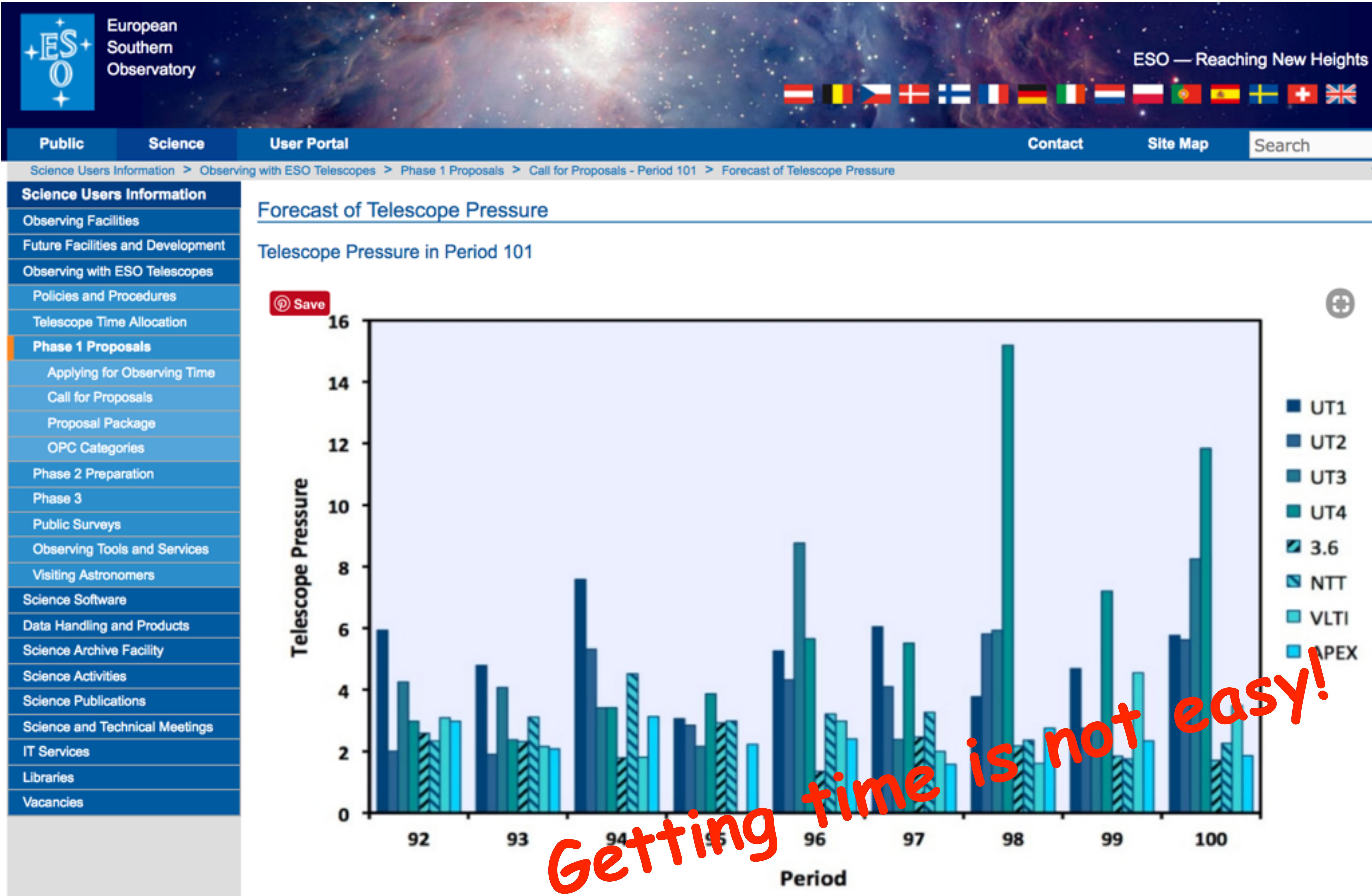
Part of the Call

Any time

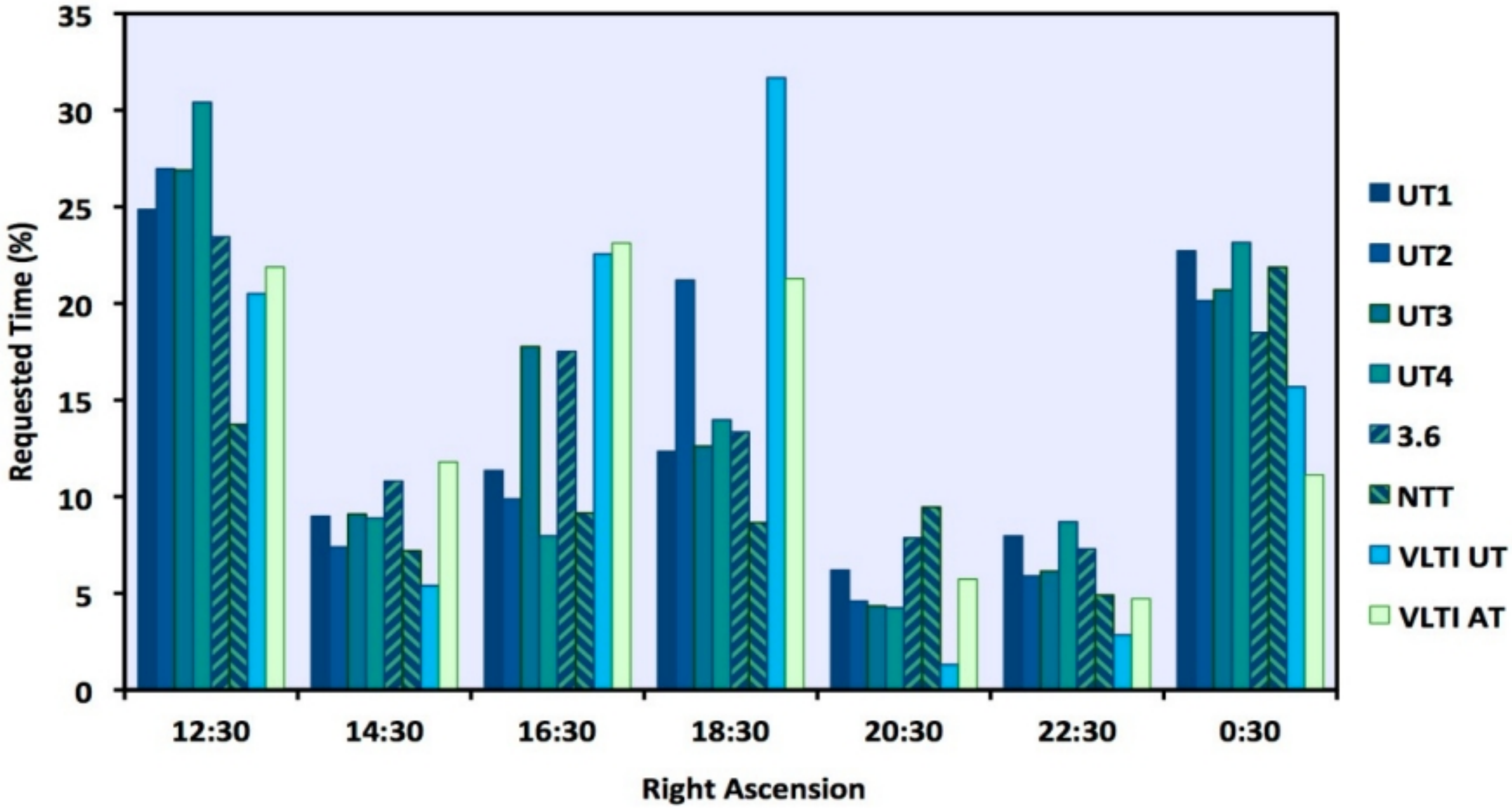
Additional important/helpful information on the website



Additional important/helpful information on the website



Sometimes one can optimise chances by choosing the right instrument and targets…



European Organisation for Astronomical Research in the Southern Hemisphere

OBSERVING PROGRAMMES OFFICE • Karl-Schwarzschild-Straße 2 • D-85748 Garching bei München • e-mail: opo@eso.org • Tel.: +49 89 320 06473

APPLICATION FOR OBSERVING TIME

PERIOD: **99A**

Important Notice:

By submitting this proposal, the PI takes full responsibility for the content of the proposal, in particular with regard to the names of CoIs and the agreement to act according to the ESO policy and regulations, should observing time be granted.

1. Title

Category: **B–6**

Are powerful polar dusty winds ubiquitous in AGN?

2. Abstract / Total Time Requested

Total Amount of Time: 0 nights VM, 19.2 hours SM

The field of active galactic nuclei (AGN) research is now facing the possibility of a paradigm change. The key ingredient of AGN unification, the dusty obscuring torus was so far held responsible for the observed mid-infrared (MIR) emission but recent studies of those objects with the best data show that instead a powerful polar dusty wind is dominating these wavelengths, leaving little room for the torus emission. But is this wind really ubiquitous? The current results make the clear prediction that all objects with a sufficiently inclined line of sight (type 2 AGN) and bright [OIV] emission should have detectable polar MIR emission, whereas the [OIV] is tracing how powerful the AGN and pronounced the ionisation cones are. Here we propose to the the ubiquity of this polar MIR emission with a straightforward detection experiment using the upgraded capabilities of VISIR.

European Organisation for Astronomical Research in the Southern Hemisphere

OBSERVING PROGRAMMES OFFICE • Karl-Schwarzschild-Straße 2 • D-85748 Garching bei München • e-mail: opo@eso.org • Tel.: +49 89 320 06473

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Write a concise and interesting abstract

European Organisation for Astronomical Research in the Southern Hemisphere

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Interesting title?!

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The [redacted] pronounced the ionisation cones are. Here we propose to the the ubiquity of this polar MIR emission with a straightforward detection experiment using the upgraded capabilities of VISIR.

Imagine you are the referee after reading already 20+ other proposals...

Write a concise and interesting abstract

Iterate it several times. The abstract is critical!!

3. Run	Period	Instrument	Time	Month	Moon	Seeing	Sky	Mode	Type
A	99	VISIR	19.2h	any	n	0.8	PHO	s	

Which ambient conditions do you need? This can decide whether you are scheduled or not!!!
(Revise values at the end)

4. Number of nights/hours | Telescope(s) | Amount of time
a) already awarded to this project:
b) still required to complete this project:

5. Special remarks:

Use this box to highlight some important/special aspect of the programme (e.g., this is a resubmission of a scheduled but not executed programme).

6. Principal Investigator: Daniel Asmus, dasmus@eso.org, ESO, ESO Office Santiago

6a. Co-investigators: Do you have the right Co-Is to pull this one off?!!

Here comes the meat. What exactly do you want to do? And why?

7. Description of the proposed programme

A – Scientific Rationale:

A new emerging paradigm for active galactic nuclei? It seems beyond doubt that active galactic nuclei (AGN) contain large amounts of dust which is heated by the accretion onto the supermassive black hole, leading to copious amounts of mid-infrared (MIR) emission, which in fact contains roughly half of the

Short introduction with relevant literature

2014,2016) show that most of the MIR emission is coming from a polar extended component extending from scales of a parsec up to tens or hundreds of parsec (depending on the AGN power), while no direct evidence for the presence of a torus was found. Hönig et al. (2012) interpreted this structure as a dusty polar wind driven by the radiation of the accretion disk (something we plan to investigate in another proposal; PI Hönig). In that case, the actual obscurer could be a much more compact and quite hot structure like a puffed up outer accretion disk as also assumed to occur in star forming disks. If this scenario would be true, it would have fundamental impact on the current AGN research field, which based many results on the presence of a prominent clumpy dust torus. *Therefore, it is crucial to test how ubiquitous is this polar dust scenario which was developed based on observations of a few objects?*

The current situation. In Asmus et al. (2016), we made the first statis… dust phenomenon by looking at all archival subarcsecond resolution MIR imag… one hand, show no nuclear starburst, and, on the other hand, are at least moder… Only a small fraction … for polar … This is explained by t… sufficient … AGN, one expects to … Second, th… powerful enough, so t… with direct … importantly, most of t… enough to … in many cases, and th… …sion. *So … with every AGN having strong polar dust emission but its low detection rate lea…*

The Problem…

The prediction. So, how can we further test the ubiquity of polar dus… a detection experiment by utilizing a prediction that is made in Asmus et al. … that the amount of extended MIR emission is correlating with the [OIV] 25.89 … originating from th… …rable scales than the po… all objects above a … x, $6 \cdot 10^{-13}$ erg/s/cm^{-2}, sl… that this threshold … t do not have polar emiss… detect it with curren… *prediction is that all type … flux larger than this … lar MIR emission.* There… nuclei in the literature with [OIV] measurements. Of these, 29 objects are ab… have already verified polar MIR emission, i.e. are in the sample of Asmus et al. … because they live in strongly disturbed, starbursting hosts, which leads to con… star formation. Of the remaining 15 objects, 9 are observable from Paranal. Of course, this sample is nor complete nor uniform but it rather represents a … population and thus is well-suited for testing our prediction.

The idea!

Explain and justify very sample selection!

B – Immediate Objective: In order to test the ubiquity of the polar MIR emission in AGN, we propose to perform deep VLT/VISIR imaging of the 9 nearby type 2 AGN selected above. Thanks to the superb angular resolution, we … …ample and robustly detect polar e… …ance. The imaging will use the m… …t low water vapour conditions, the… …ges of these objects. For the first ti… …detect robustly even marginally res… …d simultaneously is motivated by t… some cases, probing the more exte… was only possible in the N-band th… …g the warmer, more compact polar elongated dust (~ 300 K; e.g., NGC 7314). Secondly, we will immediately get information about … f the individual … esolved AGN in … ct a clear result … nificant fraction … perties like size and luminosity with the AGN fundamental parameters like bolometric luminosity and Eddington ratio over the

What exactly do you want to do?

What goals and how reached?

Comparison with models? But be specific!

… Fig. 2). The strength and … re, it is important to observe … *mary, either way, the results … field.*

Attachments (Fig…

How is this relevant for the wider field?

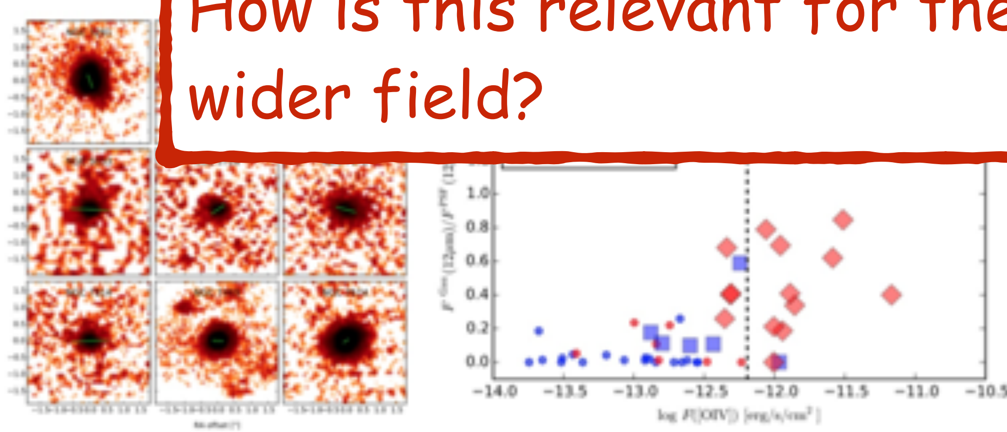

Fig. 1: *Left:* Example MIR images of the nuclear regions (inner 4 × 4 arcsec) of 9 of the polar extended AGNs from Asmus et al. (2016). The green line indicates the polar axis of the AGN (from the literature), while its length denotes 100 pc. *Right:* Relative amount of resolved MIR emission ($F^{Gau}/F^{PSF} - 1$) over the [OIV] emission line flux for the unresolved and resolved objects in Asmus et al. 2016. The dashed line denotes the threshold, $6 \cdot 10^{-13}$ erg/s/cm^{-2}, above which all objects are resolved. Furthermore, the amount of resolved emission increases further with increasing [OIV]. Note that the value on the y-axis is only a lower limit to the actual polar emission which is probably much higher as indicated from the interferometric results (e.g., Tristram et al. 2014).

Be smart with the plot arrangement

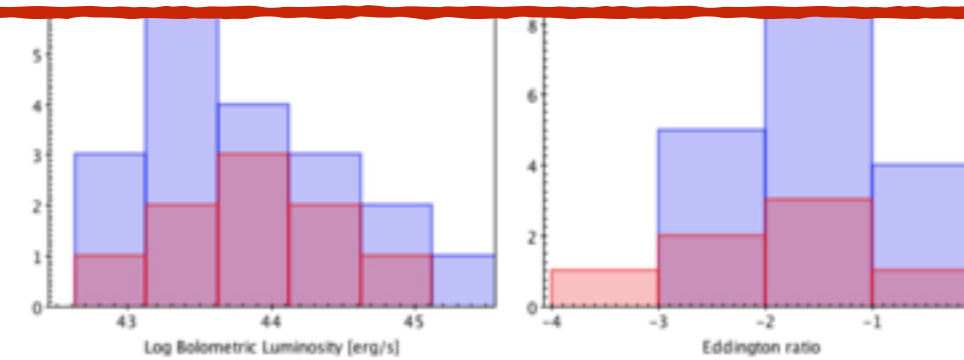

Fig. 2: *Left:* Bolometric luminosity distribution of the new sample compared to those objects with known polar MIR emission from Asmus et al. (2016). *Right:* Distribution of the Eddington ratio for the same samples. Note that for 3C 321 and IC 4518W, we could not retrieve black hole masses and thus Eddington ratios yet.

8. Justification of requested observing time and observing conditions

Lunar Phase Justification: Our MIR observations do not have any requirements on lunar phase.

Time Justification: (including seeing overhead)

We want to observe 9 AGN with deep imaging in the filters B12.4 and Q1, which are the most sensitive filters in their corresponding bands. We know the brightness of the targets from previous observations. However, here we aim at robustly detecting relatively faint extended emission, which we want to probe to a similar depth in all objects. Specifically, we aim to detect flux levels of 5 mJy at a S/N of ~ 5 in B12.4, and 10 mJy in Q1. These values represent a compromise between reasonable execution times and a depth sufficient to robustly detect extended emission up to at least 1 arcsec away from the nucleus in all cases. For this, an exposure time of 30 min suffices in both filters according to the ETC 6.2.0 in average conditions for B12.4, while in the Q1, we will use a low PWV constraint (the STDs observed in Paranal show that sensitivities of 20mJy for 10 sigma/1h are reached for PWV < 1.5 mm). We constructed corresponding OBs in p2pp 3.4.2, one per filter with blind acquisition, leading to execution times of 53 min for one.

Since we are looking for relatively small extension, consecutive observation with a PSF reference star is necessary and will take 11 min per object per filter (blind acquisition and 2 min exposure time).

Therefore, we require 1h04min per filter (including calibrator), leading to a total required time of 19.2 hours.

Describe clearly which instrument mode you want to use and how you arrived at the requirements for time and conditions.

Are you sure you understand all technical aspects?

Maybe better consult an expert…

Summary Important Advice:

- Read the Call for Proposals!
- Read the instrument manual!
- Have a clear, well-defined science goal
- Demonstrate how the observations will allow you to reach your goal
- Explain very clearly your sample selection
- Write a concise and interesting abstract, iterate it several times — it is the most important single paragraph in the proposal
- Demonstrate that your team will be able to reduce/analyse the data
- Include one or two clear and optimised figures that are easy to read and understand, supporting your case
- Describe clearly which instrument mode want to use and how you arrived at the requirements for time and conditions
- Check if similar data already exists, and if yes, explain concisely why new ones are needed

If you don't get through the first time(s), don't give up! Try again!

Working at ESO

- **Visiting**
  - Contact (potential) collaborator at ESO
- **Studentship**
  - Call for applications twice every year (May 31 & Nov 15)
  - Identify and contact potential supervisor way in advance
  - Up to 2 years at ESO (Chile or Germany), return to home institution for finishing
  - Up to 6 positions at each site per year
- **Fellow**
  - Call for applications every year (deadline Oct 15)
  - 3 years in Garching with 25% duties OR 3 years in Chile with 80 nights duty (choose Paranal or ALMA) + 1 at member state with 0% duties
  - Up to 6 positions at each site per year
- **Staff**
  - Call for applicant depending on needs (pay attention to job portal/ads)

- **Visiting**
  - Contact (potential) collaborator at ESO

Everyone can apply!!!

- **Studentship**
  - Call for applications twice every year (May 31 & Nov 15)
  - Identify and contact potential supervisor way in advance
  - Up to 2 years at ESO (Chile or Germany), return to home institution for finishing
  - Up to 6 positions at each site per year

- **Fellow**
  - Call for applications every year (deadline Oct 15)
  - 3 years in Garching with 25% duties OR 3 years in Chile with 80 nights duty (choose Paranal or ALMA) + 1 at member state with 0% duties
  - Up to 6 positions at each site per year

- **Staff**
  - Call for applicant depending on needs (pay attention to job portal/ads)

- **Visiting**
  - Contact (potential) collaborator at ESO

Everyone can apply!!!

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Get in touch!

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  - Call for applicant depending on needs (pay attention to job portal/ads)

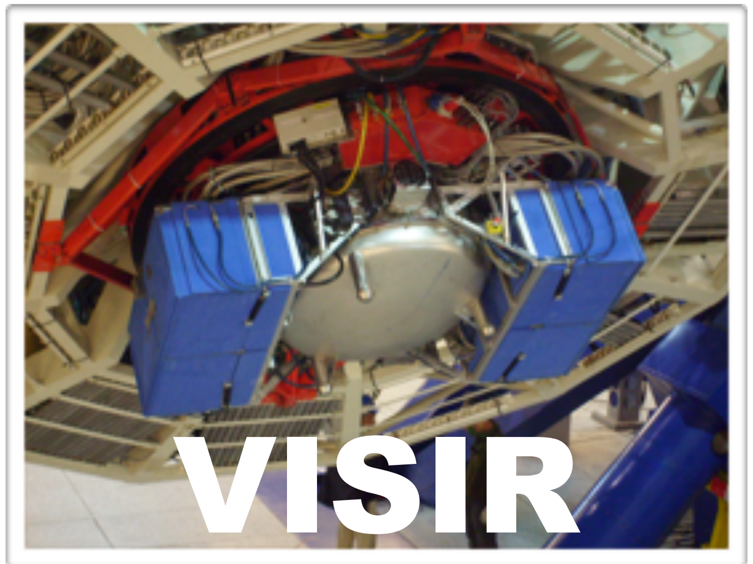
BACKUP SLIDES

FOcal Reducer and low dispersionSpectrograph

- **Wavelength:** 0.3 to 1.1 micron (UV, visible)
- **Modes:** imaging, longslit spectroscopy, multi object spectroscopy, polarimetry, spectropolarimetry, high-time resolution
- **Angular resolution:** seeing-limited (> 0.4 arcsec)
- **Field of view:** 6.8 x 6.8 arcmin or 4.3 x 4.3 arcmin
- **Spectral resolution:** 260 to 2600
- **Sensitivity:** ~27th mag (imaging), 24th mag (spectroscopy)

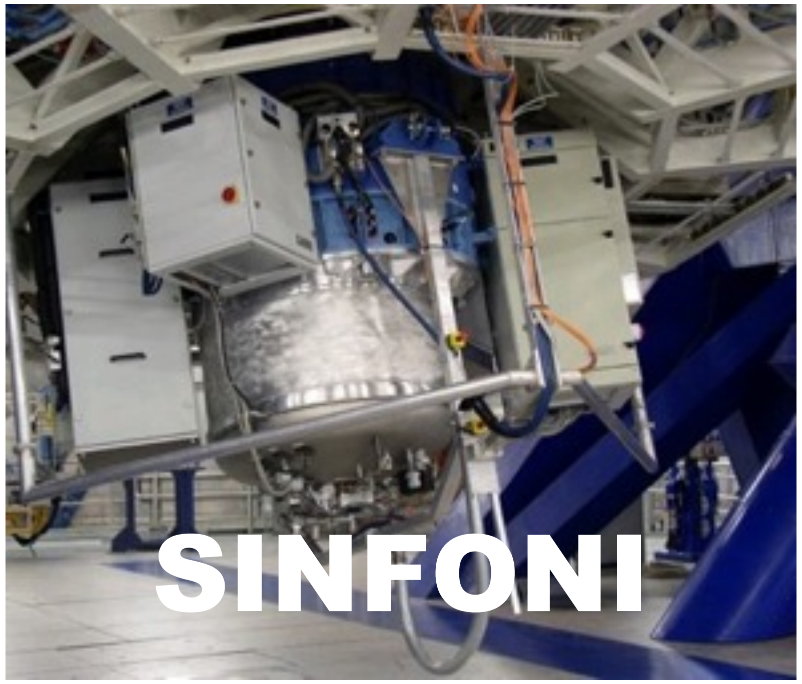
Nasmyth Adaptive Optics System Near-Infrared Camera and Spectrograph

- **Wavelength:** 1.0 to 4.0 micron (J H K L)
- **Modes:** Imaging (adaptive optics, noAO), Coronagraphy, Polarimetry, sparse aperture masking, burst
- **Angular resolution:** ~0.03 arcsec with adaptive optics (off-axis possible)
- **Field of view:** 56 x 56 to 14 x 14 arcsec
- **Spectral resolution:** —
- **Sensitivity:** ~24th mag, (18.6 in L-band)



Vlt Imager & Spectrograph for the InfraRed

- **Wavelength:** 5 (M), 7-13 (N), 16-21 (Q) micron
- **Modes:** imaging, burst, coronagraphy, sparse aperture masking, low and high resolution long-slit spectroscopy, cross-dispersed high-resolution spectroscopy
- **Angular resolution:** down to 0.2 arcsec
- **Field of view:** 38 x 38 arcsec
- **Spectral resolution:** ~200 and ~20000
- **Sensitivity:** 9th mag (imaging), 7th mag (LR spectroscopy), 3rd mag (HR spectroscopy)

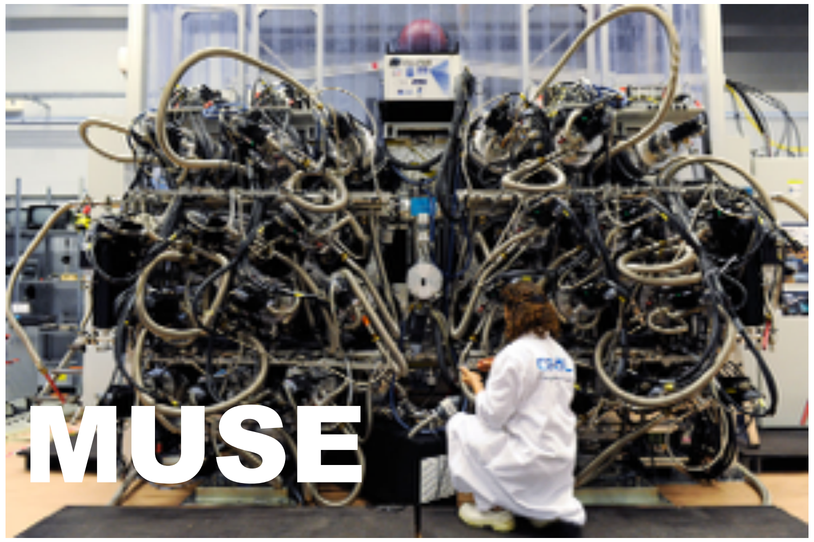


Spectrograph for INtegral Field Observations in the Near Infrared

- **Wavelength:** 1.1 to 2.5 micron (J, H, K)
- **Modes:** medium resolution integral field spectroscopy (64 x 32 spaxels)
- **Angular resolution:** ~0.05 arcsec with adaptive optics (off-axis possible)
- **Field of view:** 8 x 8, 3 x 3 or 0.8 x 0.8 arcsec
- **Spectral resolution:** 1500 to 4000
- **Sensitivity:** ~20th mag

K-band Multi Object Spectrograph

- **Wavelength:** 0.8 to 2.5 micron (visible, J, H, K)
- **Modes:** medium resolution integral field spectroscopy (14 x 14 spaxels times 24 arms)
- **Angular resolution:** seeing limited (> 0.3 arcsec)
- **Field of view:** 7.2 arcmin & 2.8 x 2.8 arcsec
- **Spectral resolution:** 2000 to 4200
- **Sensitivity:** ~20th mag



MultiUnit Spectroscopic Explorer

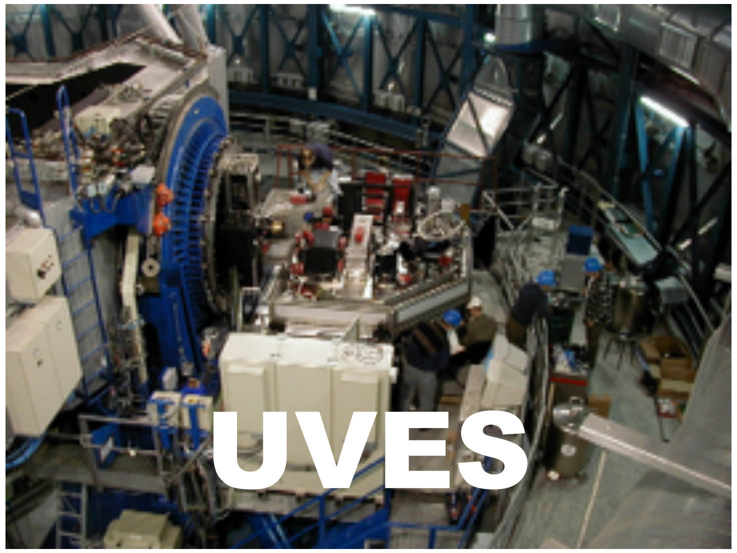
- **Wavelength:** 0.5 to 0.9 micron (visible)
- **Modes: m**edium resolution integral field spectroscopy (1024 x 1024 spaxels)
- **Angular resolution:** seeing-limited (> 0.4 arcsec; but adaptive optics in a few years)
- **Field of view:** 1 x 1 arcmin
- **Spectral resolution:** 1800 to 3600
- **Sensitivity:** ~23th mag

VIsible MultiObject Spectrograph

- **Wavelength:** 0.36 to 1.0 micron (UV, visible)
- **Modes: i**maging, multi-object medium resolution spectroscopy, integral field medium resolution spectroscopy
- **Angular resolution:** seeing-limited (> 0.4 arcsec)
- **Field of view:** 4 x 7 x 8 arcmin (imaging & MOS), 13 x 13 to 56 x 56 arcsec (IFU, 6400 fibers of 0.33 to 0.67 arcsec)
- **Spectral resolution:** 200 to 3100
- **Sensitivity:** ~27th mag (imaging)

Multiwavelength spectrograph

- **Wavelength:** 0.3 to 2.5 micron (UV, visible, J, H, K)
- **Modes:** medium resolution spectroscopy, integral field spectroscopy
- **Angular resolution:** seeing-limited (> 0.3 arcsec)
- **Field of view:** 11 arcsec (slit length) or 1.8 x 4 arcsec (IFU)
- **Spectral resolution:** 3000 to 18000
- **Sensitivity:** ~21th mag



Ultraviolet & Visible Echelle Spectrograph

- **Wavelength:** 0.3 to 1.1 micron (UV, visible)
- **Modes:** cross-dispersed high resolution spectroscopy
- **Angular resolution:** seeing-limited (> 0.4 arcsec)
- **Field of view:** 10 arcsec (slit length)
- **Spectral resolution:** 40000 to 110000
- **Sensitivity:** ~19th mag

Other instruments:

- **Current:**
  - FLAMES (visible MOS/IFU),
  - HAWKI (NIR widefield imager),
  - SPHERE (vis/NIR extreme AO imager/polarimeter)
  - VLTI/PIONIER and AMBER (NIR interferometer)
  - VISTA/VIRCAM (NIR widefield imager on 4m)
  - VST/OMEGACAM (visible widefield imager on 2m)
- **Future:**
  - VLTI/Gravity (NIR interferometer)
  - VLTI/MATISSE (mid-infrared interferometer)
  - CRIRES (1 to 5 micron high resolution AO spectrograph)
  - AO upgrades for MUSE and HAWKI
  - ESPRESSO (high-res spectrograph)