

On the forefront of astronomical research

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ESO

(05 November 2014 part of Lecture 5 & 6 & 7)

Outline

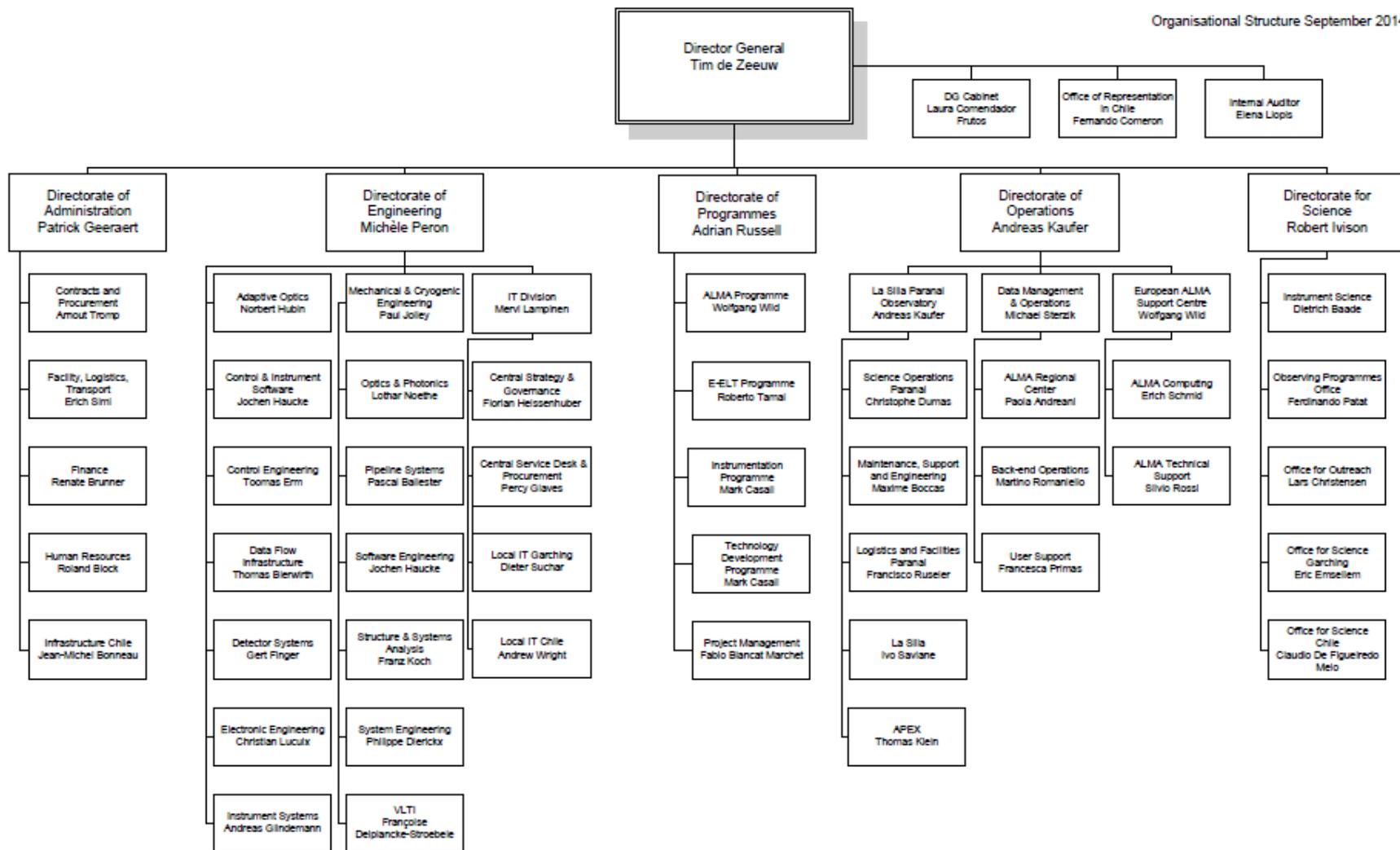
- ◆ Brief history of ESO
- ◆ ESO observatories overview
- ◆ Detectors and instruments
- ◆ Behind the scenes (how to get time?)

ESO today in 5 lines

- ◆ 15 member states+1 associated country
- ◆ approx. 700 employees (various national.)
- ◆ 4 observatories (1, ALMA, jointly operated)
- ◆ HQ in Garching, Offices Santiago
- ◆ Director General + 5 directorates

In more detail....

Organisational Structure September 2014



Brief history of ESO

How did it all start?

21 June 1953 Leiden

Why conferences are important!



<http://www.eso.org/public/images/wbaade-cschalen/>

<http://www.eso.org/public/images/vkourganoff-jhoort-hspencer/>

ESO is born

- ◆ In October 5, 1962, after years of meetings and struggles, the ESO Convention, between five of the first six countries was finally signed (Great Britain went its own way). The required ratification, however, was only completed in January 17, 1964
- ◆ **Belgium, France, Germany, Great Britain, the Netherlands and Sweden**
(later GB left the negotiations)
- ◆ **Southern hemisphere selected (SA preferred that time)**

Africa?



- ◆ <http://www.eso.org/public/images/south-africa-1961-05/>
- ◆ <http://www.eso.org/public/images/south-africa-1961-03/>

Direction Chile!

Why Chile?

- ◆ Site testing near today's La Silla proven better than South Africa in 1960's
- ◆ Relatively good accessible, dry environment, easier for logistics, owned by the government
- ◆ La Silla selected 26 May, 1964 (Cinchado-Norte mountain)
- ◆ October 30, 1964 contract between ESO and Chile signed

La Silla inauguration



- March 25, 1969
- mid sized telescopes
1-m, 1.5-m, 1.2
Schmidt
50-cm ESO telescope
- later national
telescopes

Dream comes true!

◆ http://www.eso.org/public/images/lso_inauguration_03-69_2/

La Silla



Paranal approved December 1987



◆ <http://www.eso.org/public/images/council87/>

VLT inauguration 4 December 1996



◆ <http://www.eso.org/public/images/1996-12-vlt-inaugur/>

ALMA inauguration 13 March 2013



<http://www.eso.org/public/images/ann13027a/>

E-ELT start 19 June 2014



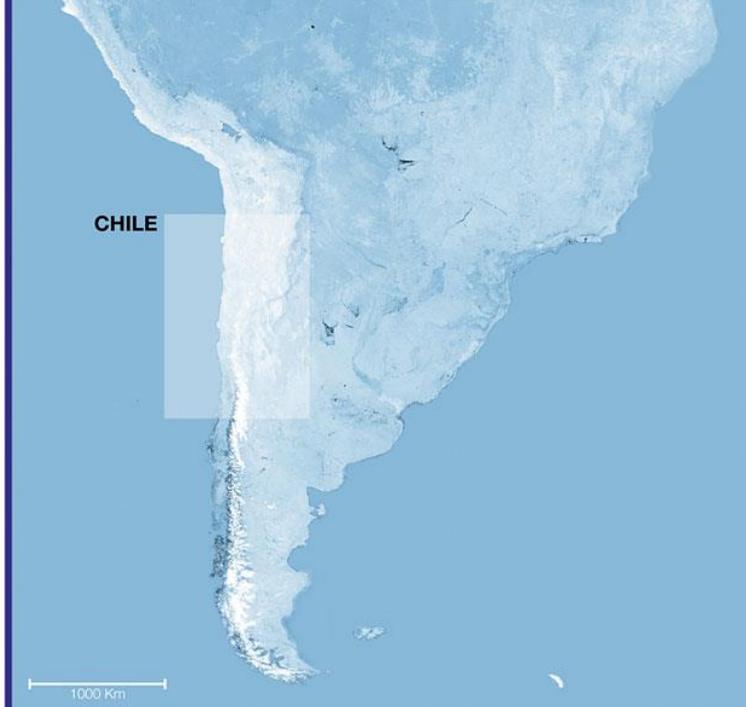
<http://www.eso.org/public/images/eso1419a>

<http://www.eso.org/public/images/potw1424a/>



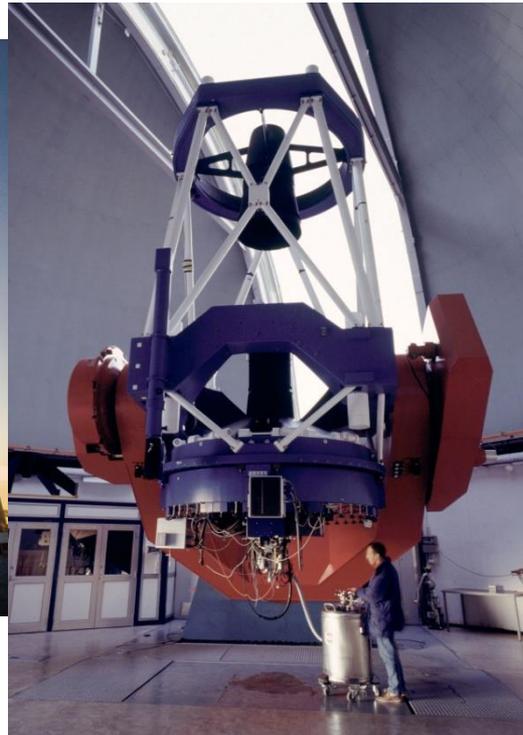
Overview of ESO facilities (as of today)

ESO sites today



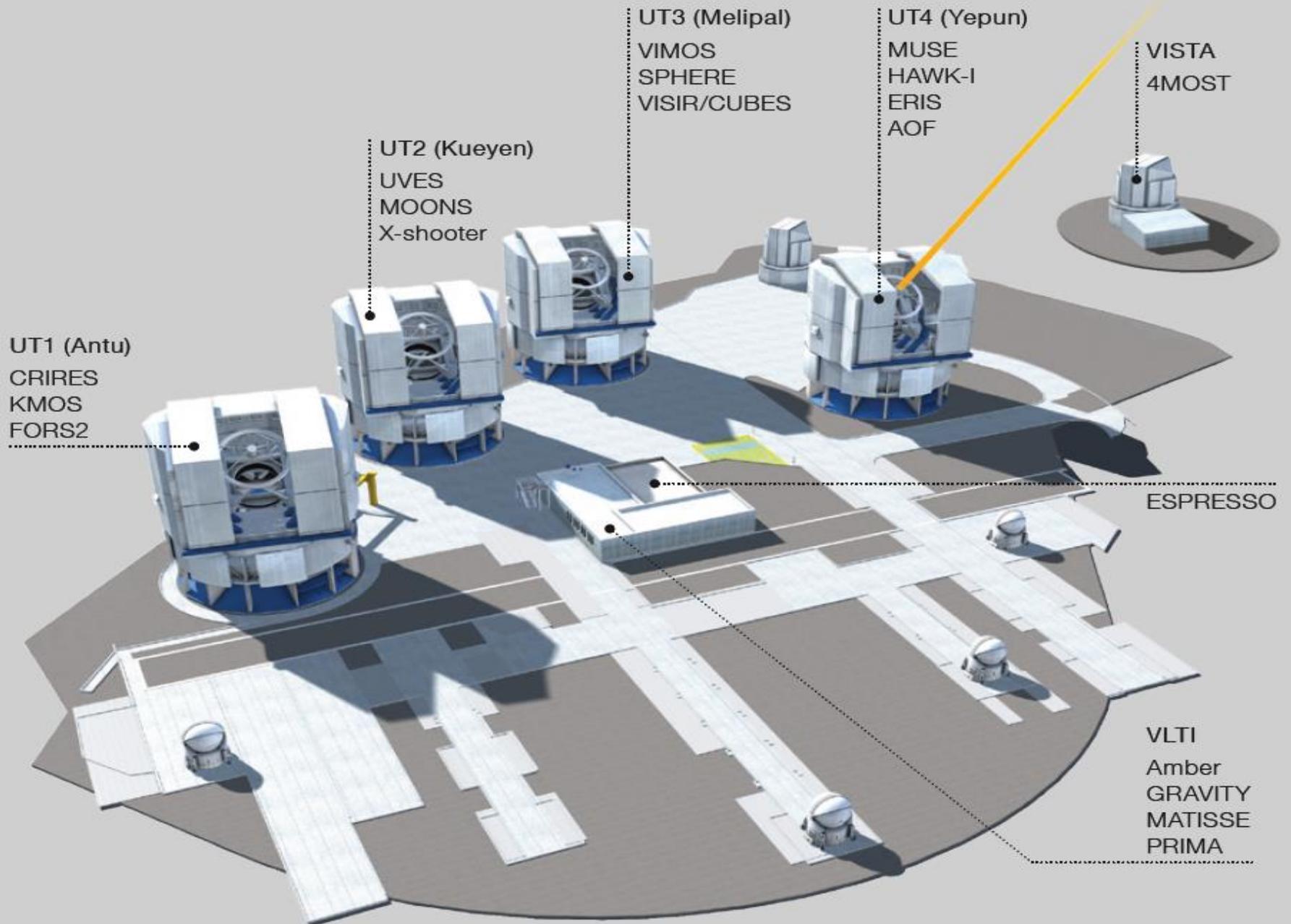
La Silla 2010+

- ◆ Concept of national telescopes
- ◆ NTT – ESO
- ◆ 3.6-m ESO with planet hunter HARPS
- ◆ 2.2-m Max Planck Institute – FEROS, WFI, GROND



Paranal





APEX

The Atacama Pathfinder Experiment



- 1st light 14 July 2005
- single 12-m dish
- Pathfinder for ALMA
- Science goals are:
astrochemistry,
cold Universe

Atacama Large Mm/submm Array (JAO)

Operated by: ESO, NAOJ, NRAO

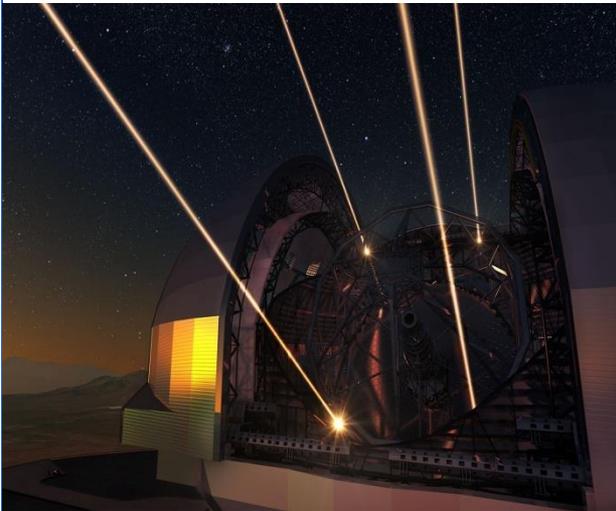


- Chajnantor plateau 4500-5000 m
- 66 antennas
- 0.32 to 3.6 mm
- 12-m array 50 antennas
- 12-m array of 4 antennas
- 7-m array of 12 antennas
- baselines 150m-16km
- Star formation, molecular clouds, early Universe

E-ELT era

Key science topics

- **Extra-solar planets**
- **Resolved stellar populations in a representative sample of the Universe**
- **The physics of high redshift galaxies**
- **Cosmology and fundamental physics**



Operations start - 2024

Benefits of ESO membership (CZ perspective)

ESO and the Czech Republic

- ◆ CZ joined ESO in 2007 as member state nr. 13
- ◆ Direct access to all ESO facilities for CZ affiliated astronomers
 - in case of visitor mode run all expense for trip paid for by ESO
- ◆ Influence in decision making for ESO's heading (ESO council, ESO finance committee, ESO scientific technical committee, ESO users committee)

ESO and the Czech Republic

- ◆ Preference for employment of CZ nationals
- ◆ Preferred access to ESO studentship/internship
- ◆ Support for CZ companies in tenders
- ◆ Potential for boosting of international collaboration
- ◆ Participation of CZ in forefront astronomical research facility

That was 13th anniversary April 1, 2012 (Google)



Let's hope for another 13+ anniversaries

How does ESO work?

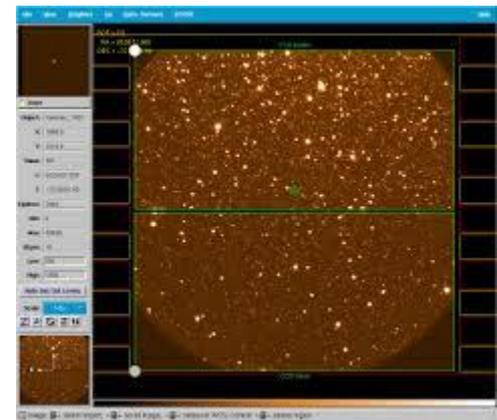
Outline

- Detectors at ESO
- Telescopes
- Adaptive optics
- LIVE from Paranal (tech. permitting 12 Nov)
- Paranal instrumentation programme (12 Nov)
- Behind the scenes (12 Nov)

Detectors at ESO

CCDs (you know them already)

- E.g. FORS2 EEV and MIT detectors (blue, red)
- Highly linear till 65000 ADUs
- Large field of view
- Photoelectric effect
- Optical detectors at ESO controlled by FIERA controllers (optical, NIR is IRACE) – box attached to the detector/instrument which commands the detector directly – interface with user

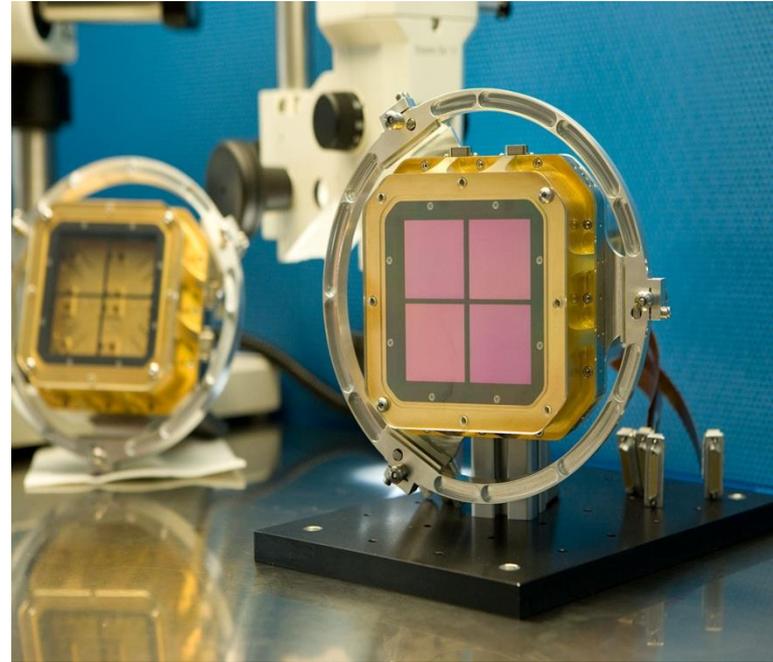


IR detectors (NO CHARGE TRANSFER)

- no charge transfer
- but photoelectric effect in charge!
- electronical readout
- typically In_2S_3 and Hg due to suitable band gaps
- cooling required

HgCdTe $0.48 \text{ eV} = 2.55 \mu\text{m}$

InSb $0.23 \text{ eV} = 5.4 \mu\text{m}$



IR detectors

Readouts

NON-Destructive

- DCS
- Fowler

DIT vs. NDIT

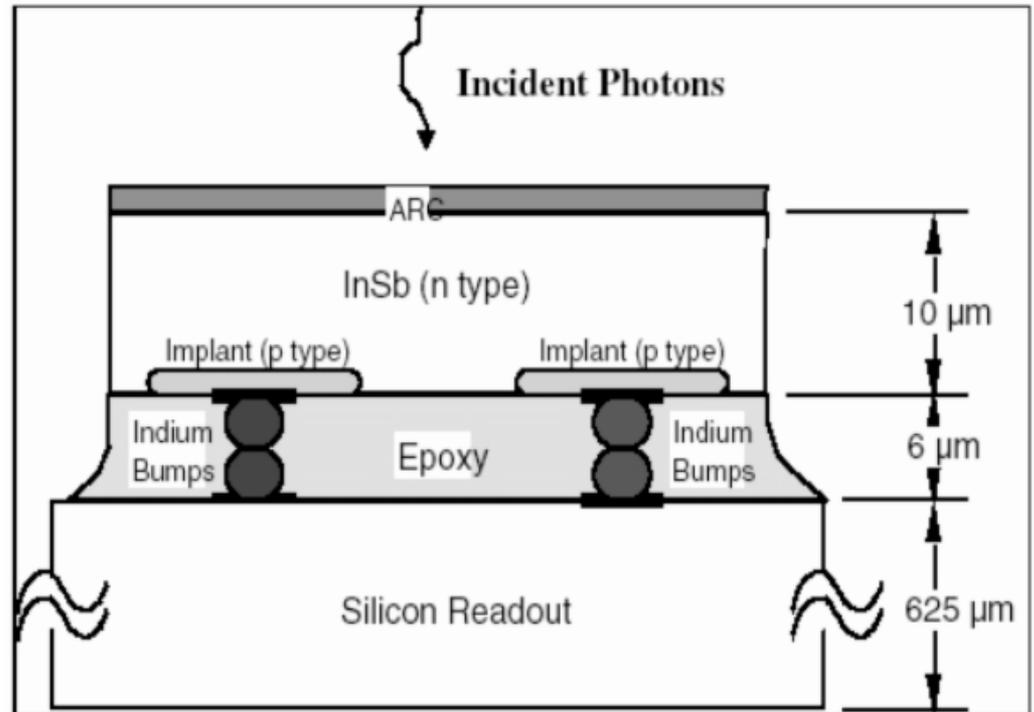
Temperature sensitive

- high sky counts
- instrument/telesc. heat

3+ micron nodding/chopping

= M2/telescope offsets

Cooling + vacuum for NIR detectors is a must!



Joyce, D., NOAO Gemini data workshop 2010

Where to find them?

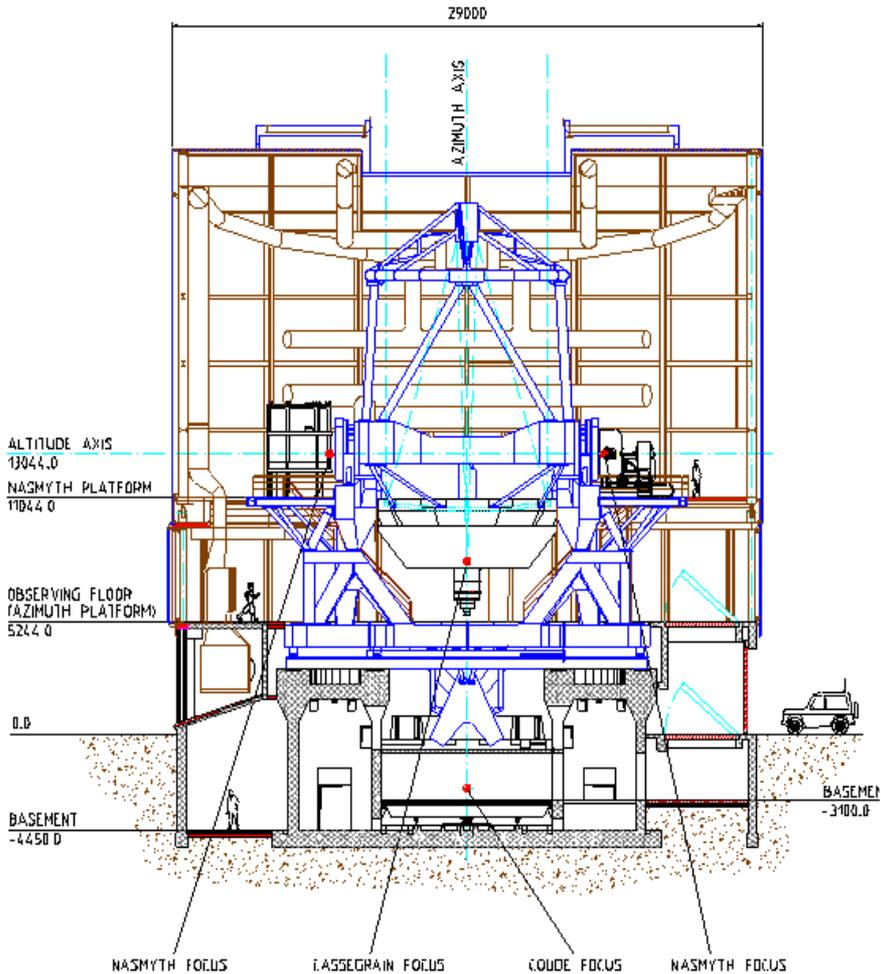
- Si CCD 0.3 – 1 μm 170 K FORS2, GMOS
- HgCdTe 0.8 – 2.5 μm 75 – 80 K HAWKI NIFS, NICI, FLAMINGOS2
- InSb 0.8 – 5.4 μm 30 K CRIRES, NACO NIRI, GNIRS, PHOENIX
- Si:As 5 – 28 μm 12 K VISIR, MICHELLE, TReCS

UTs

Antu, Kueyen, Melipal, Yepun



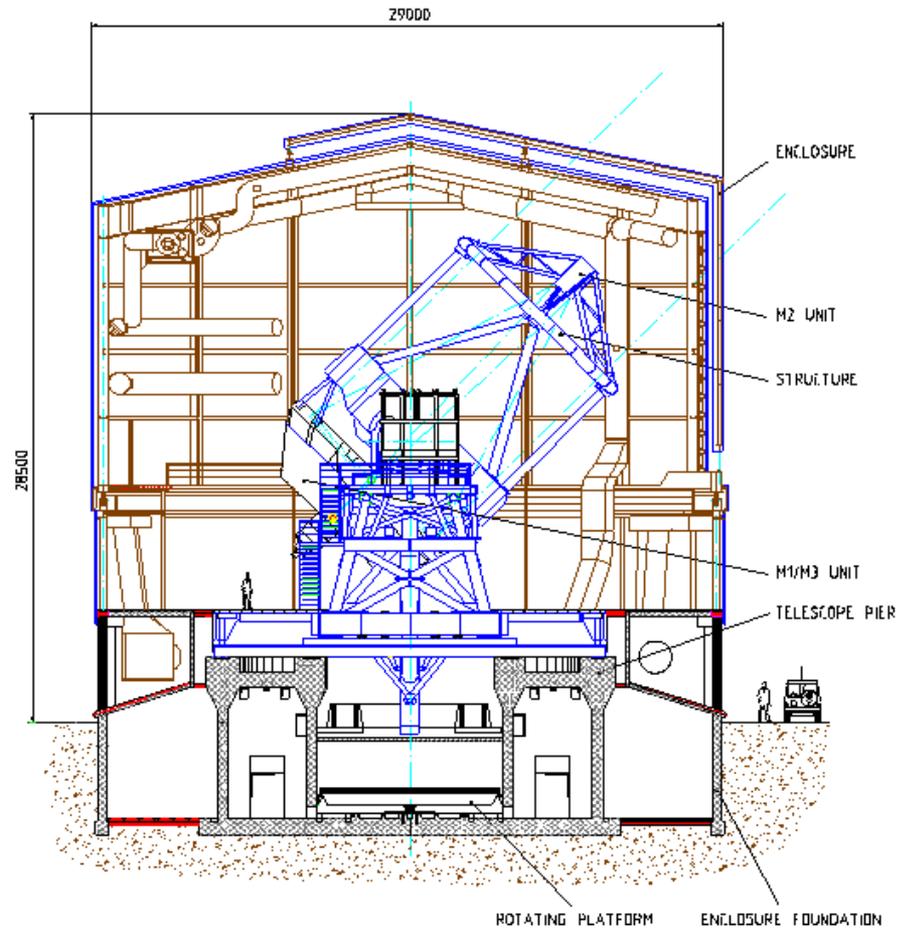
EUROPEAN SOUTHERN OBSERVATORY
 — VERY LARGE TELESCOPE —



FRONT VIEW (Section)



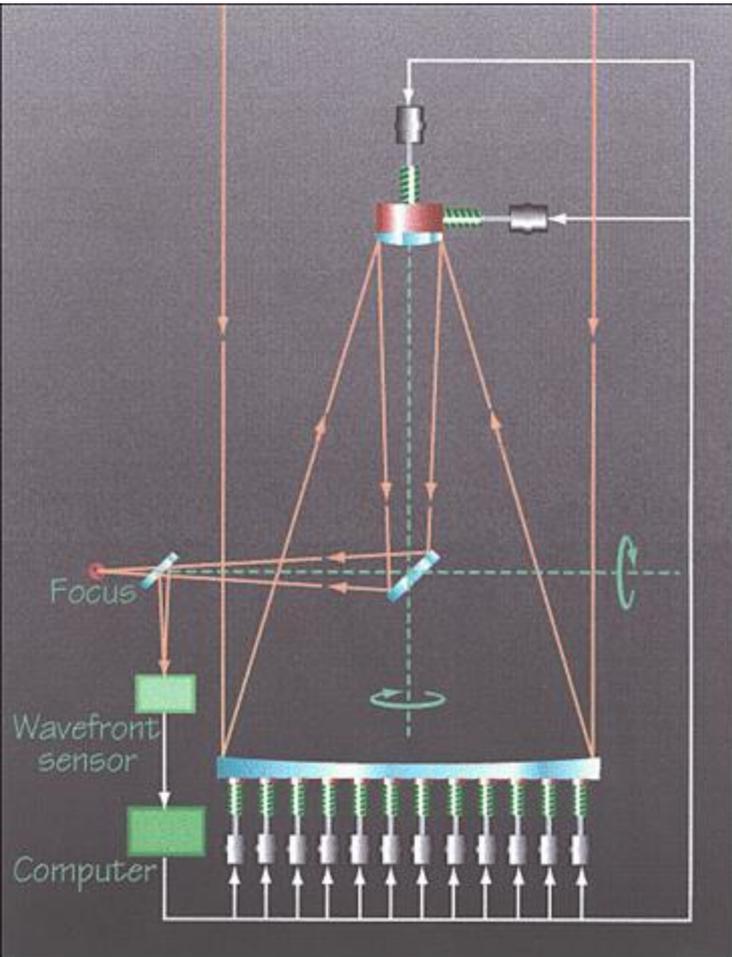
EUROPEAN SOUTHERN OBSERVATORY
 — VERY LARGE TELESCOPE —



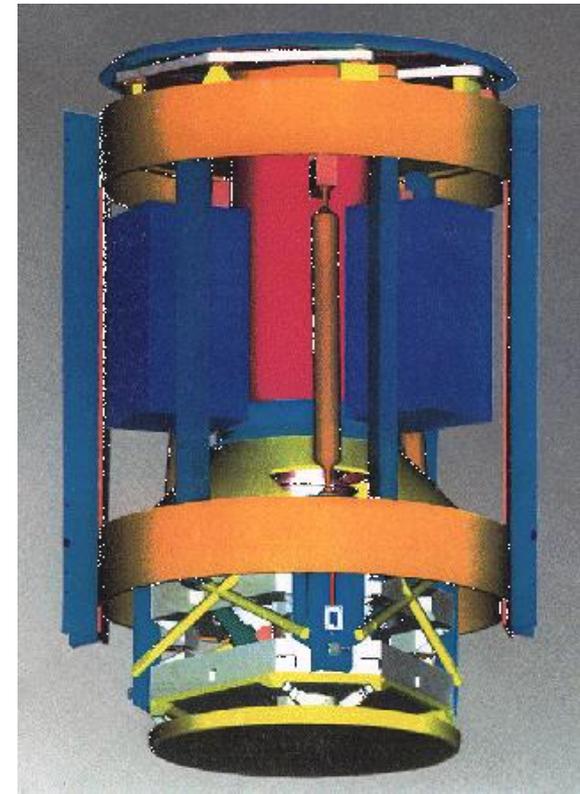
SIDE VIEW (Section)

Unit Telescopes

- Active optics (deforming M1)
- Guiding
- 3 instruments

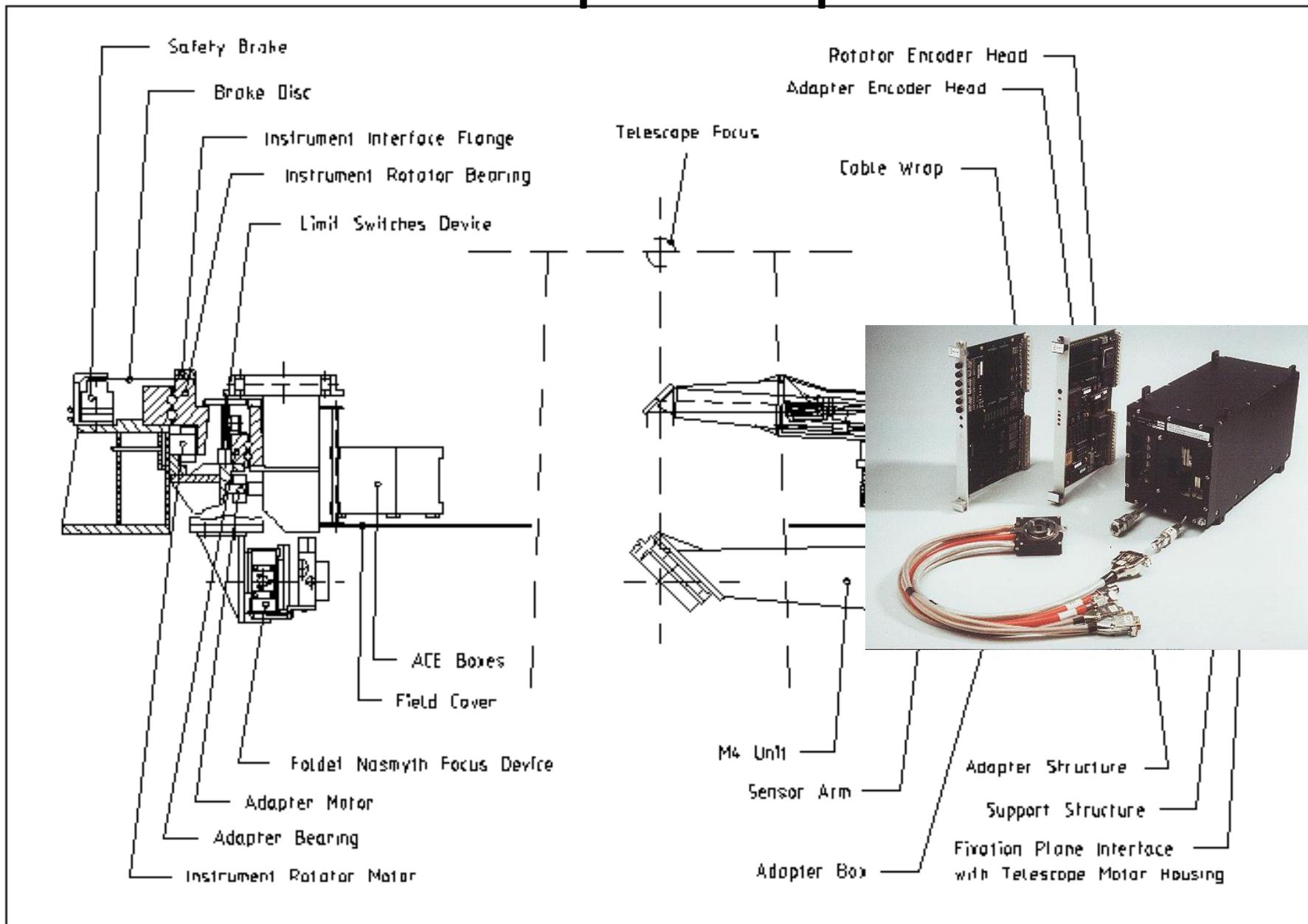


M2 tower

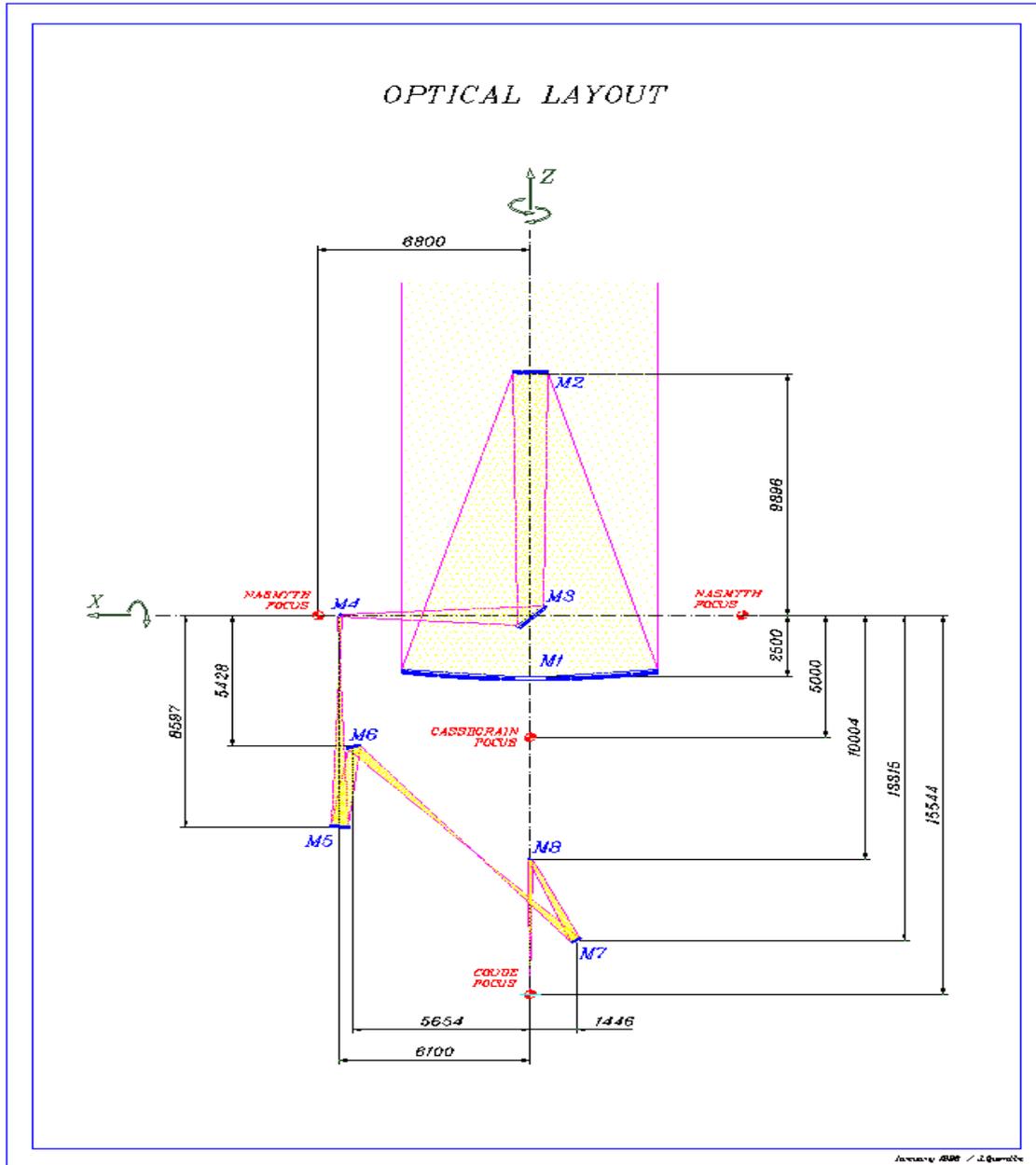


Active optics principle

Telescope adapter



Coude focus UTs



Auxiliary Telescopes

- 1.8-m telescopes (Coude)
- 4 telescopes, support VLTI (interferometry)
- Baselines up to 200 m
- movable



Adaptive optics

Fighting the atmospheric turbulence

Diffraction limited imaging

angular res limit $\sim \lambda/D$

1 - m 550nm $5.50e-7$ rad ~ 0.1 arcsec

10 - m 550nm $5.50e-8$ rad ~ 0.01 arcsec

Atmospheric turbulence can cut down about factor 100!

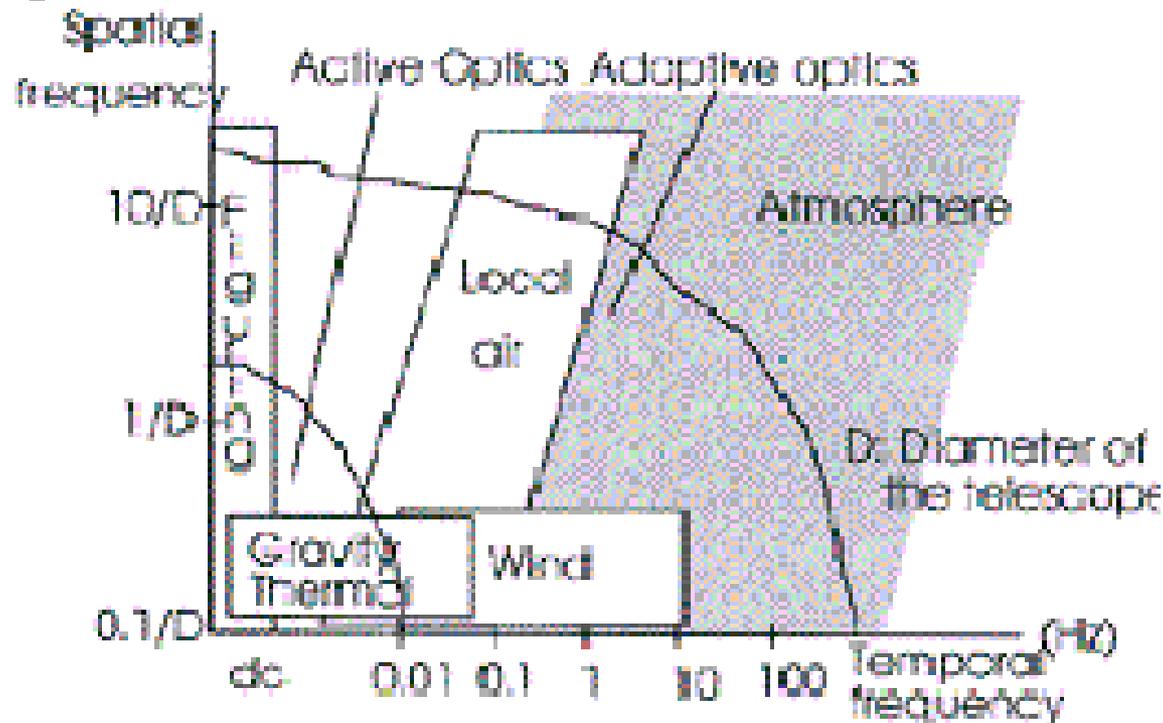


Figure 1: Frequency domain of wavefront aberrations generated by various sources. The spatial frequency is measured in terms of D , the diameter of the telescope

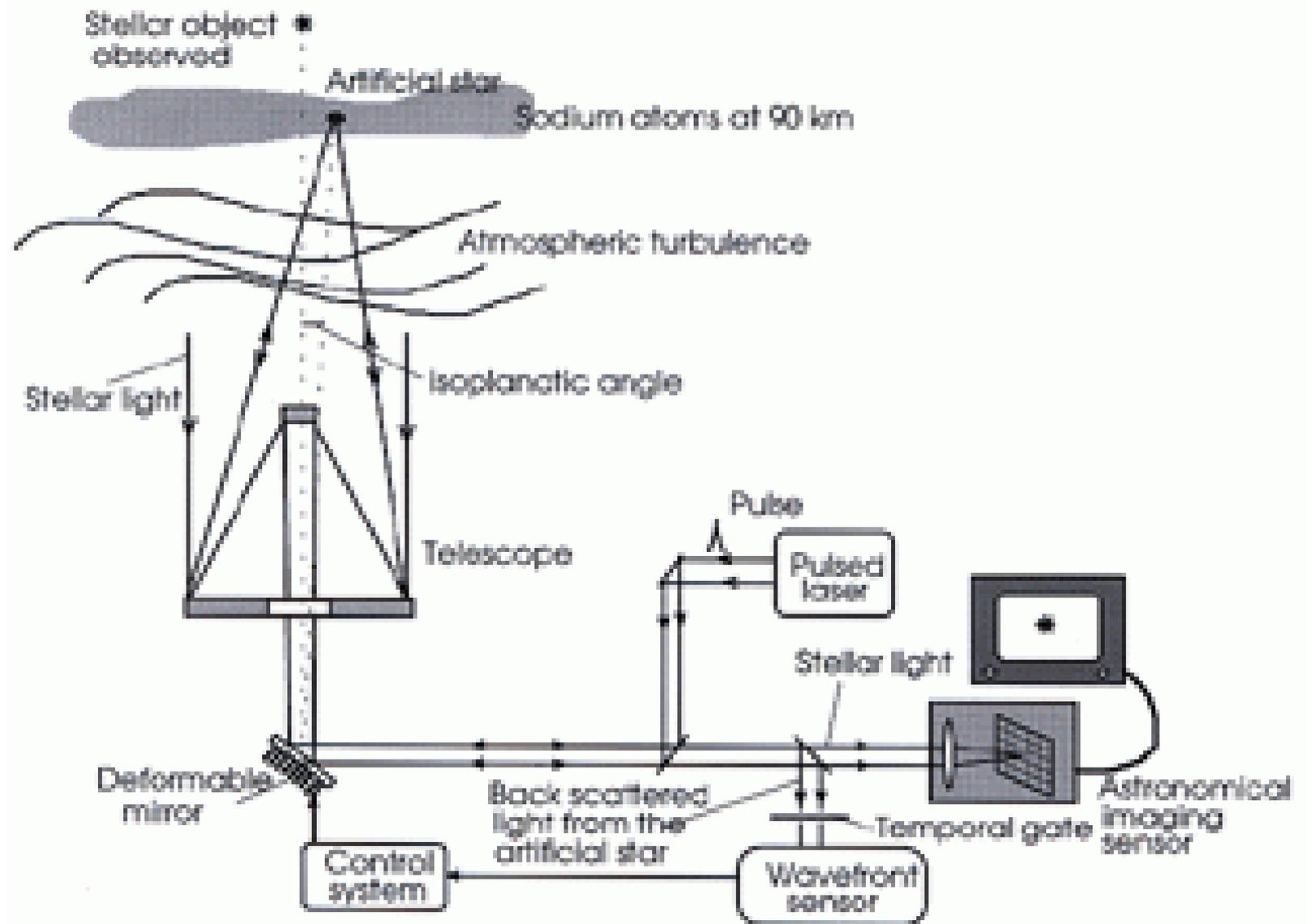


Figure 4: Adaptive Optics with laser guide star

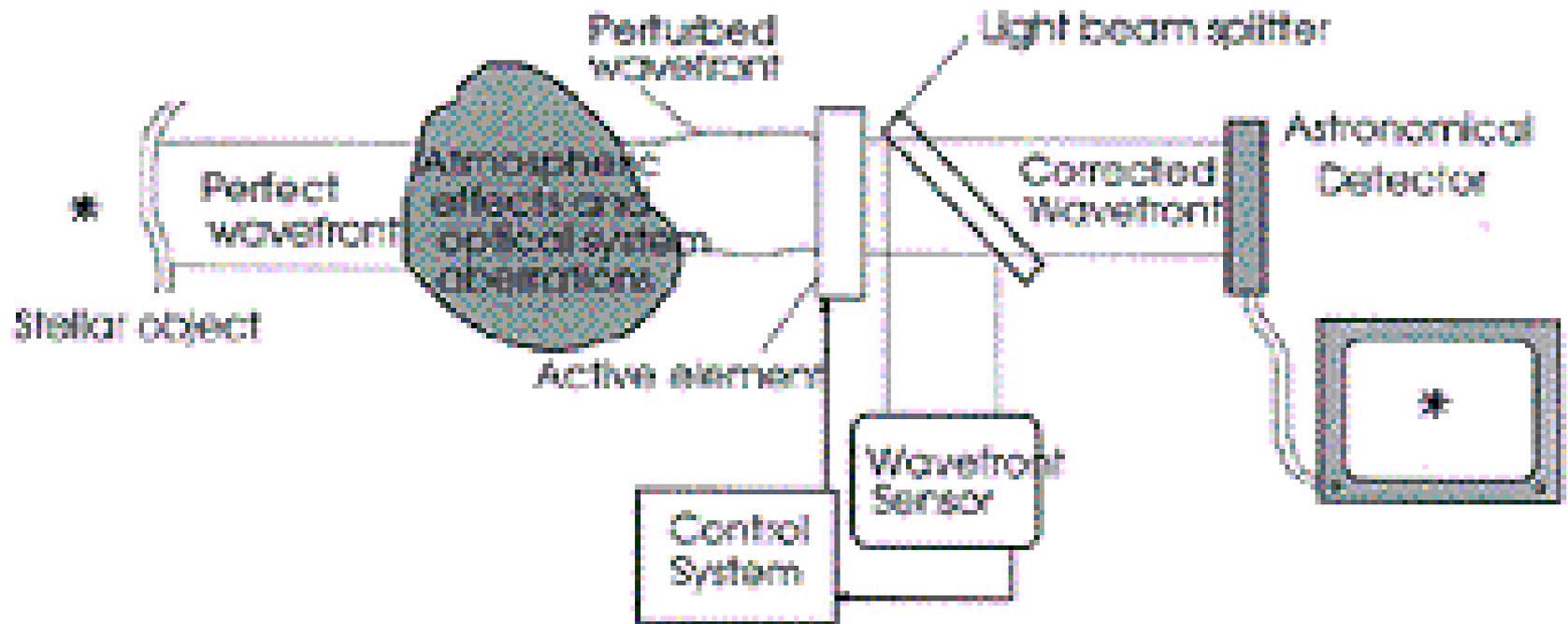
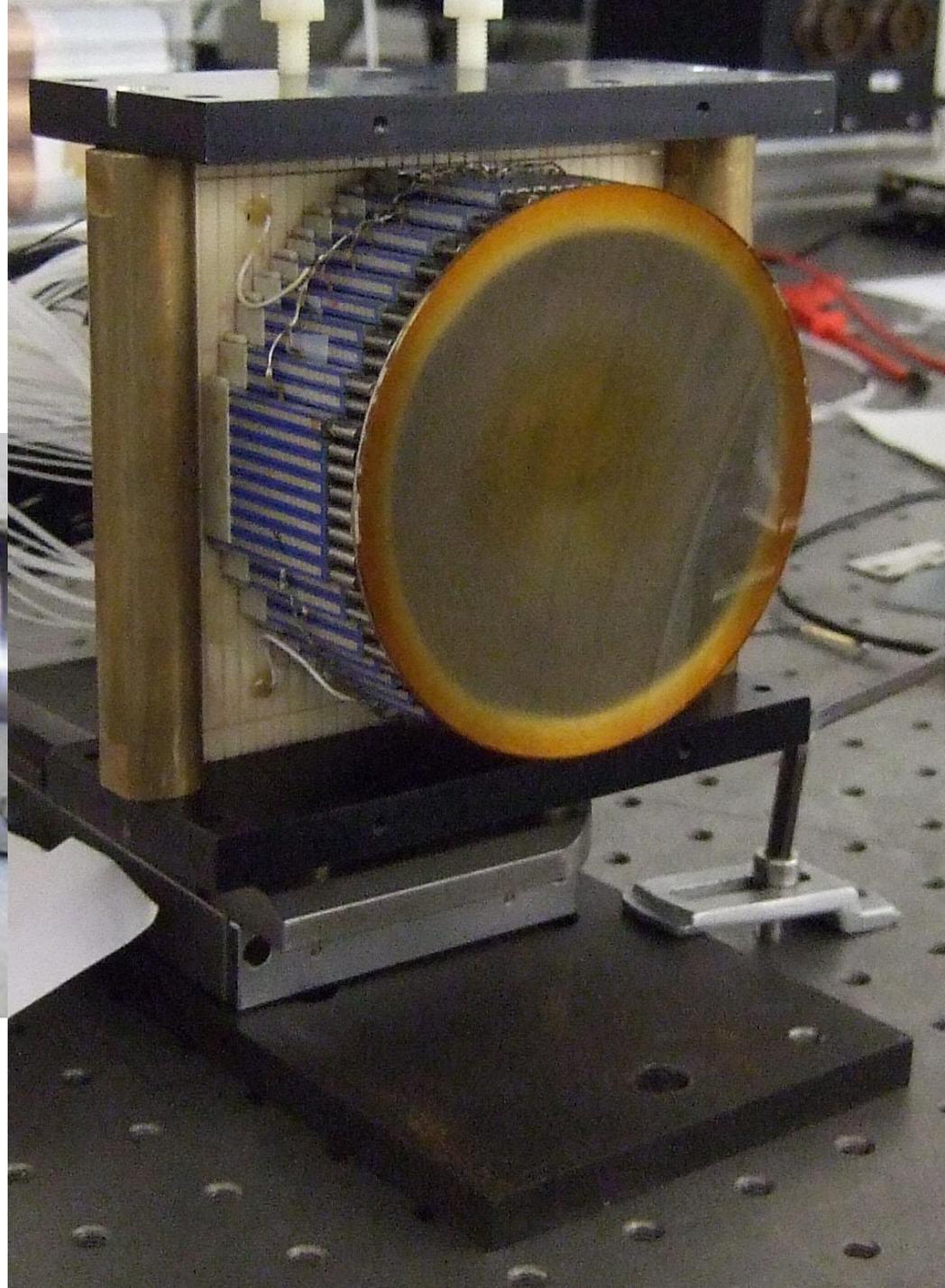
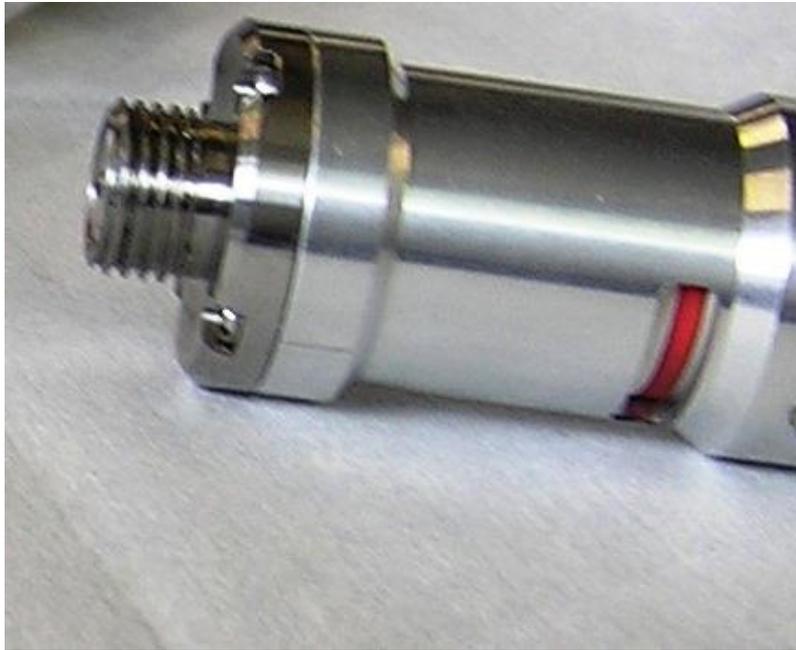
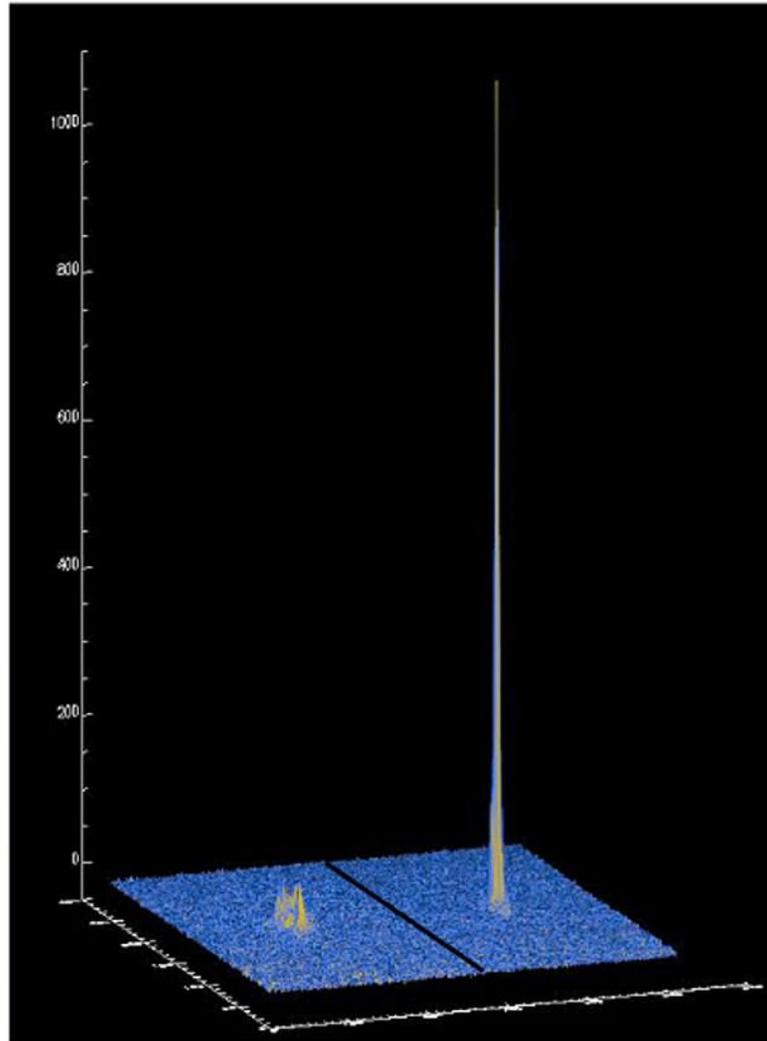
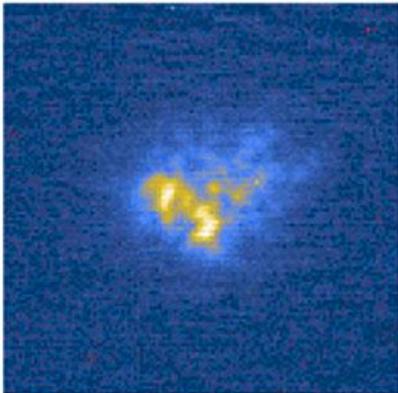


Figure 2: The principle of Active and Adaptive Optics



Diffraction limited

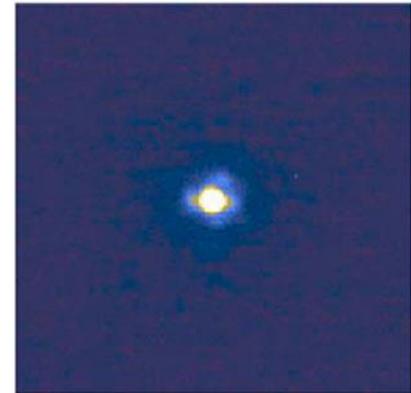
Uncorrected image
FWHM: 0.50"



Left: uncorrected

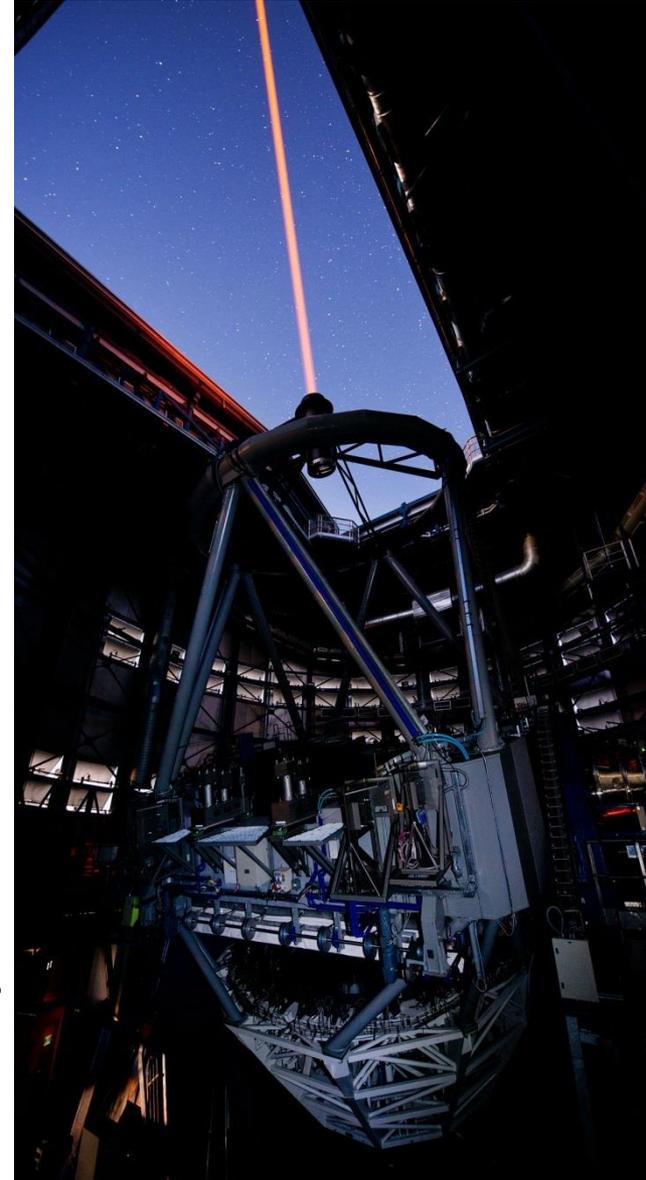
Right: corrected

AO corrected image
FWHM: 0.07"



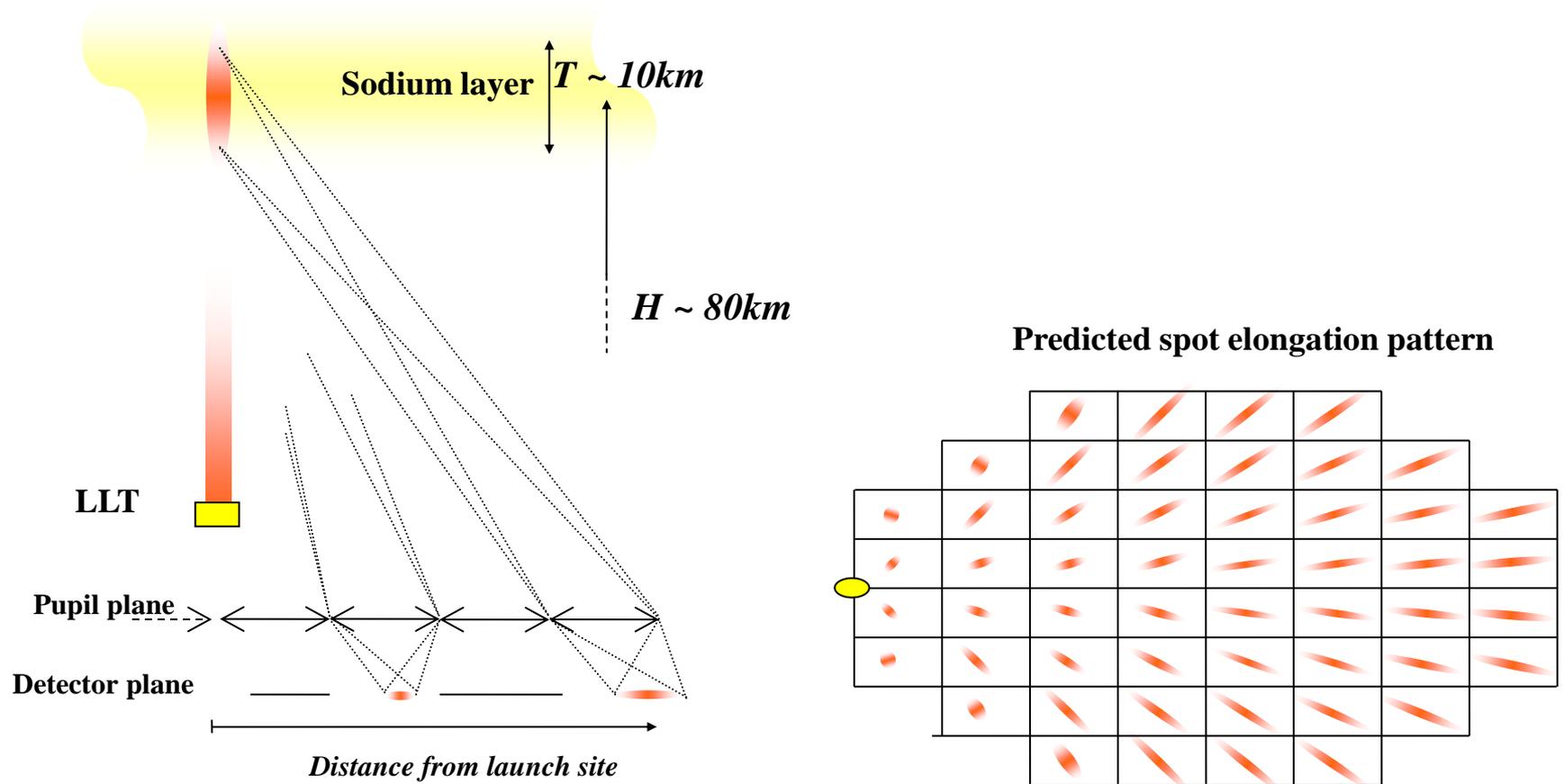
PARLA (LGS)

- Up to 7 Watts of output and is very stable. In the future 4 lasers together.
- This upgrade of the laser source takes advantage of a new solid-state [Raman fibre laser technology](#) currently under development at ESO, together with [industrial partners](#), for the AOF.
- During the commissioning, and for demonstration purposes, several targets were successfully observed using the new laser in conjunction with different VLT instruments. These included the dwarf planet Haumea and its moons, observed with SINFONI, and the nucleus of Centaurus A with NACO. These observations are available from the ESO [Science Archive Facility](#).
- The original PARSEC dye laser saw six years of service, during which it enabled important discoveries, particularly on the Galactic Centre. The upgrade simplifies the laser operation greatly and allows more flexibility in planning observations.



Picture from ESO image archive

Adaptive optics + LGS



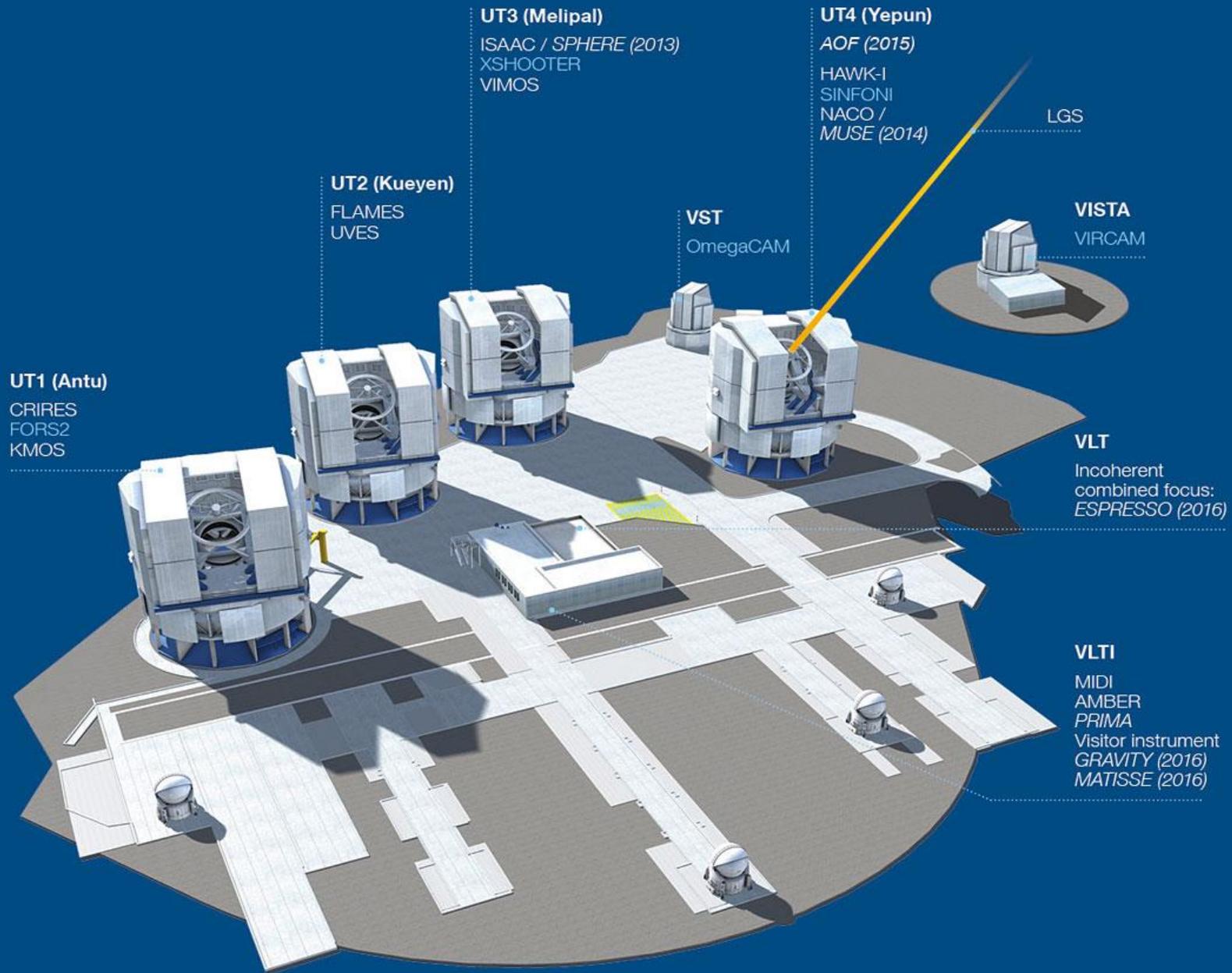
Next:

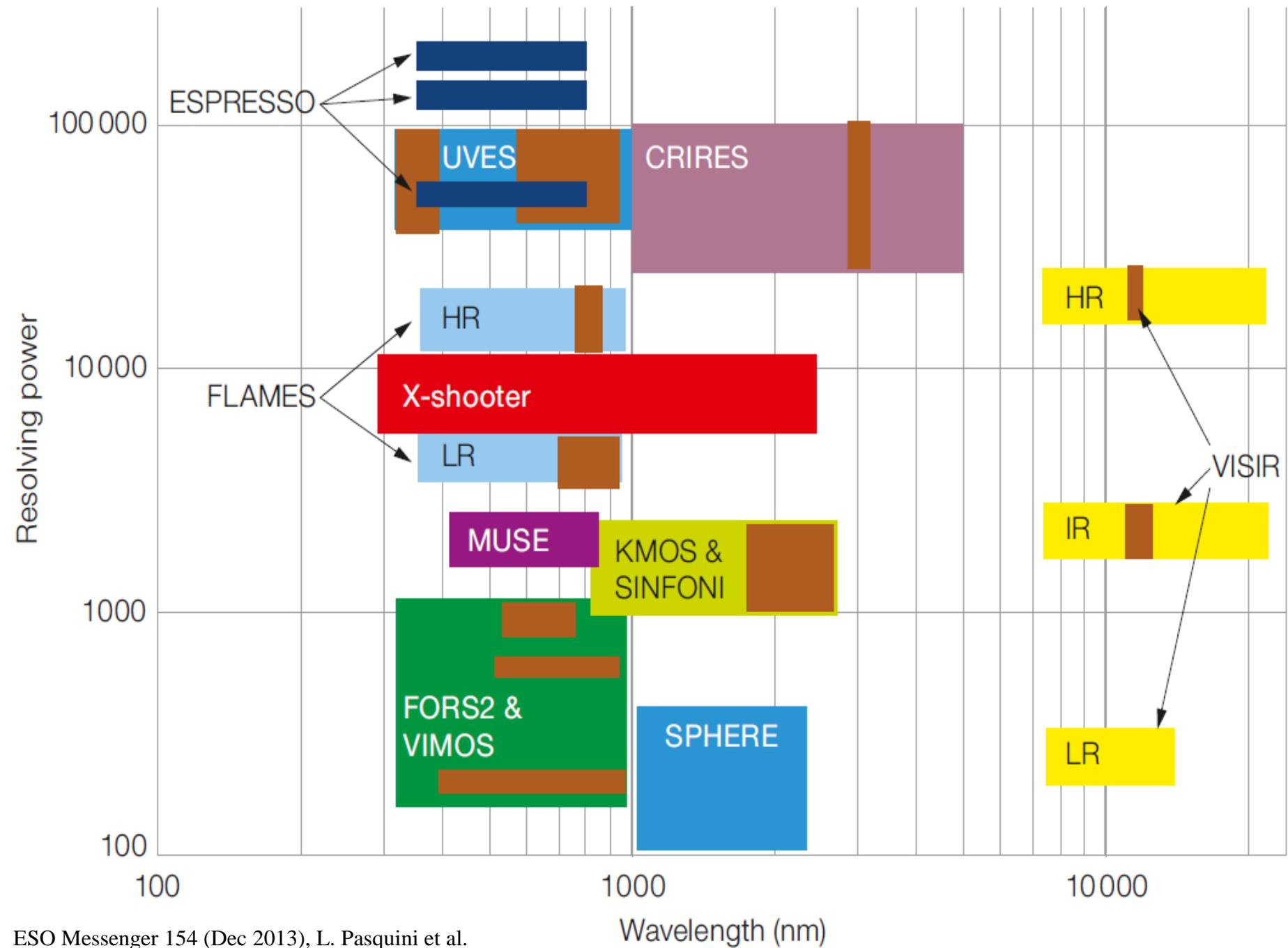
- 12 November: Live from Paranal (if no tech. problems)
- We start at 16:00 but finish 17:15 instead of 17:00!

Have a great week!

Paranal instrumentation programme

Lecture 6 (12 November)





UT1 – Antu (The Sun)

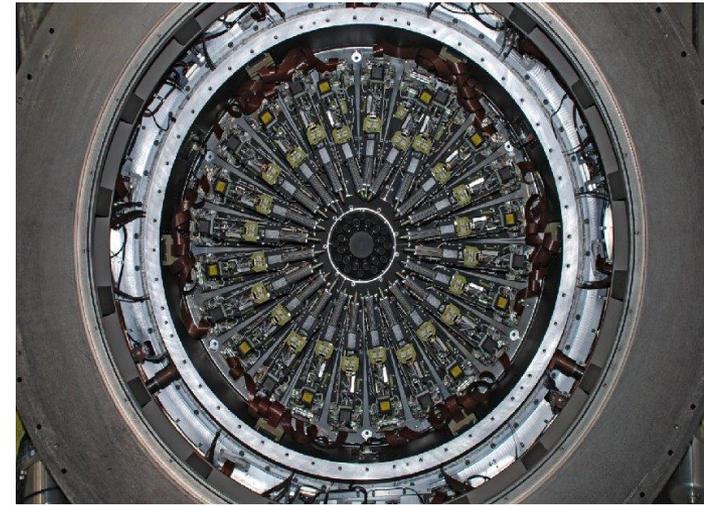
- **KMOS - K-band Multi-Object Spectrograph**
- **CRIRES - CRYogenic high-resolution InfraRed Echelle Spectrograph (Upgrade till 2017)**
- **FORS2 - FOcal Reducer/low dispersion Spectrograph 2**



KMOS

- The spectrometers each utilise a single 2kx2k HgCdTe detector and use a reflective collimator with a 6-element achromatic camera.

Requirement	Baseline Specification
Optical Throughput (predicted)	J>20%, H>30%, K>30%
Wavelength coverage	0.8 to 2.5 microns
Spectral Resolution	IZ grating R~3200 YJ grating R~3400 H grating R~4000 K grating R~4200 HK grating R~1800
Number of IFUs	24
Extent of each IFU	2.8 x 2.8 sq. arc seconds
Spatial Sampling	0.2 arc seconds
Patrol field	7.2 arcmin diameter circle
Close packing of IFUs	>=3 within 1 sq arcmin
Closest approach of IFUs	>=2 pairs of IFUs separated by 6 arcsec





FORS2

- FORS2 - imaging, polarimetry, long slit and multi-object spectroscopy (spec. res. up to 2600)
- MXU – spectroscopy with masks
- **Long-Slit (LSS) mode**
- FORS2 has 9 long-slits with fixed widths of between 0.3" and 2.5".
- **Moveable Slitlets (MOS) mode**
- FORS2 has a set of 19 pairs of arms that can be moved into the focal plane to form slitlets with user-defined widths.
- 0.25"/pixel (with the Standard Resolution collimator) and 0.125"/pixel (with the High Resolution collimator)
- FoV 6.8' x 6.8' and 4.25' x 4.25'



Science highlights – FORS2

- Bean, Jacob L. et al., 2010, "A ground-based transmission spectrum of the super-Earth exoplanet GJ 1214b". [*Nature* 468 \(7324\): 669–672](#)
- Sterzik, M. et al. 2012, Biosignatures as revealed by spectropolarimetry of Earthshine, [2012Natur.483...64S](#)



CRIRES



- Resolving power of up to 10^5 (0."2 arcsec slit)
- Spectral range from 1 to $5.3\mu\text{m}$.
- Simultaneous spectral coverage is maximized through a mosaic of four Aladdin III InSb arrays providing an effective 4096×512 focal plane detector array in the focal plane.

UPGRADE

ONGOING!

• CRIRES can boost all scientific applications aiming at fainter objects, higher spatial (extended sources), spectral and temporal resolution.

- Adaptive Optics (MACAO - Multi-Applications Curvature Adaptive optics) is used to optimize the signal-to-noise ratio and the spatial resolution.

[Käufel, H.U. et al. 2004, SPIE, 5492, 1218](#)

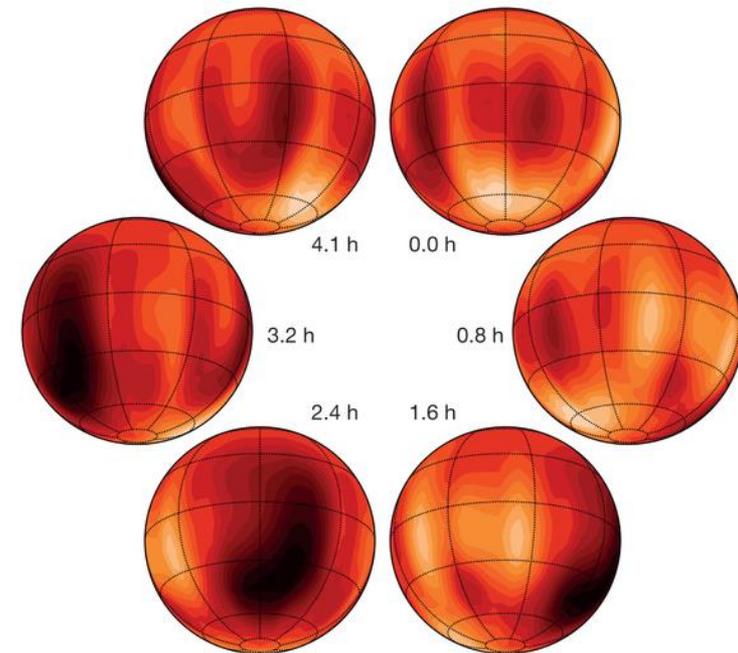
Science highlights - CRIREs

- Crossfield, I. J. M. et al. [A global cloud map of the nearest known brown dwarf](#) , [2014Natur.505..654C](#)

Data obtained within: 291.C-5006

- Paganini, L. et al. The unexpectedly Bright Comet C/2012 F6 (Lemmon) Unveiled at Near-infrared wavelengths 2014, AJ, 147, 15P

Data obtained within: 290.C-5016



UT2 – KUEYEN (The Moon)

- **UVES- Ultraviolet and Visual Echelle Spectrograph**
- **FLAMES - Fibre Large Array Multi Element Spectrograph**



UVES

- A cross-dispersed echelle spectrograph designed to operate with high efficiency from the atmospheric cut-off at 300 nm to the long wavelength limit of the CCD detectors (about 1100 nm).
- Two arms UV to B, and V to R
The two arms can be operated separately, or in parallel via a dichroic beam splitter.
- Resolving power is about 40,000 when a 1-arcsec slit is used. The maximum (two-pixel) resolution is 80,000 or 110,000 in the Blue- and the Red Arm, respectively.



- Three image slicers available
- Iodine cell available

[Dekker, H. et al. 2000, SPIE, 4008, 534.](#)



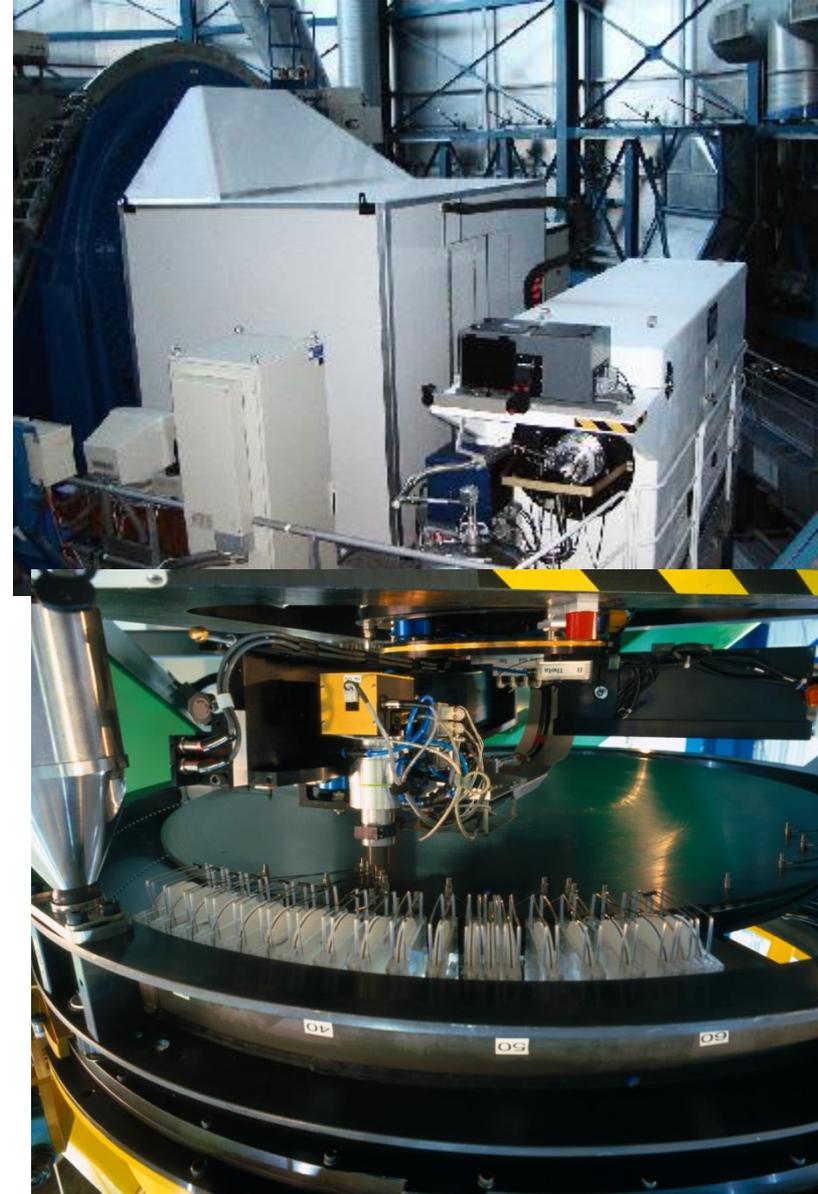
Science highlights - UVES

- Maxted, Pierre F. L. et al. [Multi-periodic pulsations of a stripped red-giant star in an eclipsing binary system](#), [2013Natur.498..463M](#)
UVES [086.D-0194](#)
- Bernet, Martin L. et al. [Strong magnetic fields in normal galaxies at high redshift](#), [2008Natur.454..302B](#)

UVES [075.A-0841](#), [076.A-0860](#)

FLAMES

- multi-object, intermediate and high resolution spectrograph of the VLT.
- field of view 25 arcmin in diameter.
- feeds two different spectrographs covering the whole visual spectral range: GIRAFFE and UVES.
- GIRAFFE allows the observation of up to 130 targets at the time or to do integral field spectroscopy, with intermediate resolution (either $R \sim 25000$ or $R \sim 10000$).
- UVES provides the maximum possible resolution ($R=47000$) but can access only up to 8 objects at the time.





Science highlights - FLAMES

- Campbell, Simon W. et al. [Sodium content as a predictor of the advanced evolution of globular cluster stars](#), [2013Natur.498..198C](#)
FLAMES, **GIRAFFE** [089.D-0038](#)
- Chiappini, Cristina et al. [Imprints of fast-rotating massive stars in the Galactic Bulge](#), [2011Natur.472..454C](#)
FLAMES, **GIRAFFE** [073.B-0074](#), [71.B-0617](#)

UT3 – Melipal (The Southern Cross)

- VIMOS - Visible MultiObject Spectrograph
- XSHOOTER
- (SPHERE) - Spectro-Polarimetric High-contrast Exoplanet Research
- VISIR - VLT Imager and Spectrometer for mid Infrared



VIMOS

- VIMOS is a visible (360 to 1000 nm) wide field imager and multi-object spectrograph
- The instrument is made of four identical arms with each a field of view of 7' x 8' with a 0.205" pixel size and a gap between each quadrant of ~2'. Each arm is equipped with 6 grisms providing a spectral resolution range from ~200-2500 and with one EEV CCD 4k x 2k.
- VIMOS operates in three different modes: Imaging (**IMG**), Multi-Object Spectroscopy (**MOS**), and with Integral Field Unit (**IFU**).
- **IMG**: Imaging is possible in *UBVRIZ* filters in a 4 x 7' x 8' field of view.
- **MOS**: Multi-object spectroscopy is carried out using masks (one per quadrant) prepared in Paranal using a laser cutting Mask Manufacturing Unit. Depending on the grism used, the spectral resolution varies from 200 to 2500, and the observable range is from 360 to 1000 nm. The maximum number of slits per mask (quadrant) varies from ~40 at $R=2500$ to ~150-200 at $R=200$, for a field of view of 4 x 7' x 8'.
- **IFU**: VIMOS is also equipped with an integral field unit made of 6400 fibers. The scale on the sky can be changed from 0.67" per fiber to 0.33" per fiber and the integral field unit can cover up 13"x 13" up to 54"x54" on sky depending on spectral resolution and spatial magnification. Spectral resolution and coverage are similar to MOS



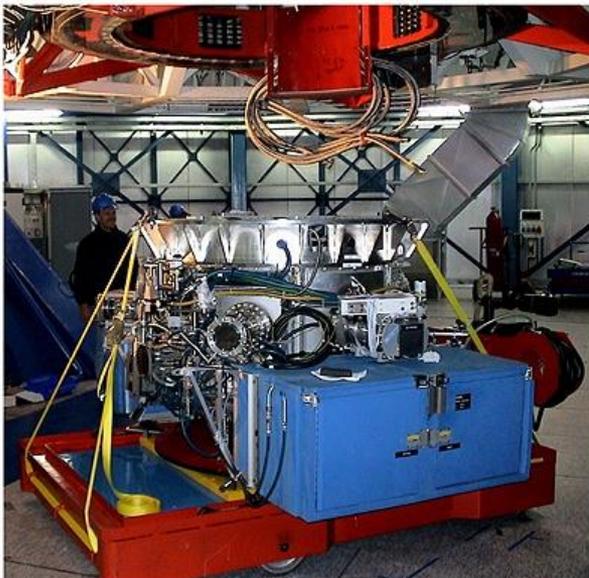
Science highlights - VIMOS

- Massey, Richard et al. [Dark matter maps reveal cosmic scaffolding, 2007Natur.445..286M](#)
VIMOS [175.A-0839](#)
- Farrell, Sean A. et al. [An intermediate-mass black hole of over 500 solar masses in the galaxy ESO243-49, 2009Natur.460...73F](#)
VIMOS [075.A-0716](#)



VISIR (currently upgrade ongoing)

- Built by CEA/DAPNIA/SAP and NFRA/ASTRON
- Provides diffraction-limited imaging at high sensitivity in the two mid infrared (MIR) atmospheric windows: the N band between 8 to 13 μm and the Q band between 16.5 and 24.5 μm , respectively.
- It features a long-slit spectrometer with a range of spectral resolutions between 150 and 30000.



VISIR under the Cassegrain Focus of the 8.2-m VLT Melipal Telescope

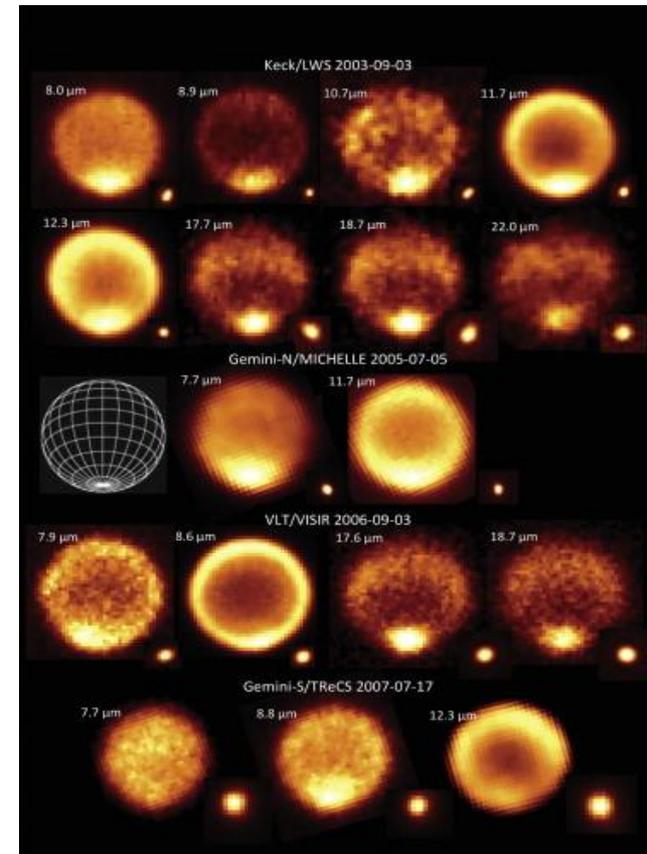
ESO PR Photo 16a/04 (12 May 2004)





Science highlights - VISIR

- 2014 Fletcher, Leigh N. et al. [Neptune at summer solstice: Zonal mean temperatures from ground-based observations, 2003-2007, 2014Icar..231..146F](#)
VISIR 077.C-0571
- 2010 Umana, G. et al. [Spitzer, Very Large Telescope, and Very Large Array Observations of the Galactic Luminous Blue Variable Candidate HD 168625, 2010ApJ...718.1036U](#)
VISIR 079.D-0748





XSHOOTER

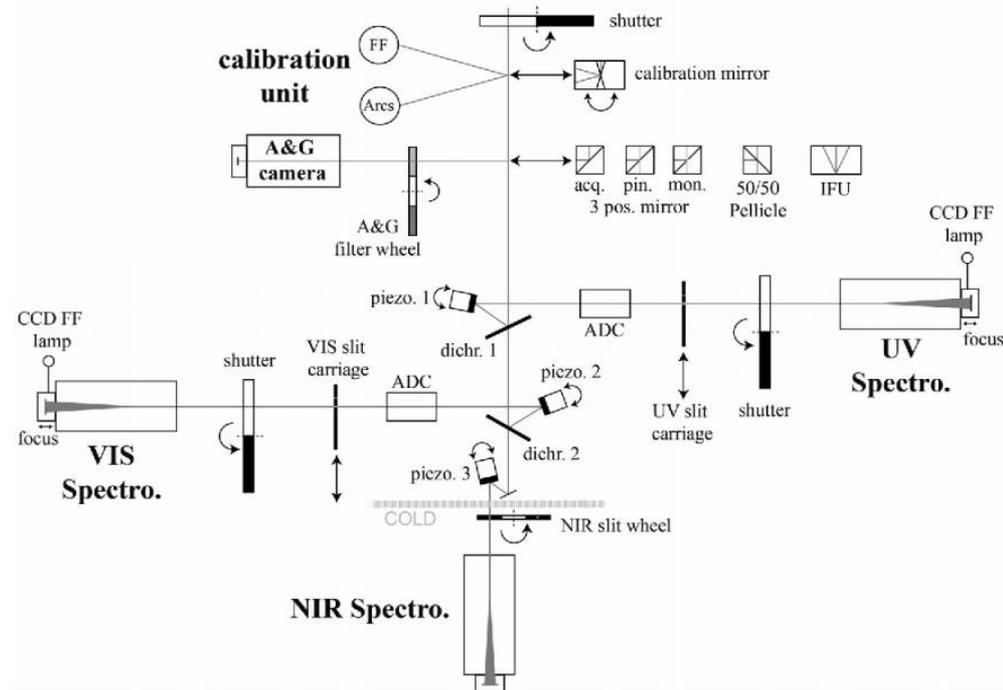
- multi wavelength (300-2500nm) medium resolution spectrograph
- 4 arms with the Acquisition and Guiding camera. It has 3 spectroscopic arms, each with optimized optics, dispersive elements and detectors:

UVB, range 300-559.5 nm

VIS, range 559.5-1024 nm

NIR, range 1024-2480 nm

- Autoguider of a 1.5'x1.5' FoV
- IFU spectroscopy, 1.8"x4" FoV
- Slit spectroscopy

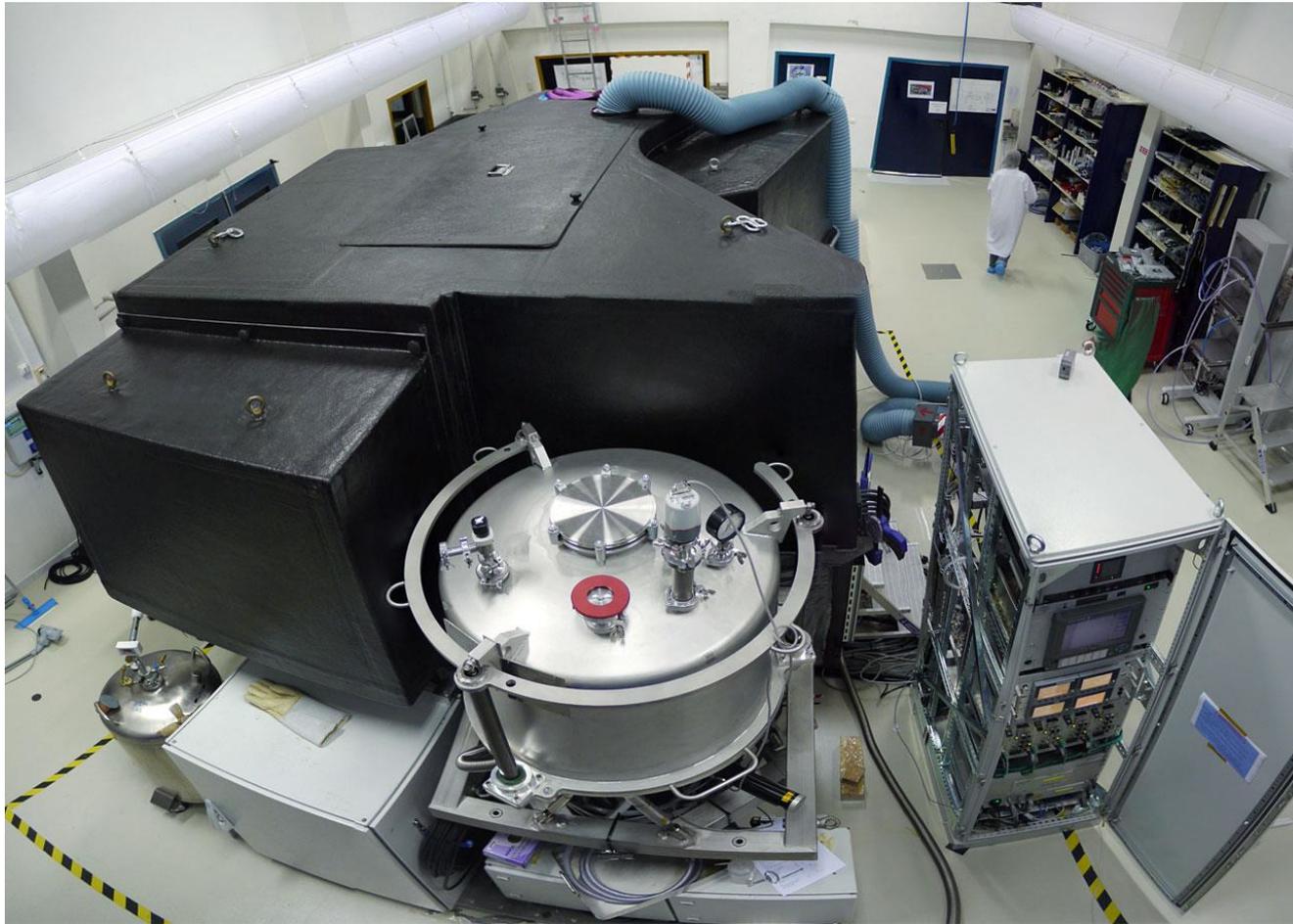




Science highlights - XSHOOTER

- Marocco, F et al., 2014, The extremely red L dwarf ULAS J222711-004547 - dominated by dust, [2014MNRAS.439..372M](#)
- Kawka, A.; Vennes, S., 2012, VLT/X-shooter observations and the chemical composition of cool white dwarfs, [2012A&A...538A..13K](#)

SPHERE (commissioned successfully)





SPHERE continued

- The prime objective of the Spectro-Polarimetric High-contrast Exoplanet Research (SPHERE) instrument for the VLT is the discovery and study of new extra-solar giant planets orbiting nearby stars by direct imaging of their circumstellar environment.
- Wavelength: 0.6 - 2.3 micron, imaging (11 arcsec FoV), spectroscopy, coronagraph – all using eXtreme adaptive optics – faster than current: 1.2 kHz correction rate, 40 sub-apertures of the WFS



UT4 - Yepun (Venus – the evening star)

- **SINFONI - Spectrograph for INtegral Field Observations in the Near Infrared**
- **HAWKI - High Acuity, Wide field K-band Imaging**
- **MUSE - Multi-Unit Spectroscopic Explorer**



HAWK-I

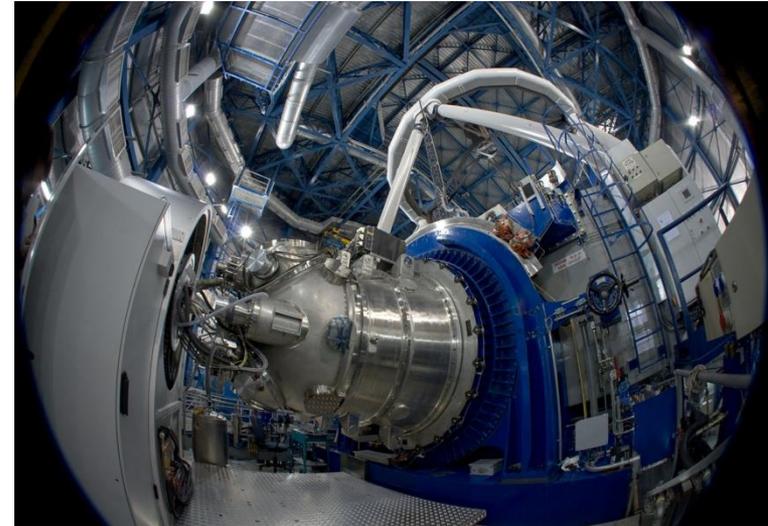
- Cryogenic wide-field imager
- Field of view is 7.5'x7.5
- The pixel scale is of 0.106".
- 4 broad band (Y, J, H & K) and 6 narrow band (Bracket gamma, CH4, H2, 1.061 μm , 1.187 μm & 2.090 μm) filters.

[Pirard et al., 2004, SPIE 5492, 510](#)

[Casali et al., 2006, SPIE 6269, 29](#)

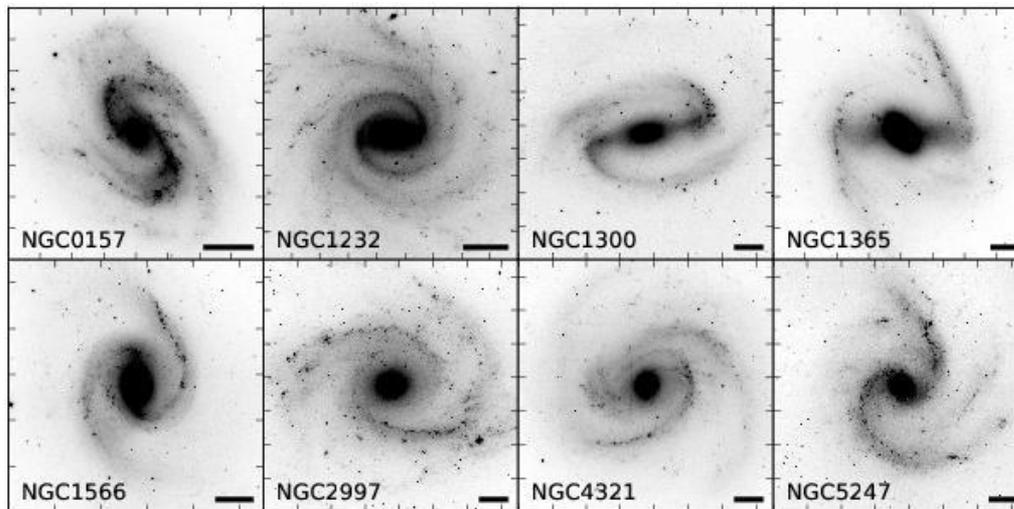
[Kissler-Patig et al., 2008, A&A 491, 941](#)

[Siebenmorgen et al., 2011, The Messenger 144, 9](#)



Science Highlights – HAWK-I

- Searching for spiral features in external disk galaxies. Data from Grosbol and Dottori 2012.

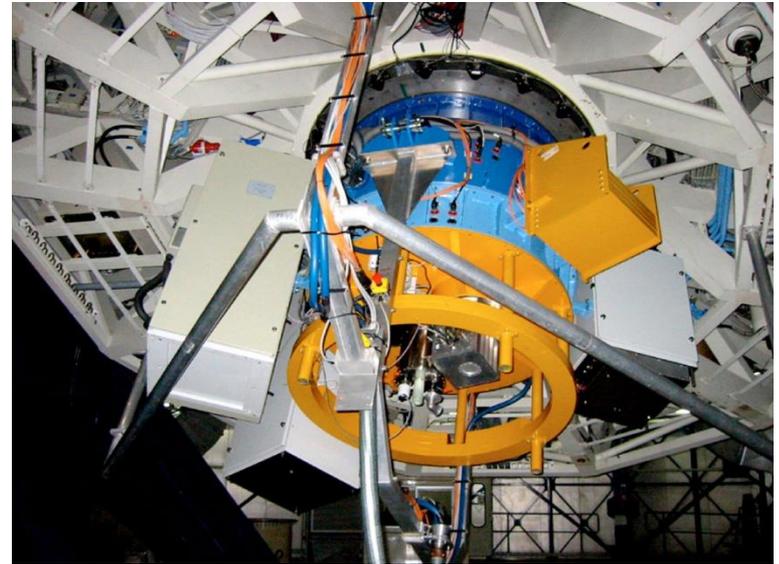


- Anderson et al. 2010, H-band thermal emission from the 19-h period planet WASP-19b, [2010A&A...513L...3A](https://doi.org/10.1051/0004-6369/201015133)



SINFONI

- Near-infrared (1.1 -- 2.45 μm)
- IFU spectrograph fed by an adaptive optics module.
- Gratings J, H, K, H+K
- Spectral res. 1500-4000
- 2048 pixels of the Hawaii 2RG (2kx2k) detector
- 3 choices of the slice height.: 250mas, 100mas and 25mas
- Field of views: 8"x8", 3"x3", and 0.8"x0.8"



- 32 slitlets are imaged onto 64 pixels of the detector. Thus one obtains 64x32 spectra of the imaged region on the sky.



(Not only SINFONI) AO & LGS

- MACAO, which stands for Multi-Application Curvature Adaptive Optics, is an ESO in-house developed 60 elements curvature adaptive optics system. MACAO-VLTI is the application of this AO principle to be used by the VLT interferometer (VLTI). Four MACAO-VLTI systems have been installed at the each UT Coude' focii feeding the VLTI delay lines with a corrected IR beam from 1000-13000nm with up to 50% Strehl @ 2.2microns.
- eXtrem AO – for SPHERE, faster, more strehl, Shack-Hartmann wave front sensor with 40 sub-apertures



Science highlights - SINFONI

- 2012 Gillessen, S. et al. [A gas cloud on its way towards the supermassive black hole at the Galactic Centre, 2012Natur.481...51G](#)
NACO, **SINFONI**, SPIFFI [073.B-0085](#), [073.B-0775](#), [074.B-9014](#), [077.B-0552](#), [081.B-0568](#), [081.B-0648](#), [082.B-0952](#), [087.B-0117](#), [087.B-0280](#), [179.B-0261](#), [183.B-0100](#), [60.A-9026](#), [60.A-9235](#), [70.A-0229](#), [71.B-0077](#)
- 2010 Lehnert, M. D. et al. [Spectroscopic confirmation of a galaxy at redshift \$z = 8.6\$, 2010Natur.467..940L](#)
SINFONI [283.A-5058](#)



MUSE

- Integral Field Spectrograph
- It has a modular structure composed of 24 identical IFU modules that together sample, in Wide Field Mode (WFM), a near-contiguous 1 squared arcmin field of view.
- almost the full optical domain with a mean resolution of 3000. Spatially, the instrument is designed to exploit the VLT AO Facility via the GALACSI AO system, sampling the sky with 0.2 arcseconds spatial pixels.
- MUSE is currently offered in Wide Field Mode with natural seeing mode. In the future, once the AOF is commissioned, a Narrow Field Mode (NFM) will be made available, and will cover 7.5×7.5 arcsec² field of view sampled at 0.025"/pixel, always with AO-correction.
- **Science Objectives**
- Formation of galaxies
- Nearby galaxies
- Stars and resolved stellar populations
- Solar system
- Serendipity



VLTI



Interferometry

- Combining the light from 2-4 telescopes (VLTI)
- AMBER, MIDI, PIONIER (all NIR wavelengths)
- More details in lecture by Dr. Liz Guzman 03 December – especially ALMA
- Reading:

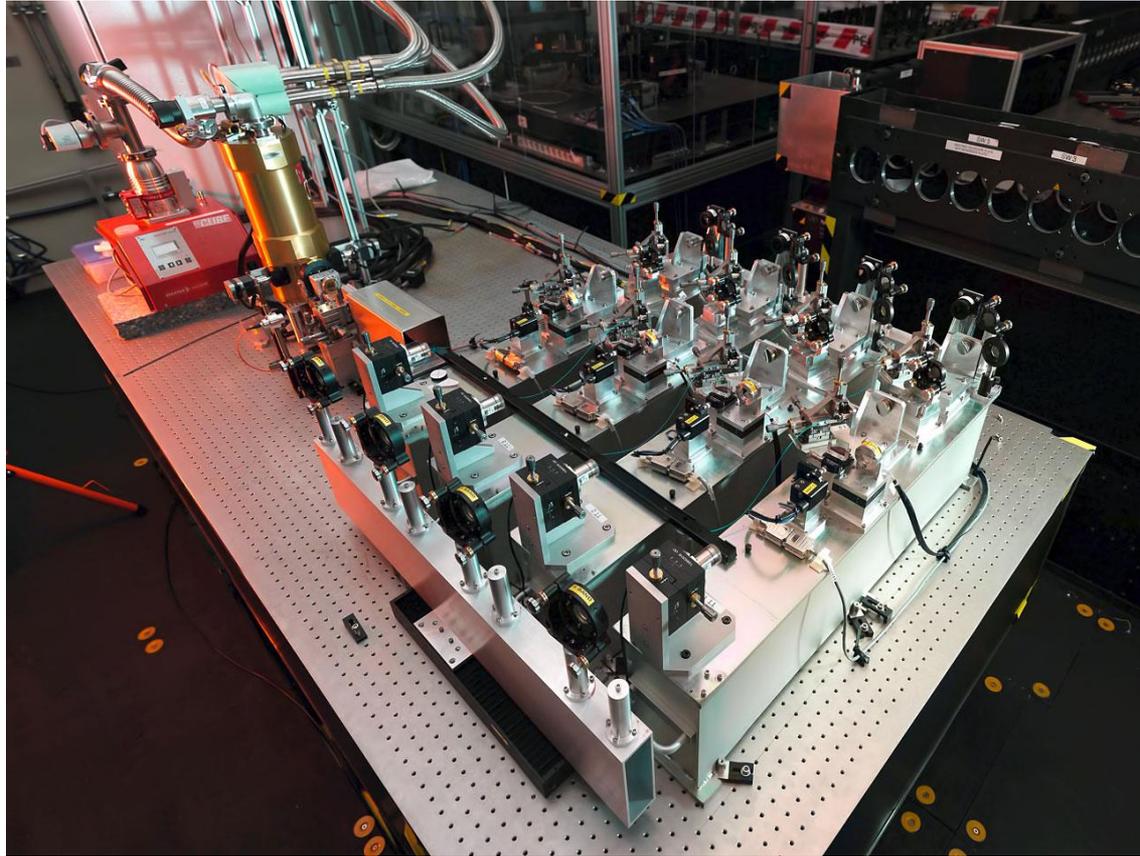
https://www.eso.org/sci/meetings/2010/stars2010/Presentations/Primer-haniff_garching10-as-used.pdf

http://www.astro.ufl.edu/~telesco/AST6725_files/5-Interferometry.pdf

http://www2.astro.psu.edu/users/alex/astro497_3.pdf

PIONIER

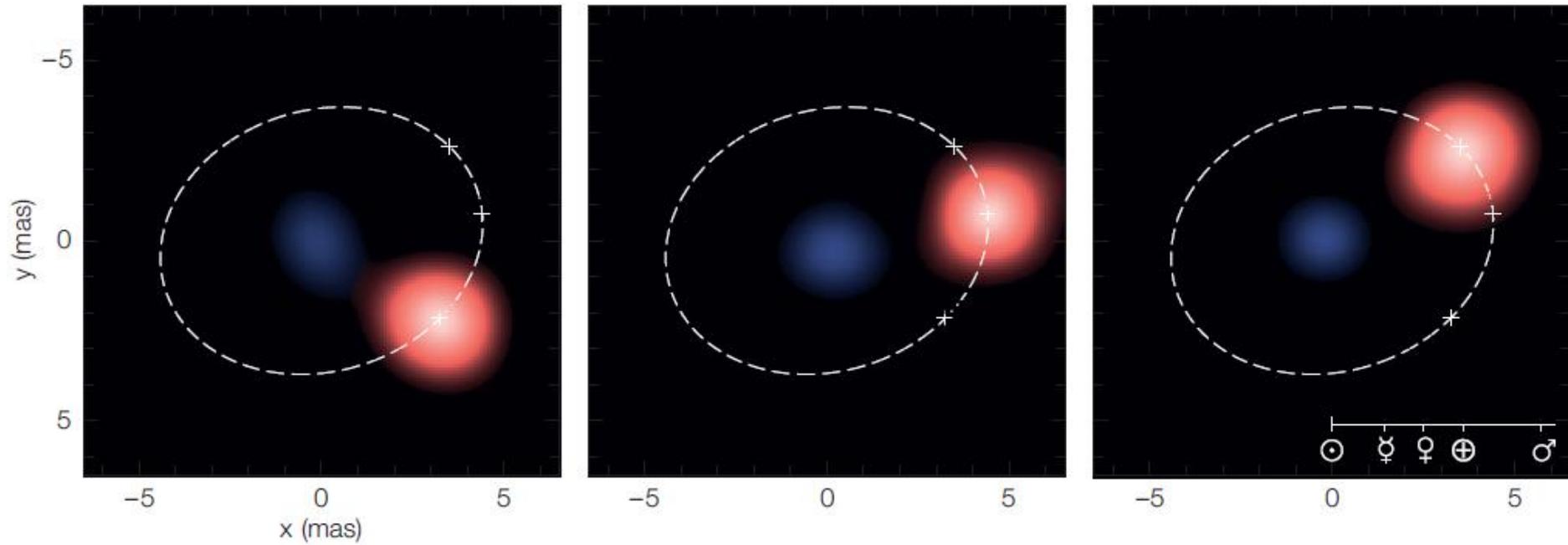
- 4 telescopes
- marcsec resolution
- spectroscopy
- Imaging



- <http://ipag.osug.fr/twiki/bin/view/Ipag/Projets/Pionier/WebHome>

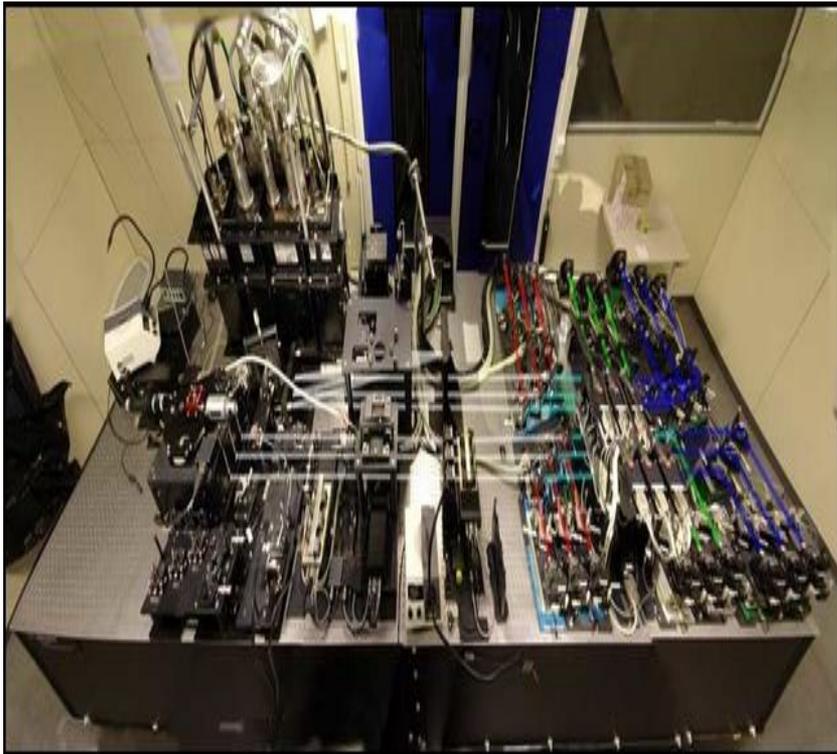
<http://www.eso.org/sci/publications/messenger/archive/no.146-dec11/messenger-no146-12-17.pdf>

PIONIER results



AMBER & MIDI

- AMBER – 3 telescopes, NIR (50-140 mas resolution)
- MIDI – 2 telescopes, mid-IR (will be decommissioned)





Other Paranal telescopes

VISTA



VST



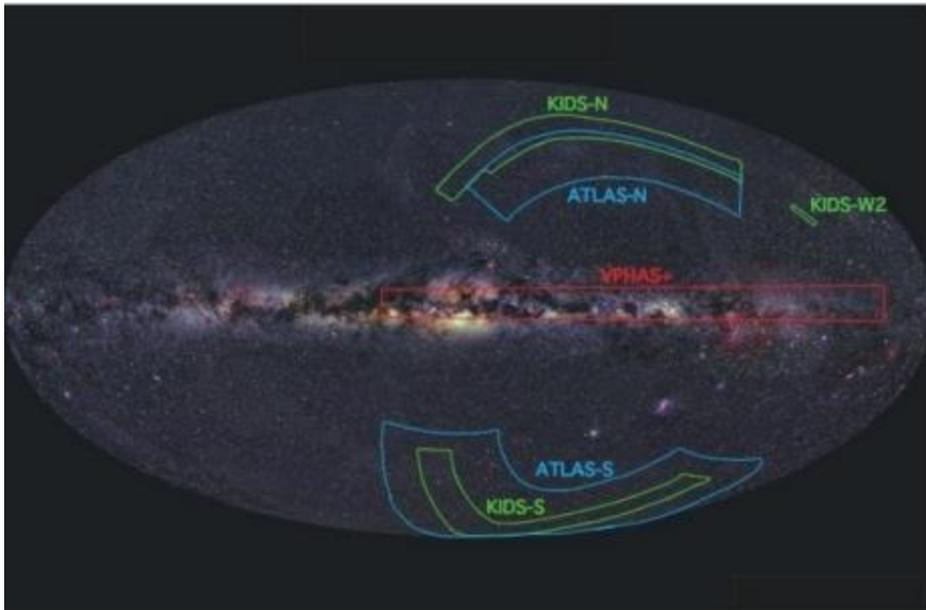
DIMM+site testing



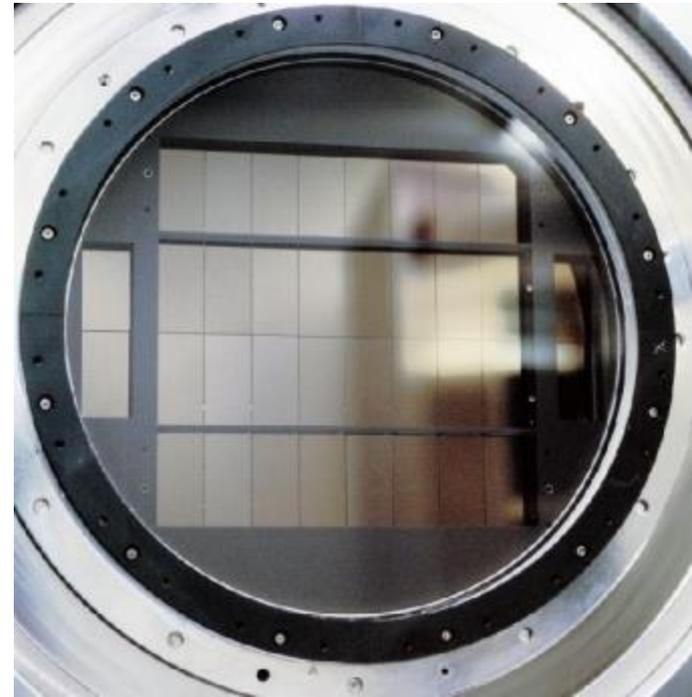
- the **N**ext-**G**eneration**T**ransit**S**urvey (not ESO operated start 2014)
- Please come to listen to talks presented by Stan and Ernst!

SURVEYS

- OMEGACAM – on 2.6-m VST (SURVEYS)
 - imager with 1x1 deg FoV
 - CCD 16x16k pixels
 - optical till 1 micron

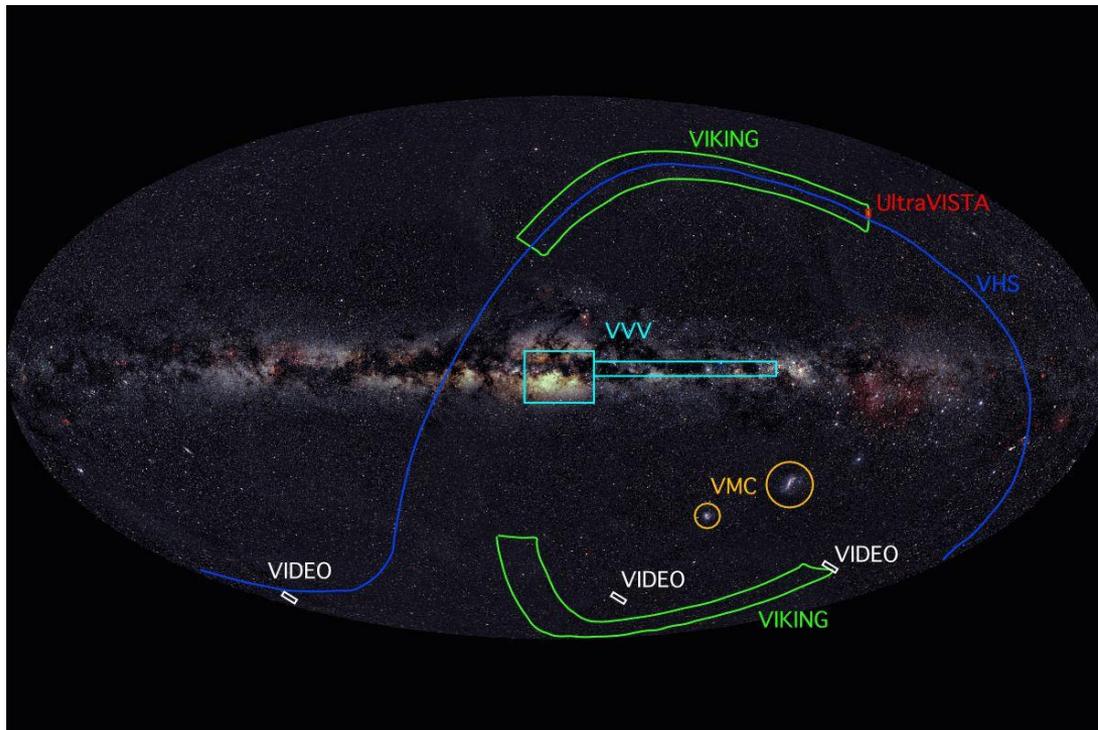


ESO



VIRCAM

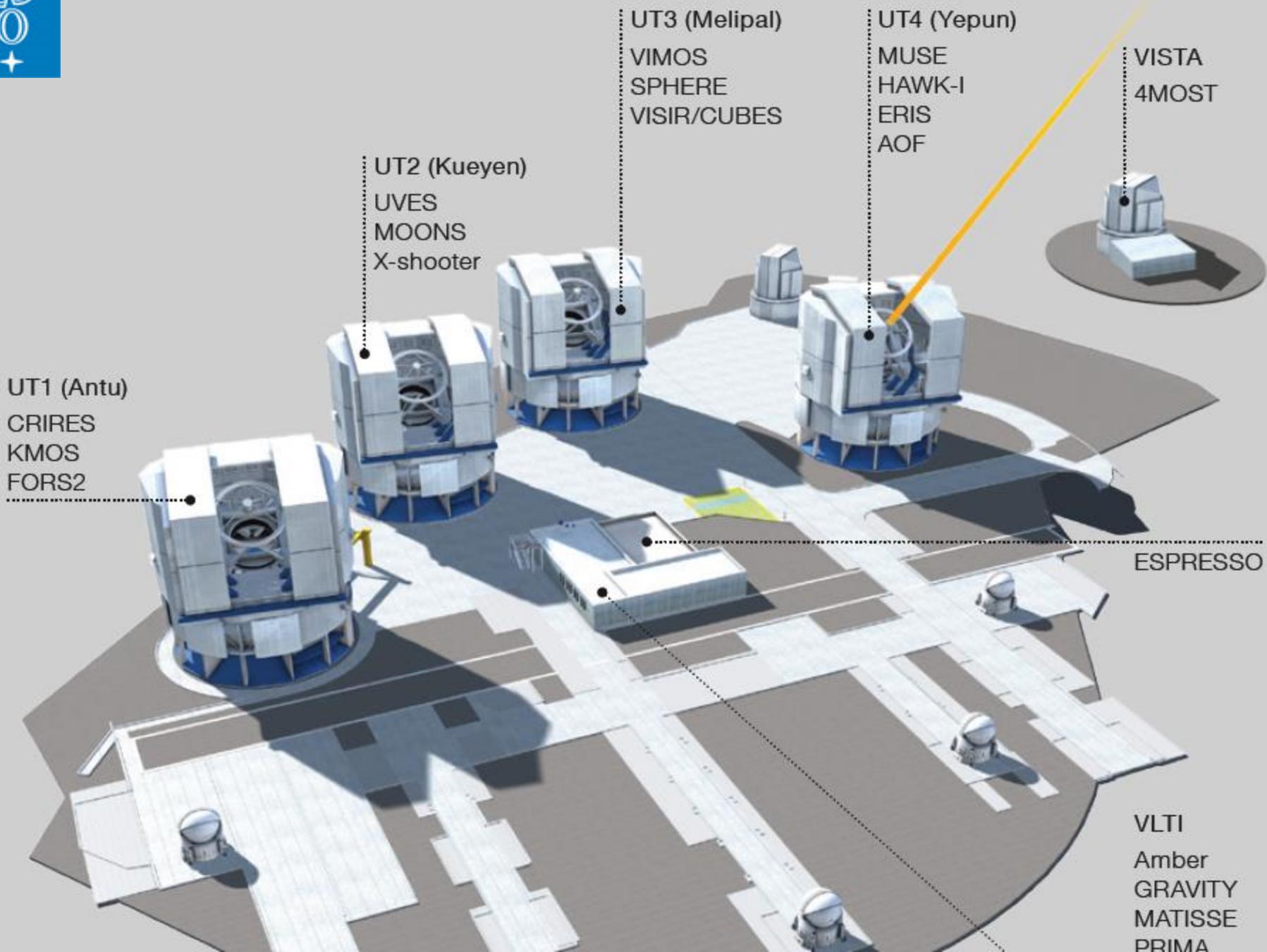
- VIRCAM at VISTA – at 4-m class telescope
 - 1.6 deg FoV, 65 millions pix.
 - 0.8 – 2.3 micron
 - public surveys





What's next?

Year	Phase A	Design & Construction	Delivery
2012	CUBES CRIRES upgrade	ERIS	KMOS VIMOS upgrade
2013		MOONS CRIRES upgrade	MUSE SPHERE
2014	Letter of interest NTT	4MOST	VISIR upgrade PRIMA astrometry GRAVITY LFC for HARPS
2015	New I (NTT?)	CUBES (?)	AOF MATISSE
2016	New II	New I (NTT?)	ESPRESSO VLT
2017	New III	New II	CRIRES upgrade
2018	New IV	New III	CUBES(?) MOONS
2019	New V	New IV	ERIS 4MOST
2020	New VI	New V	New I (NTT?)

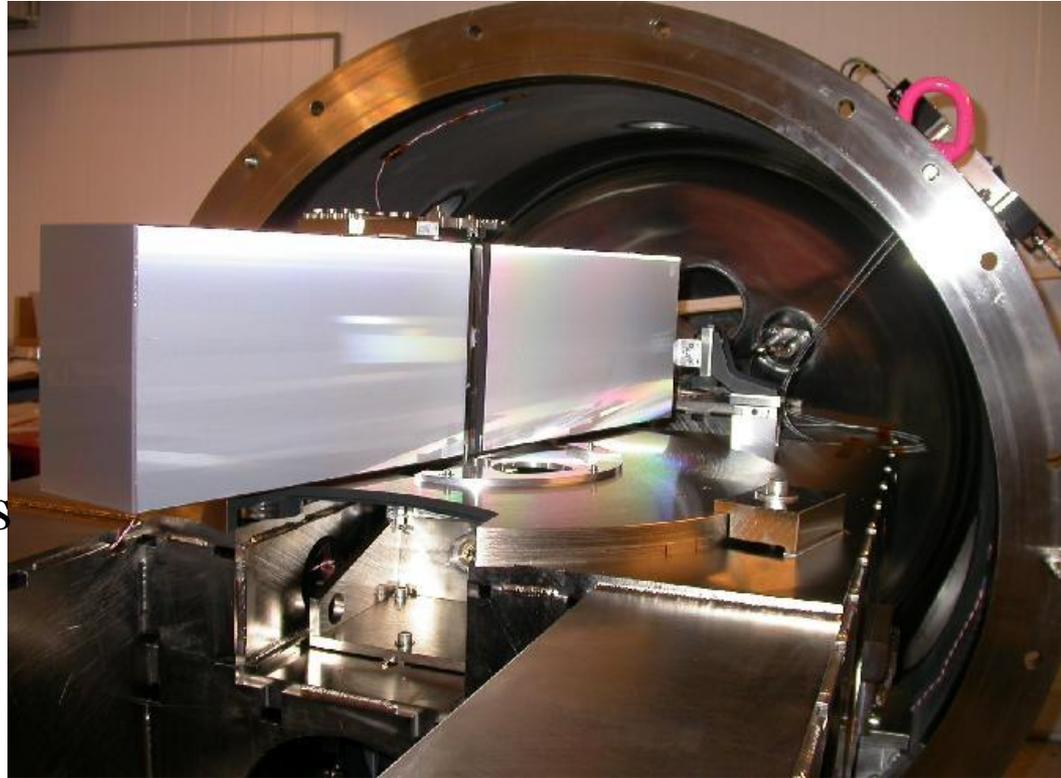


La Silla



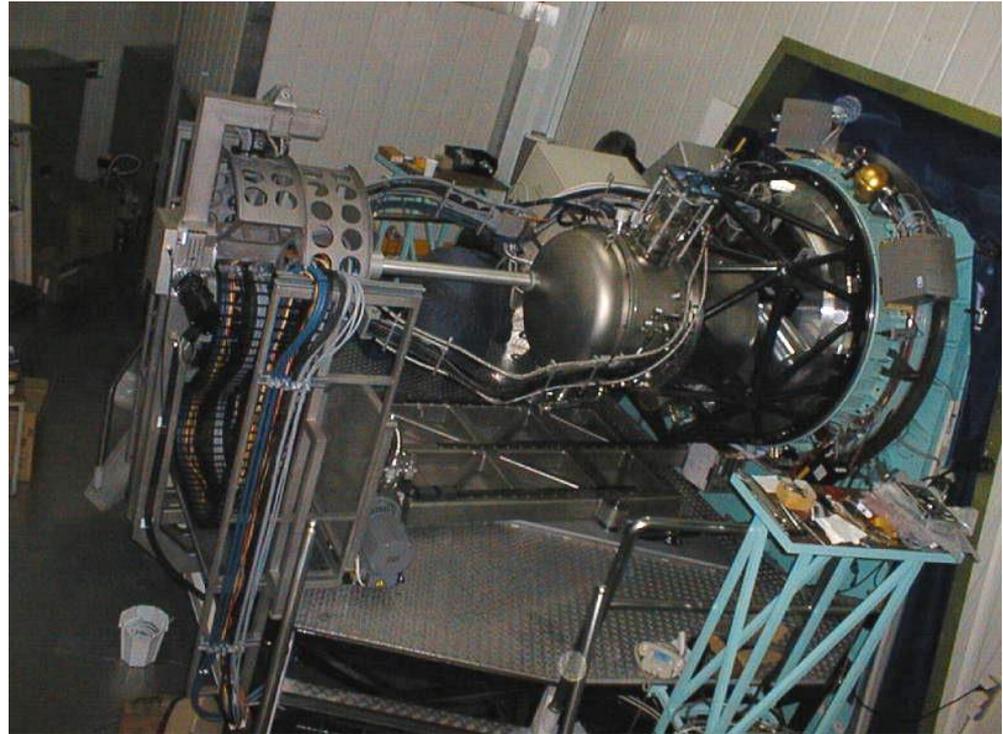
HARPS

- Planet hunter operated by ESO/Geneva University
- @ 3.6-m telescope
- high res. Echelle spectrograph
- Radial Velocities – few m/s
 - attempts a few cm/s
- detection of hundreds of planets
- even small sized planets
 - Neptune and smaller
- brother HARPS-N @ Canary islands



SOFI

- @ NTT – 3.2-m telescope
- NIR imager & spectrograph
0.9-2.3 micron
- large FoV 4.92 arcmin
- large slit 4.5 arcmin
- only Visitor Mode



EFOSC

- @NTT – plenty of modes
- 305-1110 nm
- 4.1x4.1' FoV

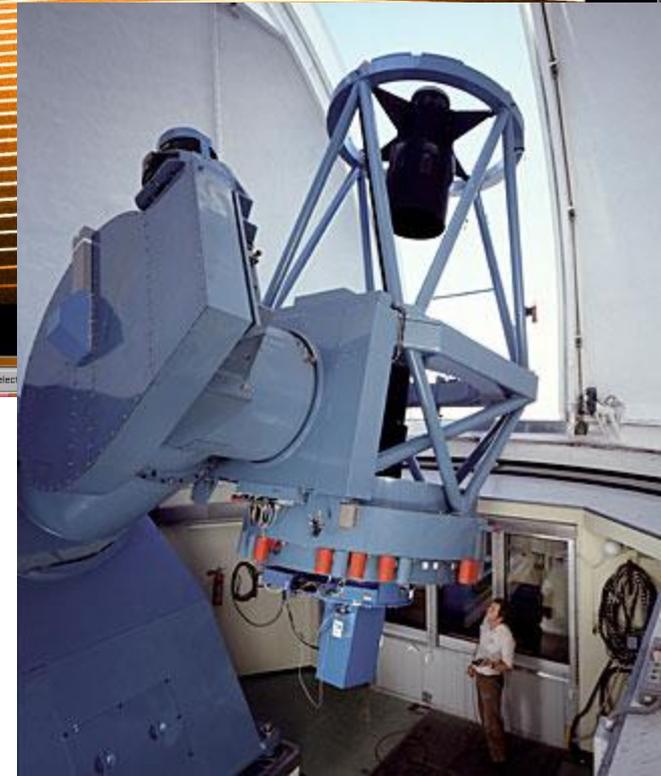
IMA	imaging
MOS	multi-object spectroscopy (masks)
LSS	longslit spectroscopy
IPOL	imaging polarimetry
SPOL	spectropolarimetry
COR	coronagraphy



Danish 1.54-m & MPG 2.2-m

- CZ involvement in both
- MPG-2.2-m
- FEROS – high res. spectrograph
- WFI – wide field optical imager
- on both AV CR has observing time in frame of TYCHO grant

- DANISH 1.5-m
 - optical imaging
 - asteroids
 - robotic thanks to Projectosft



<http://www.eso.org/sci/facilities/lasi/lla/instruments/feros.html>

TRAPPIST

- http://www.ati.ulg.ac.be/TRAPPIST/Trappist_main/Gallery/Pages/Mission-Mars2014.html#1
- 60-cm
- EXOPLANETS/COMETS



LA SILLA IS ALIVE!!!!

Next:

- 26 November (SPECIAL): Dr. Liz Guzman (ESO ALMA Fellow) – ALMA observatory and science
- 03 December: ESO behind the scenes
- 03 December: Observing process, data reduction pipelines, ESO data archives

How does observing work? (Beyond the scenes - Paranal)

The way from a proposal to the observed OB
+ insight beyond the scene

(03 December – Lecture 8)



EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

OBSERVING PROGRAMMES OFFICE • Karl-Schwarzschild-Straße 2 • D-85748 Garching bei München • e-mail: opo@eso.org • Tel.: +49-89-32 00 64 73

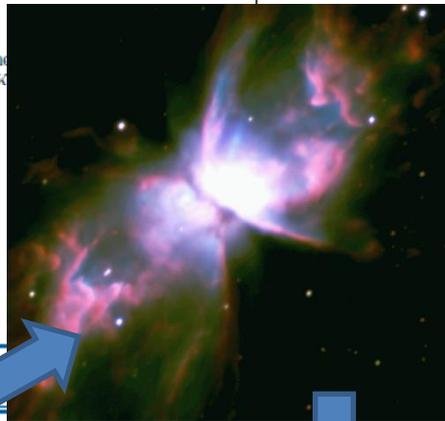
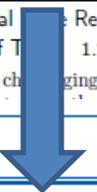


APPLICATION FOR OBSERVING TIME SHORT PROGRAMME PERIOD: 86A

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: C-7
First ground based spectrum of the extrasolar planet CoRoT-1b in near infrared	

2. Abstract / Total Time Requested
Total Amount of Time: 1.2 nights VM, 0 hours SM
One of the most challenging tasks of the last decade is the characterization of the transiting planets. We aim to directly obtain the spectrum of the planet CoRoT-1b in H&K



Status	Programme ID	Title
X	286.C-5039	Patfinder program for ground-based detection of thermal emission from extrasolar planets at 3.6 μm: the compact planet HAT-P-20b.
X	386.C-0516	First ground based spectrum of the extrasolar planet CoRoT-1b in near infrared



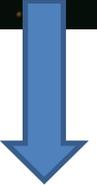
EUROPEAN SOUTHERN OBSERVATORY
Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

OBSERVING PROGRAMMES OFFICE • Karl-Schwarzschild-Straße 2 • D-85748 Garching bei München • e-mail: opo@eso.org • Tel.: +49-89-32 00 64 73

APPLICATION FOR OBSERVING TIME

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

Status	Programme ID	Title
X	290.C-5075	Water or clouds in the atmosphere of the sub-Neptune GJ1214b?
●	490.L-0594	Letter
✓	290.C-5196	<i>Nature</i> 464, 384-387 (18 March 2010) doi:10.1038/nature08856; Received 30 November 2009; Accepted 19 January 2010



1. Title	First ground based spectrum of the extrasolar planet CoRoT-1b in near infrared
2. Abstract / Total Time Requested	Total Amount of Time: 1.2 nights VM, 0 hours SM One of the most challenging tasks of the last decade is the characterization of the transiting planets. We aim to directly obtain the spectrum of the planet CoRoT-1b in H&K

A transiting giant planet with a temperature between 250 K and 430 K

H. J. Deeg^{1,2}, C. Moutou³, A. Erikson⁴, Sz. Csizmadia⁴, B. Tingley^{1,2}, P. Barge³, H. Bruntt⁵, M. Havel⁶, S. Aigrain^{7,8}, J. M. Almenara^{1,2}, R. Alonso⁹, M. Auvergne⁵, A. Baglin⁵, M. Barbieri^{3,10}, V. Benz¹¹, A. S. Bonomo³, P. Bordé¹², F. Bouchy^{13,14}, J. Cabrera^{4,15}, L. Carone¹⁶, S. Carpano¹⁷, D. Ciardi¹⁸, M. Deleuil³, R. Dvorak¹⁹, S. Ferraz-Mello²⁰, M. Fridlund¹⁷, D. Gandolfi²¹, J.-C. Gazzo



Service & Visitor modes

PHASE I

18

P2PP version 3 User Manual

Doc. No. VLT-MAN-ESO-19200-5167

The screenshot shows the P2PP 3.3.3 software interface. The title bar indicates the version. The menu bar includes File, Edit, Finding Charts, Ephemeris File, Readme File, Reports, and Help. The icon bar contains various icons for observation and scheduling. The main window is titled 'Observing Runs' and features tabs for 'Obs/Calib Blocks' and 'Schedule'. A table displays the schedule data, with columns for Name, Priority, Contrib. to Group, Abs. Time Intervals, Earliest After Prev., and Latest After Prev. Red arrows and boxes highlight the menu bar, icon bar, and the 'Obs/Calib Blocks'/'Schedule' tabs. A dropdown menu for 'View runs since period' is set to 60, and the 'ordered by' dropdown is set to 'period'.

Name	Priority	Contrib. to Group	Abs. Time Intervals	Earliest After Prev.	Latest After Prev.
60.A-9253(N)/SM/VIRCAM					
target1	1		0		
test1_Area2_1_1_1	1		0		
test1_Area2_1_1_2	2		0		
test1_Area2_1_2_1	3		0		
test1_Area2_1_2_2	6		0		
Target 1	4				
test1		10	0		
test1_S2_1_1_1		10	0		
test1_S2_1_1_2		30	0		
test1_S2_1_2_1		18	0		
test1_S2_1_2_2		50	0		

ESO is about Obs!

- OB = Observing Block
 - set of commands how to execute your observing blocks
 - also defines the observing constraints for your run: e.g. THIN clouds OK, 1.1 and better seeing etc...
 - OB is a SIMPLE ASCII file
 - later used by Night Astronomer or you at Paranal/La Silla to execute your observations



SM observing

Maximize **science efficiency** by executing the programmes with highest scientific priority first and under the required observing conditions;

Maximize **operational efficiency** by sharing calibration data between programmes, and by helping infrequent users of complex facilities in optimizing the use of the allocated observing time;

Maximize the **scientific use** of telescope time by having appropriate programmes ready for execution under a broad range of observing conditions;

Maximize the **scientific productivity** of the facility by means of the reuse of the data, made possible by building uniform data sets accessible through an archive.



Who is involved at ESO side?

- The [Observing Programmes Office\(OPO\)](#),
- The [User Support Department \(USD\)](#),
- The [Paranal Science Operations](#) Team or
- the [La Silla Science Operations](#) Team,
- The [Data Flow Operations \(DFO\) Department and its Quality Control \(QC\) Group](#), and
- The [Science Archive Facility \(SAF\)](#).

Further I will talk mostly about Paranal operations!



Hints for a successful SM OB

- Check carefully your observing constraints!
 - do you really need 0.6" seeing?
 - do you really need dark time?
 - do you really need photometric conditions?
 - can your program be done as a filler?
- BUT if you need one or more of above conditions do NOT relax the OB constraints
- The time scheduling constraints double checked?
- The coordinates, proper motion value and offsets etc. double checked?



Visitor Mode (VM)

- Used for difficult and challenging runs where real time decision are required
- The visiting astronomer is responsible for preparation and checking of his/her OBs directly at Paranal
- The visitor is supported directly by the Night Astronomer and/or the Telescope Instrument Operator at the telescope control in the Control room
- The losses due to weather are not compensated



How to decide VM or SM?

- Difficult run? Adjustments needed during the run? Special modes are requested?

THEN

Visitor Mode

- Flexible scheduling constraints? Easy run, where target can be identified well or the position is known? And many hours of observing needed?

THEN

Service Mode

Decided? What now?

- Science goal decided
- Instrument decided
- Mode (SM/VM) decided

WHAT next?

GOOD LUCK!

- MORE ABOUT PROPOSAL SELECTION WILL BE PRESENTED BY ERNST IN NEXT TWO LECTURES
- NOW WE SUPPOSE, YOU GOT THE TIME!

PHASE II

OBs preparation is P2PP3

18

P2PP version 3 User Manual

Doc. No. VLT-MAN-ESO-19200-5167

The screenshot displays the P2PP 3.3.3 software interface. At the top, the title bar reads "P2PP 3.3.3". Below it is a menu bar with items: File, Edit, Finding Charts, Ephemerts File, Readme File, Reports, and Help. A red arrow points to this menu bar with the label "Menu bar". Below the menu bar is an icon bar containing various icons for different functions. A red arrow points to this icon bar with the label "Icon bar". The main window is titled "Observing Runs" and has two tabs: "Obs/Calib Blocks" and "Schedule". A red arrow points to these tabs with the label "OB view/Schedule view tabs". To the right of the tabs, there are two dropdown menus: "View runs since period:" set to "60" and "ordered by:" set to "period". Below these is a table with the following columns: Name, Priority, Contrib. to Group Abs., Time Intervals, Earliest After Prev., and Latest After Prev. The table contains a tree view of observing runs under the path "60.A-9253(N)/SM/VIRCAM".

Name	Priority	Contrib. to Group Abs.	Time Intervals	Earliest After Prev.	Latest After Prev.
60.A-9253(N)/SM/VIRCAM					
target1	1		0		
test1_Area2_1_1_1	1		0		
test1_Area2_1_1_2	2		0		
test1_Area2_1_2_1	3		0		
test1_Area2_1_2_2	6		0		
Target 1	4				
test1	10	10	0		
test1_S2_1_1_1	10	10	0		
test1_S2_1_1_2	30	30	0		
test1_S2_1_2_1	18	18	0		
test1_S2_1_2_2	50	50	0		

P2PP3 – editing an OB

No name

Obs. Description Target Constraint Set Time Intervals

Obs. Description

OD Name

User Comments

Instrument Comments

Execution Time

TemplateType

Template
VIRCAM_img_acq_altaz
VIRCAM_img_acq_quick
VIRCAM_img_acq_tile

Setting commands

Obs. Description Target Constraint Set Time Intervals

Obs. Description

OD Name:

User Comments:

Instrument Comments:

Execution Time:

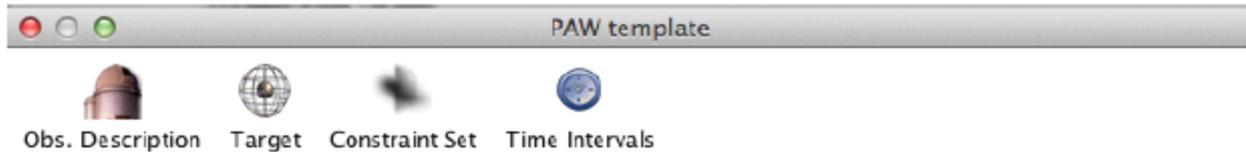
TemplateType:

Template:

- VIRCAM_img_obs_paw
- VIRCAM_img_obs_tile1
- VIRCAM_img_obs_tile3
- VIRCAM_img_obs_tile6

VIRCAM_img_acq_tile	1	VIRCAM_img_obs_tile6	1
Camera sky position angle	0.0	(List of) integration time(s)	15
Differential tracking in RA	0.0	(List of) number of integrations	3
Differential tracking in DEC	0.0	Name of jitter pattern	Jitter3d
Epoch system (default J=Julian)	J	Maximum size of jitter	20.0
X coord of pointing	0.0	Number of jitters	5
Y coord of pointing	0.0	Jitter scale multiplier	1.0
Active optics priority (will be remembe...	NORMAL	Nesting	FPJME
Science filter name	J	Guide star setup file for pawprint 1	NODEFAULT
		Guide star setup file for pawprint 2	NODEFAULT
		Guide star setup file for pawprint 3	NODEFAULT
		Guide star setup file for pawprint 4	NODEFAULT
		Guide star setup file for pawprint 5	NODEFAULT
		Guide star setup file for pawprint 6	NODEFAULT
		Name of tile pattern	Tile6u
		Scale factor	1.0
		Name of microstep pattern	Single
		List of science filters	J
		Is object extended?	<input type="checkbox"/>
		Pipeline recipe	DEFAULT

Target and OB constraints



Target	
Name	NGC12345
Right Ascension	21:02:00.000
Declination	-12:00:20.000
Equinox	J2000
Epoch	2000.0
Class	BLLac
Proper Motion RA	0.000000
Proper Motion Dec	0.000000
Diff. RA	0.000000
Diff. Dec	0.000000

PAW template

Obs. Description Target Constraint Set Time Intervals

This screenshot shows the 'Constraint Set' tab of the PAW template software. The window title is 'PAW template'. The navigation bar includes 'Obs. Description', 'Target', 'Constraint Set', and 'Time Intervals'. The 'Constraint Set' tab is active, displaying a form with the following fields:

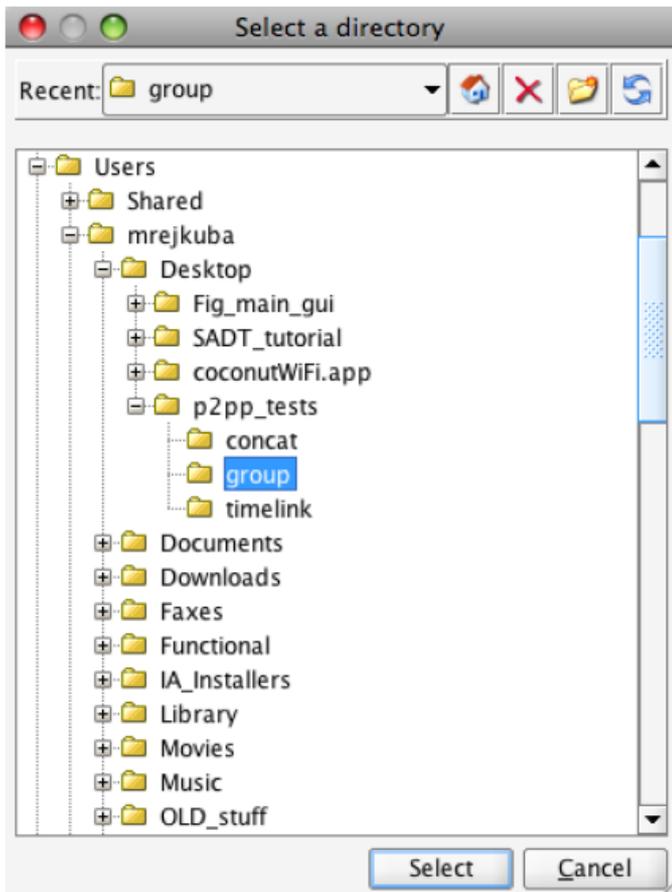
Constraint Set	
Name	constraint1
Sky Transparency	Clear
Seeing	1.0
Airmass	1.3
Lunar Illumination	1.0
Moon Angular Distance	30
Twilight	0
Baseline	
Strehl (%)	0.0
PWV (mm)	0.0
Atmospheric Turbulence Model	

Final steps

- Timing intervals if any, containers/sequences
- Do not forget the finder chart
- Do not forget to edit/attach the README for the Night Astronomer
 - this is extremely important, along with the finder chart, for the Night Astronomer these two things are the only clue how to judge if everything is OK! Be precise and clear in the README!

Now export and DONE!

.OBX ASCII FILE to be submitted to ESO via submit button



```
IMPEX.VERSION "2.0" type "O" STTimeIntervals "" calibrationReq
"" InstrumentComments "" userComments "" userPriority
"1" LineNumber "0" name "observations HAT-P-
26b" finding_chart_list "hatp26_mask_finding_chart.jpg" comments
"" objectClass "" ra "14:12:30.956" dec ""
04:01:32.880" epoch "2000.0" equinox "2000.0" propDec
"0.000000" propRA "0.000000" diffRA "0.000000" diffDec
"0.000000" LineNumber "0" TARGET.NAME "HAT-P-26
pointing" air_mass "5.0" fractional_lunar_illumination
"1.0" sky_transparency "Clear" moon_angular_distance "30" seeing
"2.0" CONSTRAINT.SET.NAME "No Name" longDescription
"" IPVersion "89.01" instrument "FORS2" LineNumber
"0" OBSERVATION.DESCRPTION.NAME
"exposure" ACQUISITION.TEMPLATE.NAME
"FORS2_mxu_acq" DET.FIELD.UIT1 "1" SEQ.CCD
"R" TEL.AG.GUIDESTAR "CATALOGUE" TEL.GS1.ALPHA
"0" TEL.GS1.DELTA "0" INS.FILT1.NAME "OG590+32" INS.FOCF.SETUP
"mxu2.2..p_focf" INS.GBR.SETUP "mxu2.2..p_gbr" INS.TARG.SETUP
"mxu2.2..p_targ" TEMPLATE.NAME "FORS2_mxu_obs_slit" DET.WIN1.UIT1
"1" INS.FILT1.NAME "OG590+32" INS.FOCF.SETUP
"mxu2.2..p_focf" TEMPLATE.NAME "FORS2_mxu_obs_off" DET.WIN1.UIT1
"20" DET.READ.CLKIND "100kHz,2x2,high" SEQ.NEXPO "120" SEQ.NOFF
"1" TEL.TARG.OFFSETY "0" INS.FILT1.NAME "OG590+32" INS.FOCF.SETUP
"mxu2.2..p_focf" INS.GRIS.NAME "GRIS_600z+23"
```

SM OBs

- Now your Obx files go to USD (User Support Department (ESO Garching))
- The files are being checked for completeness and for any possible errors
- Mind the DEADLINES for PHASE II in SM!
- If everything OK, they are sent to Paranal observing queues!
- YOU ARE IN!
- Visitor Mode – no USD interaction, you go directly to Paranal and interact with Night Astronomers

Now, getting started

- Register at ESO User portal!
- https://www.eso.org/sso/login?service=https%3A%2F%2Fwww.eso.org%3A443%2FUserPortal%2Fsecurity_check
- Download the ESO proposal pack for a given period
- Write down your idea
- Wait for the telescope time allocation!
- Download p2pp3 or p2pp for La Silla

The observing process
(what happens after phase 2?)

Paranal Operations

- Engineering – maintenance of the instruments
- Paranal Science Operations department:
 - ***Astronomers*** – operation of the instruments, SM queues, astronomical decisions during observing, interaction with the USD department, VM handling
 - ***Telescope Instrument Operators*** – operating the instruments and telescopes

The Control Room



How are the OBs observed in the SM?

- Three queues system – A,B,C (highest -> lowest rank)
- An automated tool OT3 (Observing Tool 3) ranks observations based on the weather/other conditions (time critical) provided by the Night Astronomer or the Telescope Instrument Operator
- The highest ranked OB by OT3 is observed
- Night astronomer classifies according to conditions

OT3 (Observing tool)

ORANG DB server:acdb15dev.hq.eso.org:6789 Telescope: VISTA

Obs Readme Ephemeris File Reports Finding Charts OB Reports Options

OB-Consideration

SMTS.VIRCAM.TODAY

UT Time: 2014-03-07T09:00:00 To Now

Duration: All Night Exec at Start-Time

Rank Rows: 200

Weather-Conditions

Seeing [0.20 .. inf.]

Wind

Sky Photometric

AO atmosphere: default ATM

PWV 10.0 mm.

Visibility-Constraints

Air-Mass: 0

Sidereal 30 min.

Evening Twilight 0 min.

Sun -18 deg.

Moon

FLI

Moon D.

Zenith Avoidance(5 deg.) Filter Masks

Filter out Laser observations Schedule check enabled

Rank VISTA

Observable OB (3904) Non observable OB (705) Report of executed OBS

Selected Columns

OB name Prog.ID P/P factor PI Target
 RA Dec Instrument Seeing Twilight
 Sky tran. Airmass FLI MoonDis Strehl
 ExecTime Opt.elem. Rank class QC grade Sidereal Min
 Sidereal max Baseline Ephemeris file User Pr. OB comment
 PWV ATM Mask Status Mask Slot Mask Channel
 Mask Barcode Container name

Query Break Clear Execution Sequence Copy Export... OB Report... Finding Charts View

OB ID	Status	Container	Container ID	FLI	MoonDis
931875	+	a	943113	1.000	30
931873	+	c	943110	1.000	30
931871	+	c	943107	1.000	30
931869	+	c	943104	1.000	30
931867	+	c	943162	1.000	30
931865	+	c	943159	1.000	30
931863	+	c	943156	1.000	30
931861	+	c	943153	1.000	30
931857	+	c	943139	1.000	30
931849	+	c	943125	1.000	30

Filtered rows: 200

Container Info: SVDF_Tile4 Score: 0 %
Rank Justification for 931875
Ob Tree View: SVDF2_vista_spt_deep_xdl_small_1_1_4

START DATE: Fri Mar 07 09:00:00 GMT 2014 | END DATE: Fri Mar 07 09:22:31 GMT 2014
 RA | DEC: 23:46:03.600 | -56:21:03.960 degrees
 AIRMASS AT START:13.37 | LST AT START [hhmmss]: 15:18:24 | LAMBDA FILTER:600.00
 REQUESTED CONSTRAINTS (1): Airmass: 1.7 | Seeing: 1.000 | Seeing(@600nm): 0.211 | Seeing(@600nm,AirmassLimit): 0.907
 REQUESTED CONSTRAINTS (2): FLI: 1.0 | Sky Transparency: 3THN | Moon Angular Distance: 30 | ATM: no constraint | PWV not defined.
 EXECUTION TIME [hhmmss]: 00:53:36.000
 REPORT:
 EXEC NOW OFF
 seeing filter in visibility filter
 sky transparency filter disabled
 ATM set to default
 PWV not a constraint
 wind filter disabled
 lst start date: 15:18:24
 lst at dusk 06:40:14
 sidereal time tolerance: 30 minutes
 twilight constraint disabled
 setting time: Fri Mar 07 00:23:15 GMT 2014 rising time: Fri Mar 07 09:22:31 GMT 2014
 Moon: NOT visible at start of interval
 Moon: NOT visible at end of interval
 Moon angular distance: constraint requested:30 - start interval: 92.12 - end interval: 92.22
 FLI constraint requested: 1.0 - start interval: 0.38 - end interval: 0.39



First quality check

- The Night Astronomer at the mountain checks the quality of the data taken
 - *checking if the correct object is observed with the Finding chart*
 - *checking if the conditions like seeing, sky transparency, sometimes SNR in frame are fulfilled*
 - *classifies the obtained data based on the above constraints as A,B, C or D (fulfilled completely, some constraints violated but still acceptable, must repeat, not fulfilled but not repeat)*

Classification

All Concatenation OBs are e(X)ecuted.

Report for e(X)ecuted OB

OB property	Requested Constraints	Within Current Conditions
Ob id: 739622	Seeing: 1.0	<input checked="" type="radio"/> Yes <input type="radio"/> Almost <input type="radio"/> No <input type="radio"/> N/A
Ob name: con_0tc_art-0_2010121...	Airmass: 2.0	<input type="radio"/> Yes <input checked="" type="radio"/> Almost <input type="radio"/> No <input type="radio"/> N/A
Run id: 179.A-2004(C)	Sky Transparency: Photometric	<input type="radio"/> Yes <input type="radio"/> Almost <input checked="" type="radio"/> No <input type="radio"/> N/A
Ob status: X	FLI: 0.0	<input type="radio"/> Yes <input type="radio"/> Almost <input type="radio"/> No <input checked="" type="radio"/> N/A
Grade: (A) fully within constr... ▼	Moon Distance: 30	<input type="radio"/> Yes <input type="radio"/> Almost <input checked="" type="radio"/> No <input type="radio"/> N/A
Propagate Grade(A)/(B)/(D) to all Concatenation OBs <input type="checkbox"/> Yes	Twilight: 0	<input type="radio"/> Yes <input checked="" type="radio"/> Almost <input type="radio"/> No <input type="radio"/> N/A
	Apply To All Conditions:	<input type="button" value="Yes"/> <input type="button" value="Almost"/> <input type="button" value="No"/> <input type="button" value="N/A"/>
	Fringe Quality:	<input checked="" type="radio"/> Yes <input type="radio"/> Almost <input type="radio"/> No <input type="radio"/> N/A
	Ellipticity:	<input type="radio"/> Yes <input checked="" type="radio"/> Almost <input type="radio"/> No <input type="radio"/> N/A
	IQ Variation:	<input type="radio"/> Yes <input type="radio"/> Almost <input checked="" type="radio"/> No <input type="radio"/> N/A

Public comment:

test dfs-9460

Internal comment:

test dfs-9460 internal

OK Cancel



Calibrations and data cycle

- Next day, calibration data is taken
- The instrument performance is checked regularly by the Paranal and Garching staff
- The data are archived in the ESO Archive where it can be downloaded by the PIs

Daily calibrations check

FORS2 calChecker: calibration completeness monitor for science data

<http://www.eso.org/observing/dfo/quality/FORS2/reports/CAL/calChec...>



in other sites: [PL \(internal link\) HQ](#)

Calibration completeness monitor

CAL | HC | Refs | QC

CALCHECKER

[HOME](#) | [HELP](#)

[ALL INSTRUMENTS](#)

UT1

[CRIRES](#)

[FORS2](#)

[KMOS](#)

UT2

[FLAMES/DRAFFE](#)

[LINES/FLAMES/LINES](#)

UT3

[VMOS](#)

[X-SHOOTER](#)

[MSIR \(out of ops\)](#)

UT4

[HAWK-I](#)

[NACO \(out of ops\)](#)

[SINFONI](#)

VLTI

[AMBER](#)

[MIDI](#)

[Survey Cameras](#)

[OMEGACAM](#)

[VIRCAM](#)

[QC links:](#)

[QC home](#)

[Cal Checker](#)

[Health Checker](#)

[Reference Frames](#)

[QC database](#)

[Paranal autrep database](#)

(ESO internal)

CAL FORS2 calChecker: calibration completeness monitor

Last update: 2014-04-07T19:26:27 (UT) (0d 00h:08m ago) [\[?\]](#) Paranal date*: 2014-04-06 mu01 [\[?\]](#) server: www.eso.org HQ [HELP](#) [ASSOC-RULES](#) [DETAILS](#)

Last header: FORS2: 2014-04-07T11:13:19.140 hdr ✓ transfer ✓ ngas [\[?\]](#) *Date on this monitor changes at 21:00 UT. Refresh frequency: 12hr/day and night

General news:

FORS2 news:

[HC](#) [analyse ISSUES](#) [HELP](#) | [DATA ASSOC-RULES](#) | [history...](#) | [contact](#) | [DataTransferMonitor](#) | [BandWidth](#)

[science](#) - [cal](#) [cal](#)

Long-term calibrations and maintenance [compare overview](#) [how to execute](#) [\[?\]](#)

type of calibration	validty(days)	age (days)	evaluation
DARK_low_gain_MIT	30	30.1	REMINDER: take as soon as possible
DARK_high_gain_MIT	30	30.2	REMINDER: take as soon as possible
DETE CT OR_M0N_high_gain_2x2_MIT	30	26.2	soft REMINDER: next 12 day(s)
DETE CT OR_M0N_low_gain_2x2_MIT	30	26.2	soft REMINDER: next 12 day(s)
DETE CT OR_M0N_low_gain_1x1_MIT	30	26.1	soft REMINDER: next 12 day(s)

Product availability depends on the data transfer to Garcingh and the archive access there (check the "transfer" and "ngas" flags above).

daytime calls: finished 11:18UT

DATE*: [\[?\]](#) 2014-03-31 2014-04-01 2014-04-02 2014-04-03 2014-04-04 2014-04-05 2014-04-06 LOST? [\[?\]](#) Calibration action? [\[?\]](#) Setup: [\[?\]](#)
(color if science data acquired) SM 4 SM 36 SM 42 SM 128 (may require OB false these data types ... grade review) ... for these setups

P... Product quality: [\[?\]](#) ✓ products ✓ products

Data types: Setup:

SCI_IMG	200Kps/low_SR_2x2	ok	analyzed: [1]	all ok
	200Kps/low_SR_R_SPECIAL_2x2	ok	ok	all ok
	200Kps/low_SR_b_HIGH_2x2	ok	ok	all ok
	200Kps/low_SR_u_HIGH_2x2	ok	ok	all ok
	200Kps/low_SR_v_HIGH_2x2	ok	ok	all ok
SCI_MXU	100Kps/high_SR_GG435_G600RI_+923017_2x2	nok	analyzed: [2]	STD_MOS 100Kps/high_SR_GG435_G600RI_+923017_2x2
SCI_MOS	100Kps/high_SR_OG590_G3001_43963_2x2	ok		all ok
SCI_LSS	100Kps/high_SR_G1200B_0_7_2x2	ok	ok	all ok
	100Kps/high_SR_GG435_G1200R_0_7_2x2	ok	ok	all ok
	100Kps/high_SR_OG590_G1028z_1_0_2x2		nok	STD_MOS 100Kps/high_SR_OG590_G1028z_1_0_2x2
			analyzed: [3]	

ANALYSIS NOTES:

hdex data type	setup	date	flag	analysis
[1]	SCI_MG 200Kps/low_SR_2x2	2014-04-03	OK	[science OB does not require a standard (analyzed by serel@eso.org)]
[2]	SCI_MXU 100Kps/high_SR_GG435_G600RI_+923017_2x2	2014-04-02	NO K	[the last relevant STD_MOS calibration is too old, please take a new one soon (analyzed by qc_fors2@eso.org)]
[3]	SCI_LSS 100Kps/high_SR_OG590_G1028z_1_0_2x2	2014-04-03	NO K	[the last relevant STD_MOS calibration is too old, please take a new one soon (analyzed by qc_fors2@eso.org)]

<http://www.eso.org/observing/dfo/quality/FORS2/reports/CAL/calCh>

checker FORS2

CONFIGURATION [\[?\]](#)

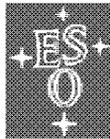
Number of days scanned: 7
 Range of days for the issue memory monitoring: 15
 Range of days for the calibration memory (issue memory plus biggest validity): 22

Days in the calibration & issue memory: | 2014-03-15: | 04:09 UT

Instrument health monitoring

UVES trending system: HEALTH CHECK report BIAS_median_DHC

<http://www.eso.org/observing/dfo/quality/UVES/reports/HEALTH/tren..>



mirror sites: [PL \(internal link\)](#) [HQ](#) [2]

Health Check monitor

[CAL](#) | [HC](#) | [refs](#) | [QC](#)

HealthCheck Monitor

[HOME](#) | [UsersGuide](#)

[ALL INSTRUMENTS](#)

[FULL reports](#)

UVES:

[score overview](#)

[detector_bias](#)
[detector_monitoring](#)
[parasitic_light](#)
[cross_dispensers](#)

ECHELLE

[gratings_position_daily_all_CD](#)
[lamps_stability](#)
[wavelength_calib_daily_CD2_CD3](#)
[wavelength_calib_all_CD](#)

MOS

[gratings_position](#)
[lamps_stability_580_REDU](#)
[_same_580_REDL](#)
[wavelength_calib_580](#)
[fibres_stability_and_status_\(REDU\)](#)

[system_efficiency](#)

[QC_UVES+FLAMES/UVES](#)

Other HC:

UT1
[CRIRES](#)
[FORS2](#)
[KMOS](#)
UT2
[FLAMES/GIRAFFE](#)
[UVES&FLAMES/UVES](#)
UT3
[VIMOS](#)
[SHOOTER](#)
[VISTA \(MUSE\)](#)
UT4
[NAOS](#)
[ACQUA](#)
[SINFONI](#)
VLT

[page auto-refreshes after 300 sec] [stop] [on]

[press Ctrl+Shift+R to enforce refresh of scores, dates and news]

UVES trending system: HEALTH CHECK report

Last update: 2014-04-07T16:00:13 (UT) (0d 03h: 12m ago) | now: 2014-04-07T19:12:57 (UT)

[HELP](#) [USERS-GUIDE](#) [MORE](#)

rmc02 QC pipeline: uvcs-5.4.0 (installed 2014-03-26)

same group: [Median](#) [Master_RON](#) [Raw_RON](#) [Struct_X](#) [Struct_Y](#)

General news:

UVES news:

Report news:

DATE*	2014-03-31	2014-04-01	2014-04-02	2014-04-03	2014-04-04	2014-04-05	2014-04-06
report NLT							

no OPSLOG data

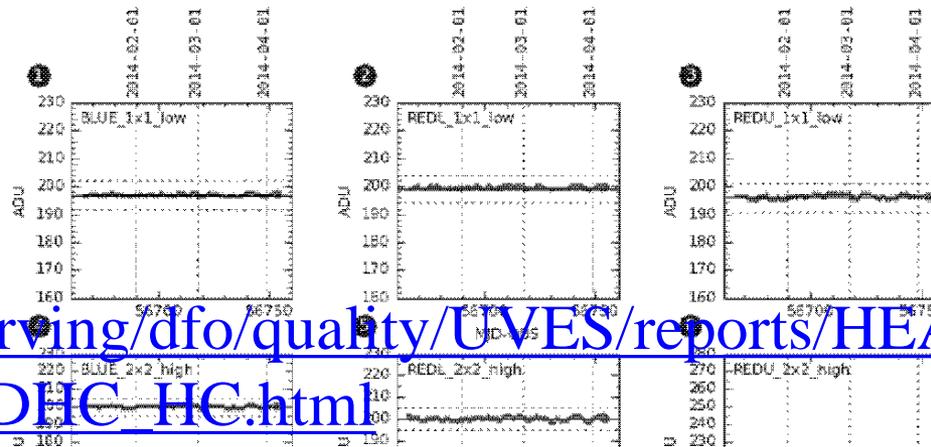
P... Product quality: [products](#) [products](#) [products](#) [products](#) [products](#) [products](#) [products](#) [products](#)

[scores&comments](#) | [FULL](#) | [history...](#) | [plot tutorial...](#) | [contact](#) [daily/often, important to check](#) [?]

*Date on this monitor changes at 21:00 UT

UVES: Median in master_bias (last 90 days)

QC data range: 2014-01-08 ... 2014-04-06*



http://www.eso.org/observing/dfo/quality/UVES/reports/HEALTH/trendreport_BIAS_median_DHC_HC.html

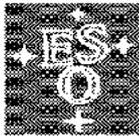
ESO archive – data retrieval

Data made available very fast after the observing night!

http://archive.eso.org/eso/eso_archive_main.html

ESO Archive Query Form

http://archive.eso.org/eso/eso_archive_main.html



ESO Archive Query Form

[ESO Archive Overview](#) [Help Page](#) [FAQ](#) [Archive Facility HOME](#) [ESO HOME](#)

If you would like to query the Archive for instrument specific parameters, please use the [dedicated query forms](#).
To search for **reduced Data Products**, please have a look at the [ESO Data Products](#) page and the [Advanced Data Products](#) query form.
To search through the science data products generated by the observers, please refer to the [Phase 3](#) query form.

The checkboxes on the right of the parameters define whether or not they will be displayed on the query result page.

Output preferences: Return max rows.

Target, Program and Scheduling Information

<u>Target Name</u> <input type="checkbox"/>	Resolved by SIMBAD	<u>Night</u> <input type="checkbox"/>	(YYYY MM(M) DD)
<u>RA</u> <input type="checkbox"/>	<u>DEC</u> <input type="checkbox"/>	<i>Otherwise give a query range using the following start/end data</i>	
<input type="text" value="00 10 00"/>	<input type="text" value="J2000"/>	<u>Start</u> <input type="checkbox"/>	<input type="text" value="12 hrs [UT]"/> : <u>End</u> <input type="checkbox"/>
<u>Search Box</u> <input type="checkbox"/>	<u>Input</u> <input type="checkbox"/>	<u>Program ID</u> <input type="checkbox"/>	<u>Program Type</u> <input type="checkbox"/>
<input type="text" value="Sexagesimal (h, deg)"/>	<input type="text" value="RA(h) DEC(deg)"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>Output</u> <input type="checkbox"/>	<input type="checkbox"/>	<u>PI CoI</u> <input type="checkbox"/>	<u>SV</u> <input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>List of Targets</u> <input type="checkbox"/>	<input type="text" value="Browse..."/> No file selected.	<u>Title</u> <input type="checkbox"/>	

Observing Information

<u>Imaging</u> <input type="checkbox"/>	<u>Spectroscopy</u> <input type="checkbox"/>	<u>Interferometry</u> <input type="checkbox"/>	<u>Other</u> <input type="checkbox"/>	<u>Data Product Info</u> <input type="checkbox"/>
<input type="checkbox"/> ALL <input type="checkbox"/> NONE				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> EFOSC2/LaSilla	<input type="checkbox"/> CES/LaSilla	<input type="checkbox"/> AMBER/MLTI	<input type="checkbox"/> BOL/APEX	
<input type="checkbox"/> EMMI/LaSilla	<input type="checkbox"/> CRIRES/VLT	<input type="checkbox"/> MIDI/MLTI	<input type="checkbox"/> HET/APEX	
<input type="checkbox"/> FORS1/VLT	<input type="checkbox"/>	<input type="checkbox"/> LGSE	<input type="checkbox"/>	

What can I see in my data?

- Data delivered in ESO fits format
 - image part
 - standard header
 - many parameters logged
 - telescope keywords: position, airmass
 - hierarchical keywords: some detector params
 - other keywords: date obs, JD, ...

ESO header example

```
SIMPLE =          T / Standard FITS
BITPIX =          8 / # of bits per pix value
NAXIS =           0 / # of axes in data array
EXTEND =          T / Extension may be present
ORIGIN = 'ESO-Paranal' / European Southern Observatory
DATE = '2013-11-17T08:18:36.1863' / Date the file was written
TELESCOP= 'ESO-VLT-U4' / ESO Telescope Name
INSTRUME= 'HAWKI ' / Instrument used.
OBJECT = 'test persistence' / Original target.
RA =           52.822054 / 03:31:17.2 RA (J2000) pointing
DEC =          -29.01201 / -29:00:43.2 DEC (J2000) pointing
EQUINOX =       2000.0 / Standard FK5
RADECSYS= 'FK5 ' / Coordinate reference frame
EXPTIME =       300.000000 / Integration time
MJD-OBS =       56613.34272521 / Obs start 2013-11-17T08:13:31.458
DATE-OBS= '2013-11-17T08:13:31.4580' / Observing date
UTC =           29608.000 / 08:13:28.000 UTC at start
LST =           26284.045 / 07:18:04.045 LST at start
PI-COI = 'UNKNOWN ' / PI-COI name.
OBSERVER= 'UNKNOWN ' / Name of observer.
ORIGFILE= 'HAWKI_IMG_OBS_GenericOffset321_0026.fits' / Original File Name
HIERARCH ESO ADA ABSROT END = 70.28992 / Abs rot angle at exp end
HIERARCH ESO ADA ABSROT PPOS = 'POS ' / sign of probe position
HIERARCH ESO ADA ABSROT START= 71.87293 / Abs rot angle at exp start
HIERARCH ESO ADA GUID DEC = -29.09959 / -29:05:58.5 Guide star DEC J2000
HIERARCH ESO ADA GUID RA = 52.896342 / 03:31:35.1 Guide star RA J2000
HIERARCH ESO ADA GUID STATUS = 'ON ' / Status of autoguider
HIERARCH ESO ADA POSANG = -0.00000 / Position angle at start
HIERARCH ESO DET CHIP NAME = 'HAWKI-MOSAIC' / Detector name
HIERARCH ESO DET CHIP TYPE = 'IR' / The Type of Det Chip
HIERARCH ESO DET CHOP FREQ = 0 / Chopping Frequency
HIERARCH ESO DET CON OPMODE = 'NORMAL' / Operational Mode
HIERARCH ESO DET DID = 'ESO-VLT-DIC.IRACE-1.48' / Dictionary Name and R
HIERARCH ESO DET DIT = 300.000000 / Integration Time
HIERARCH ESO DET DITDELAY = 0.000 / Pause Between DITs
HIERARCH ESO DET EXP NAME = 'HAWKI_IMG_OBS_GenericOffset321_0026' / Exposu
```

ESO multi extension files etc.

- Some ESO/other facilities instruments store data in cubes or multi extension fits
 - meaning multilayered fits images, e.g. more chips images in one file, for NIR instruments – every image stored in a large cube – each layer is a new 2D exposure
- One can see them with DS9 (open as multi ext/cube)
- Or one can open them in IRAF

Practical hint to see fits keywords

- dfits command
 - dfits XXX.fits | fitsort "KEYWORD"

Now, what to do when we get the data?

- Download in the archive
- Analyze the data – quick look
- Use the quick-look data products provided by ESO (if provided for a given instrument, for many they are)
- Use the regular ESO data reduction pipeline or use your own, e.g. IRAF or other packages

Where to get the software?

- <http://www.eso.org/sci/software/scisoft/>

Contents of Scisoft

- [IRAF 2.15 - Updated in Scisoft 7.7](#)
 - [ctio](#) - Utilities from CTIO
 - [gemini 1.11](#) - Utilities from the Gemini Telescopes - Updated in Scisoft 7.7
 - [gmisc](#) - Miscellaneous utilities for Gemini
 - [mxtools \(Dec2001\)](#) - Utilities from NOAO including QDPHOT
 - [guiapps](#) - Graphical applications for IRAF
 - xdimsum (Jan2003) - Enhanced IR data reduction and mosaicing software
 - dimsum 3.0 (Aug2002) - IR data reduction and mosaicing software
 - [color](#) - Utilities for creating colour images
 - [fitsutil](#) - FITS utilities
 - [mscred](#) - Mosaic camera CCD reduction tasks from NOAO
 - esowfi 1.3 (Mar2001)
 - eis 1.8 (May2002) - ESO Imaging Survey IRAF tasks (EIS Drizzle etc)
 - [rvsao 2.7.8](#) - Spectral Radial Velocity package from CfA
 - [nmisc 020618 - IRAF miscellany](#)
 - [xccdred](#) - CCD reduction for multi-port chips
 - [stecf 2.0 beta](#) - Utilities from ST-ECF, including polarimetry reduction and spectral restoration packages - Updated in Scisoft 7.6
 - [STSDAS/TABLES 3.13](#) - HST data analysis and tables systems - Updated in Scisoft 7.6
 - [ECL](#) - Enhanced CL
- [Eclipse 5.0](#) - Includes ISAAC, CONICA, WFI, Lua and ADONIS add-ons
- [ESO-MIDAS 11Sep pl1.1](#) - Updated in Scisoft 7.7
- [PyMidas 1.0.5](#)
- [IDL 8.1](#) - Interactive Data Language from RSJ. Commercial package, requires license - Note: NOT included in

ESO data reduction pipelines

- Many instruments have their reduction pipelines
- Pipelines can run
 - in command line:
ESO-Rex
 - interactively (complex)
REFLEX
 - interactively (easy)
GASGANO

ESO-REX

- Simple command line using the existing set of recipes for a given instrument
- Download:
<http://www.eso.org/sci/software/cpl/esorex.html>
- SINFONI pipeline example:
http://www.eso.org/observing/dfo/quality/SINFONI/pipeline/recipe_science.html

REFLEX - XSHOOTER

Standard-extracted and Merged Spectrum.
SN: 323.92 (430-470 nm); 272.81 (510-530 nm)

2D Merged Std Star Spectrum

Recipe Parameters:

- general | stack | removechisingle
- decode-bp: 2144227919
- pre-overcan-corr: 1
- extract-method: HOD
- max-slit: 5.7
- min-slit: -5.3
- combined-method: MEAN
- correct-sky-bymedian: TRUE
- atextract-instep-size: 30
- correct-tellurics: TRUE

Continue W/ | Be-run Recipe | Help | Disable this window

x=560.192 y=-0.07422 value=-960.632

executing

From talk of A. Kawka – Workshop: 7 years in Chile

GASGANO

GASGANO v2.1 n Kornwei / Linux

File Selected files Tools Help

Default grouping expand Find entry: find 1

File	CLASSIFICATION	TPL ID	ORIGFILE	TPL.E...	TPL.N...
Displaying 50 files Unfiltered.					
pid 168.A-0322(B)	VIMOS	555555555			
pid 60.A-9022(B)	GIRAFFE				
pid 60.A-9050(A)	VIMOS				
pid 60.A-9120(A)	WFI UNKNOWN				
100120929	SkyFlatHalp				
WFI.2003-04-15T10:39:55.363.1.fits	SKY FLAT	WFI_img_cal_SkyFlat	WFI_FI...	3	3
WFI.2003-04-15T10:39:55.363.fits	SKY FLAT	WFI_img_cal_SkyFlat	WFI_FI...	3	3

/home/nkornwei/fits/WFI.2003-04-15T10:39:55.363.1.fits WFI_FlatSkyIma.15.fits SKY FLAT

Extension: HEADER Find in header: find Load Filter Filter Auto Disp

Keyword	Value
SIMPLE	T
BITPIX	16
NAXIS	0
ORIGIN	ESO
DATE	2003-04-15T10:40:45.493
MJD-OBS	52744.44439078
DATE-OBS	2003-04-15T10:39:55.363
EXPTIME	48.5397
EXTEND	T
OBJECT	FLAT,SKY
INSTRUME	WFI
OBSERVER	UNKNOWN
PI-COI	UNKNOWN
TELESCOP	MPI-2.2

And finally a few words

Does it make sense to apply for the VLT time?

- Well, if the program requires 8-m telescope then YES!
- VLT is a leading facility and Czech Republic is an ESO member state, therefore we should be using the advantages of being ESO members
- Competition is tough. If the time is not awarded immediately, one has to resubmit or modify and resubmit again the proposal
- Before applying, the ESO Archive should be checked -> there is plenty of data already available!

What's next?

NEXT LECTURE: 10 December

NON-ESO facilities/Successful
proposals/OPC/Telescope time allocation

Ernst/Petr