



The Infrastructures

A.Kaufer, ESO



Dec. 1987
Decision to
build the VLT



Dec. 1990
Paranal site
selected



Dec. 1996
Foundation
Ceremony



May 1998
First Light
for UT1



Sep. 2000
First Light
for UT4



Mar. 2001
First Light
for VLT



Jan. 2004
First AT
installed



Feb. 2006
Laser above
Paranal



Dec. 2006
Fourth AT
installed



May 2008
Ten-year
anniversary
of First Light

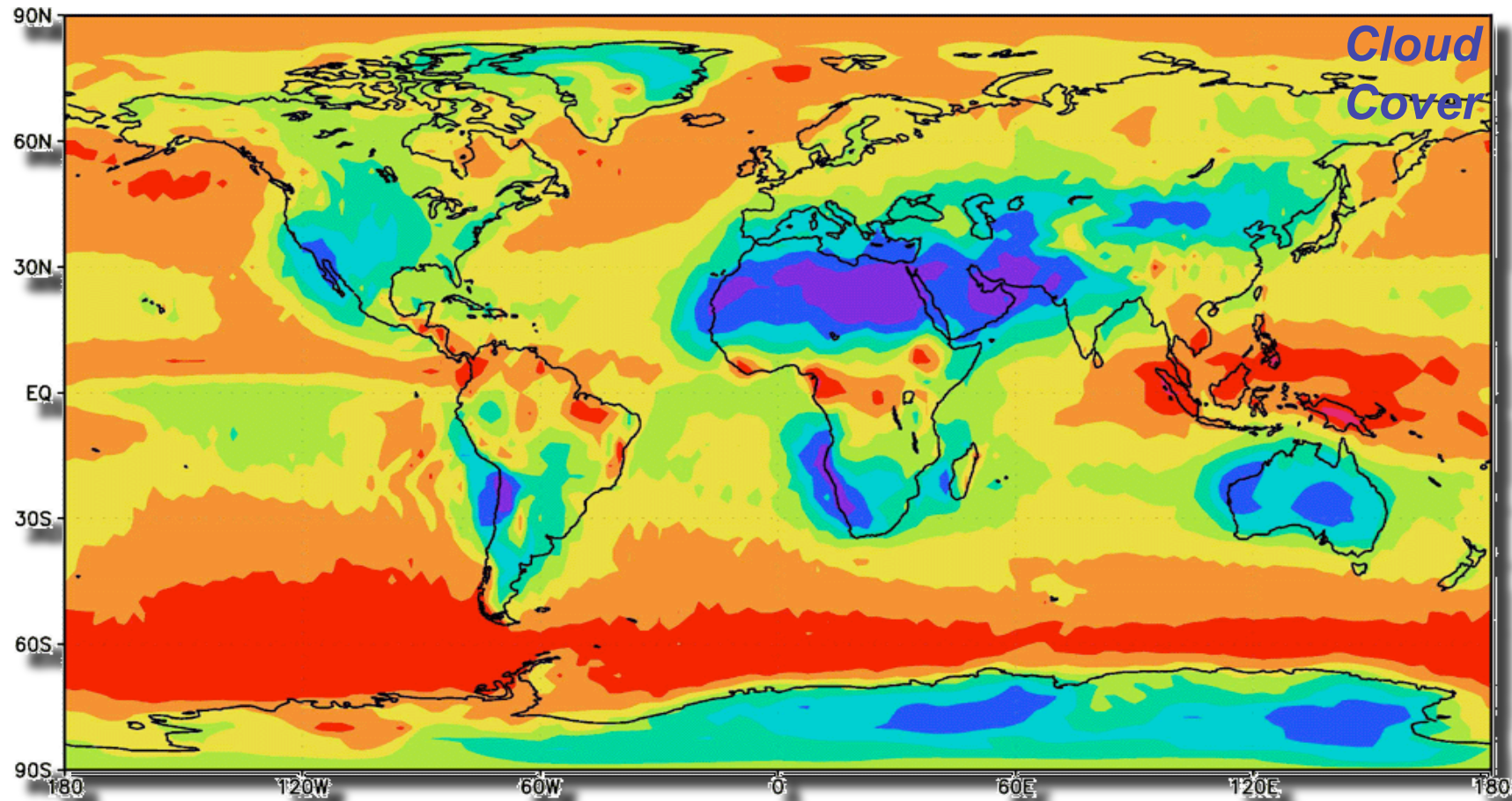


European Southern Observatory

- ESO (the **E**uropean **S**outhern **O**bservatory) is the intergovernmental European Organisation for Astronomical Research in the Southern Hemisphere.
- On behalf of its **fourteen** member states ESO operates a suite of the world's most advanced ground-based astronomical telescopes located at the **La Silla Paranal Observatory** in the Atacama desert in Chile.
- The ESO Headquarters are situated in Garching near Munich, Germany.



European Southern Observatory



GrADS: COLA/IGES

2002-05-13-12:18

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Lisbon, September 7, 2010

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ESO Sites in Chile



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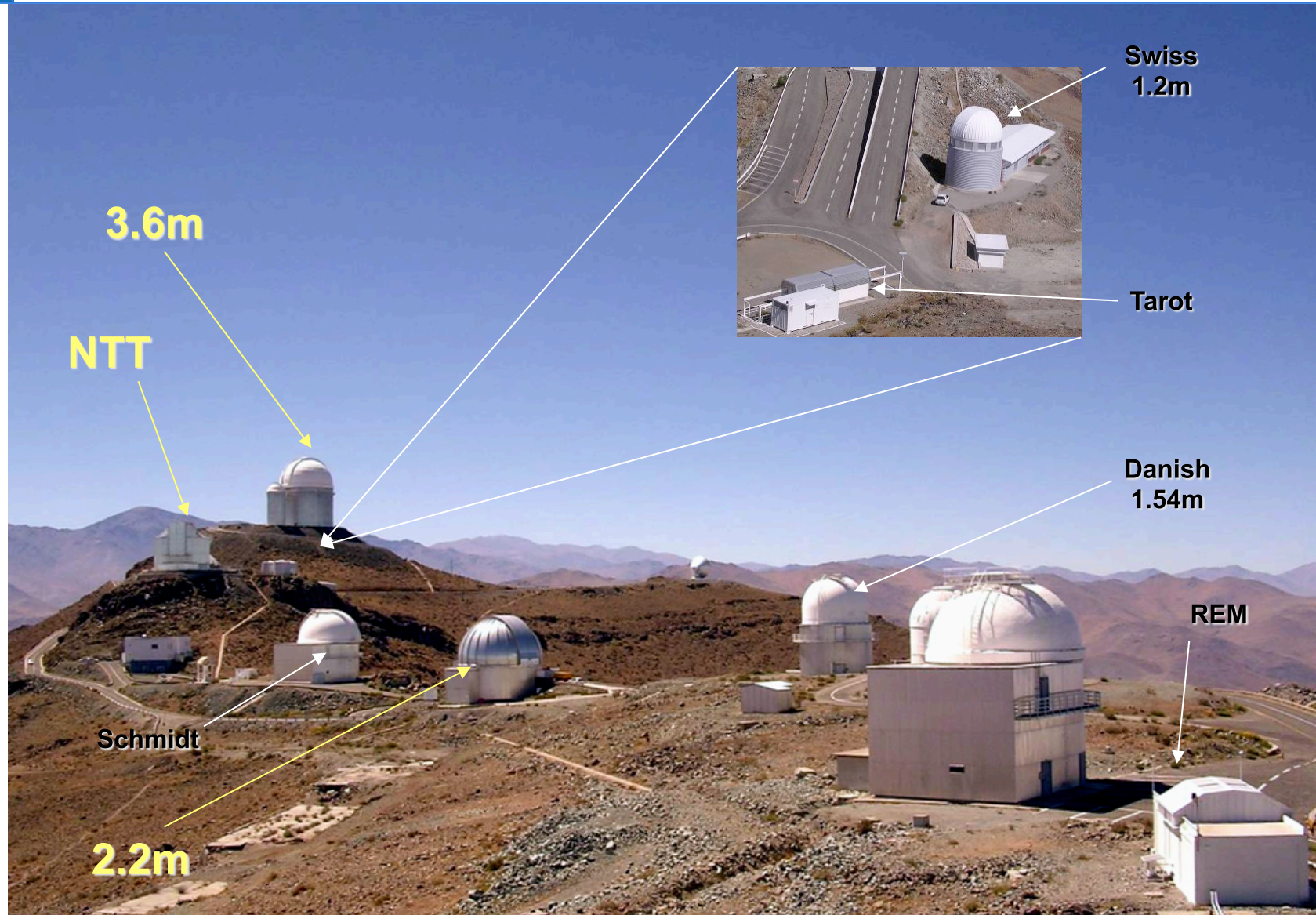


La Silla Paranal Observatory

- The **La Silla Paranal Observatory** is from the organizational and managerial point of view **one Observatory with three sites**:
 - La Silla Observatory (3.6, NTT, 2.2, National)
 - Paranal Observatory (VLT, VLTi, VST, VISTA)
 - Atacama Pathfinder Experiment (APEX) telescope
- The **E-ELT** will become part of the La Silla Paranal Observatory through the extension of the Paranal site to include Cerro Armazones.



La Silla Observatory



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La Silla: **6** Operational Instruments

3.6m



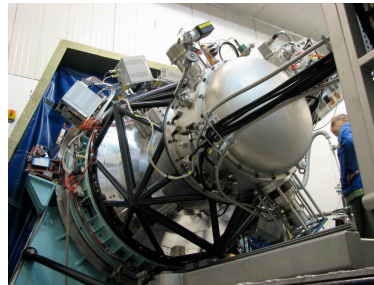
HARPS



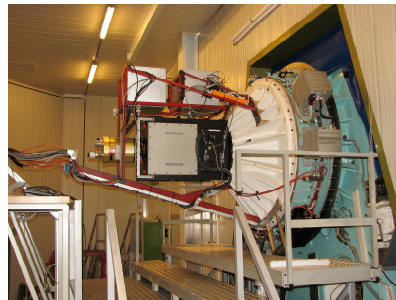
NTT



SOFI



EFOSC2

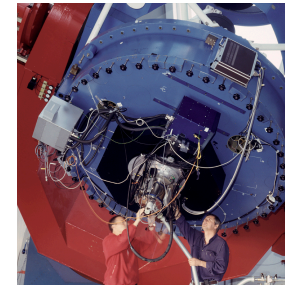


**VISITOR
Instruments**

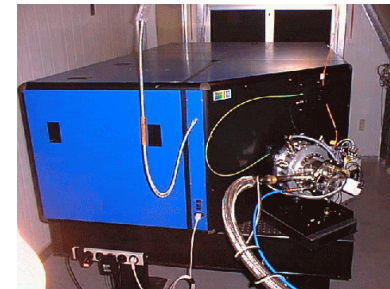
2.2m



WFI



FEROS



GROND



La Silla Observatory

- Currently Operated by ESO in La Silla:
 - NTT: EFOSC2, SOFI, Visitor Instruments
 - 3.6m: HARPS, Visitor Instruments
 - 2.2m (under agreement with MPIA Heidelberg):
WFI, FEROS, GROND (support)



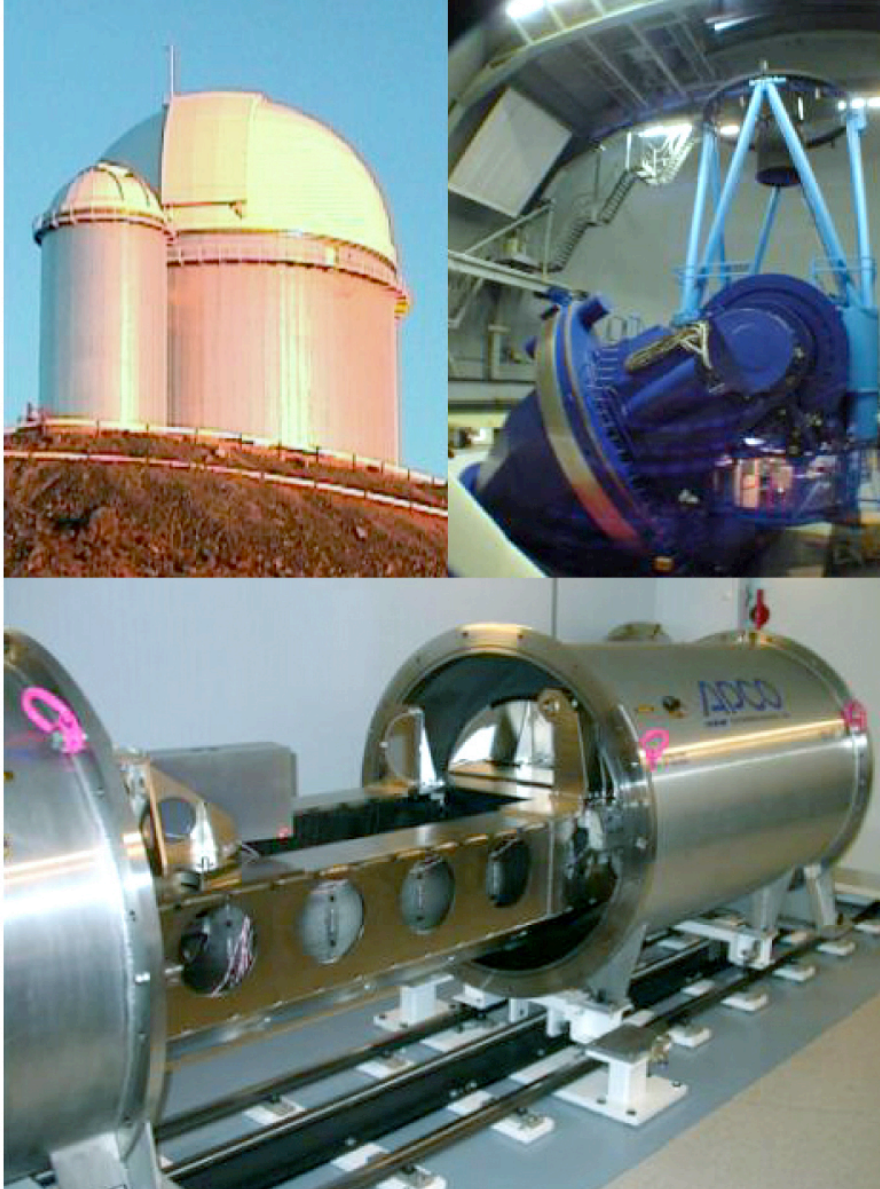
La Silla Observatory

■ Currently Supported Member State Telescopes:

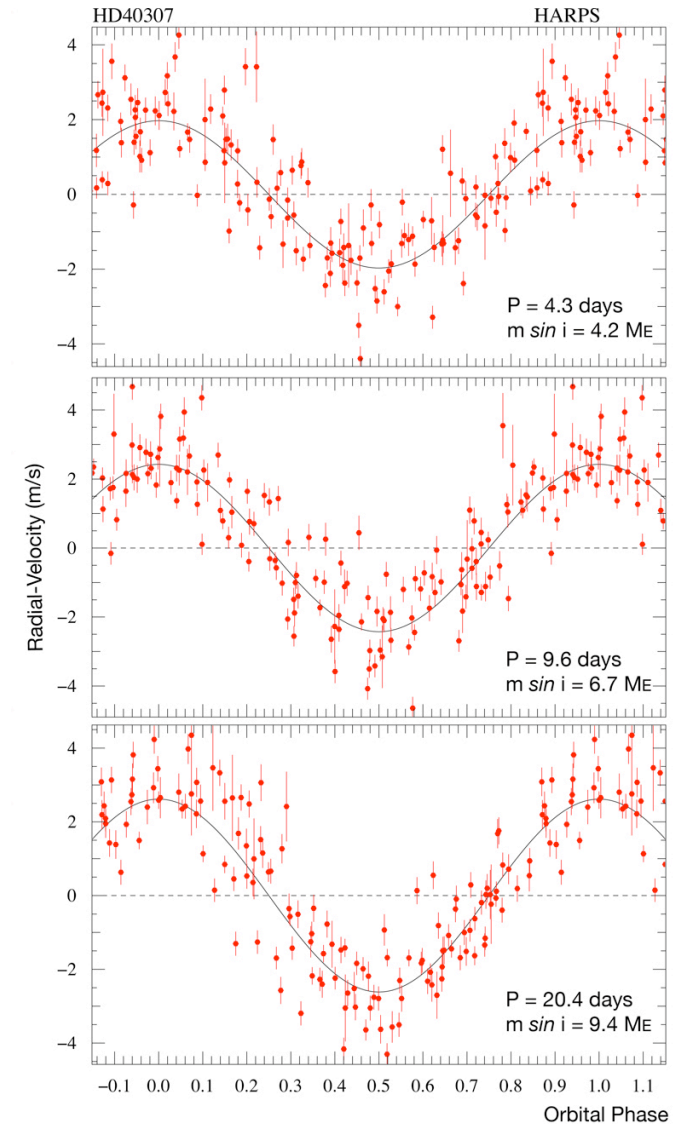
- Schmidt (Quest Camera)
- Danish 1.54m (Copenhagen University)
- TAROT (France)
- REM (Italy)
- SWISS 1.2m Euler (Geneva Observatory)
- TRAPPIST (Belgium – Swiss)



HARPS @ 3.6m : the planet hunter

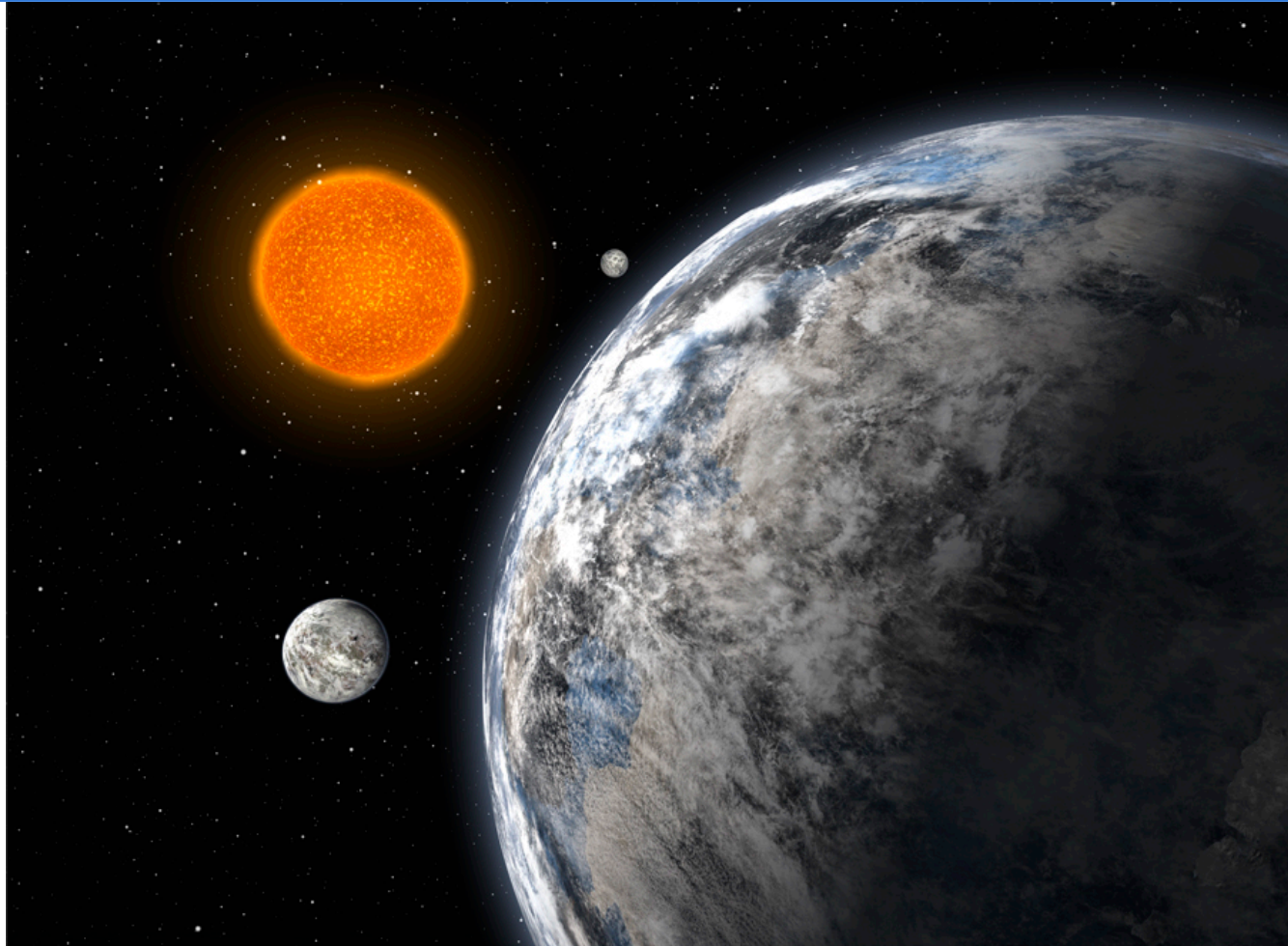


Lisbon, September 7, 2010



Measurements of HD 40307
(HARPS/3.6-m)

HARPS @ 3.6m : the planet hunter



A Trio of Super-Earths
(Artist's Impression)

ESO Press Photo 19a/08 (16 June 2008)

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20 years Cerro Paranal



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Cerro Paranal today



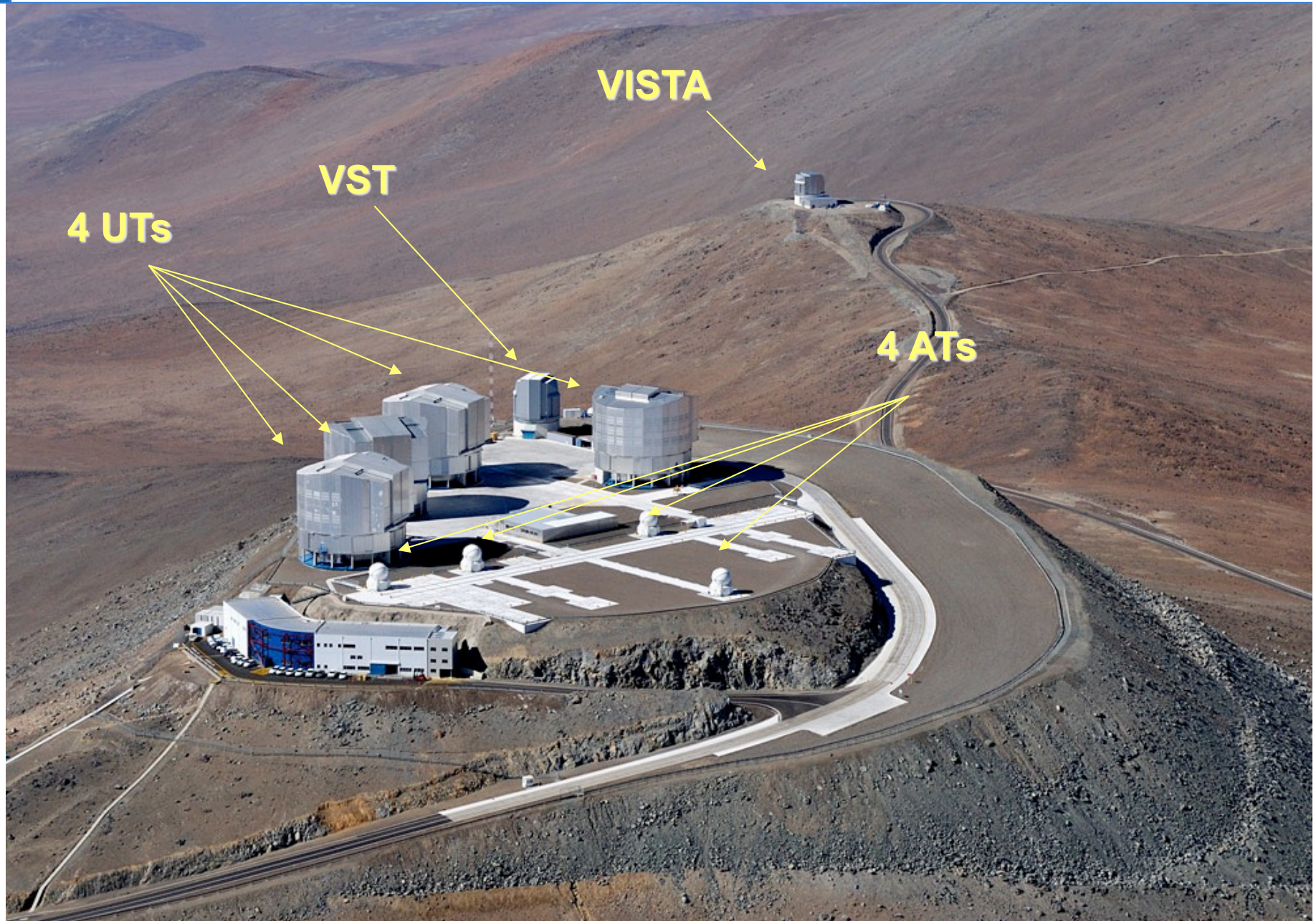
A.Kaufer, JENAM 2010, SPS1
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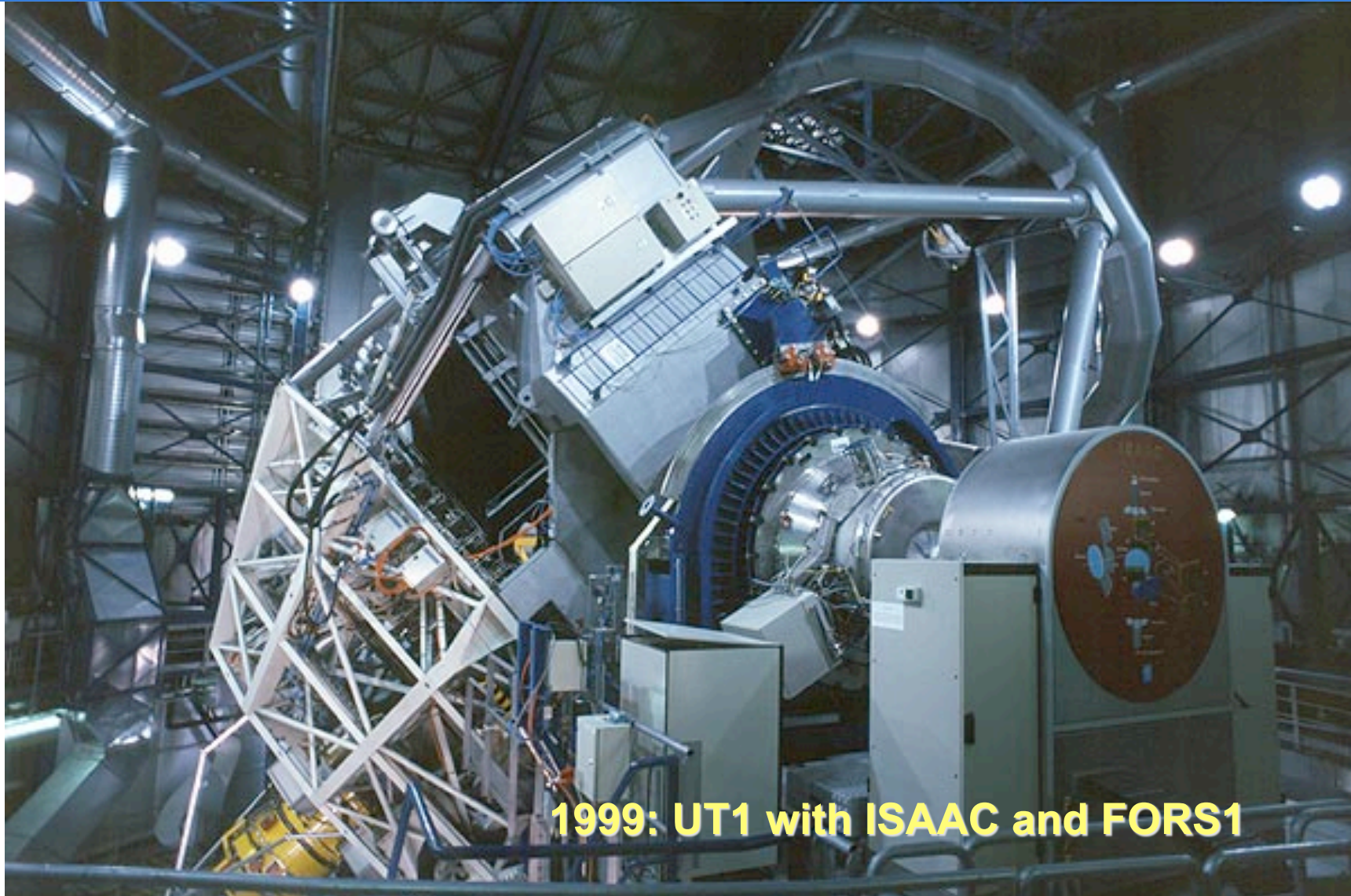




Very Large Telescope Paranal



Very Large Telescope Paranal

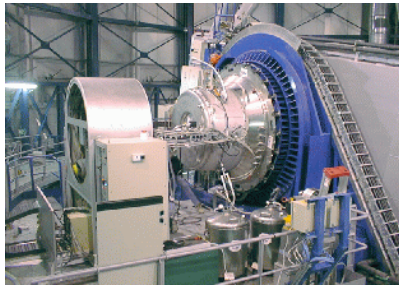


1999: UT1 with ISAAC and FORS1



Very Large Telescope Paranal

13 instruments in operations



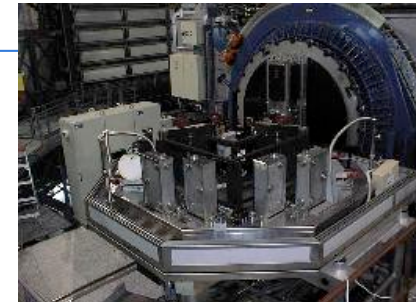
ISAAC



FORS



CRIRES



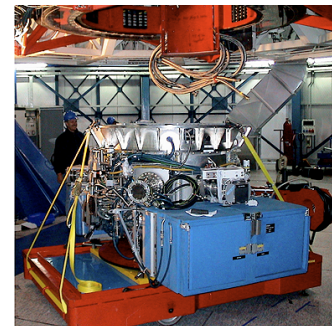
UVES



FLAMES



VIMOS



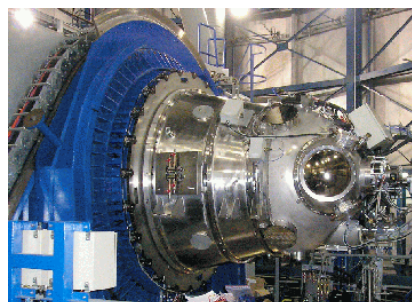
VISIR



SINFONI



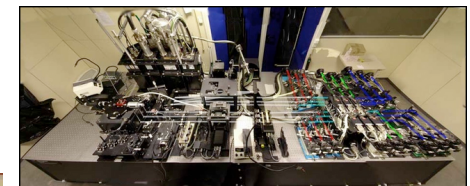
NACO



HAWKI



MIDI



AMBER

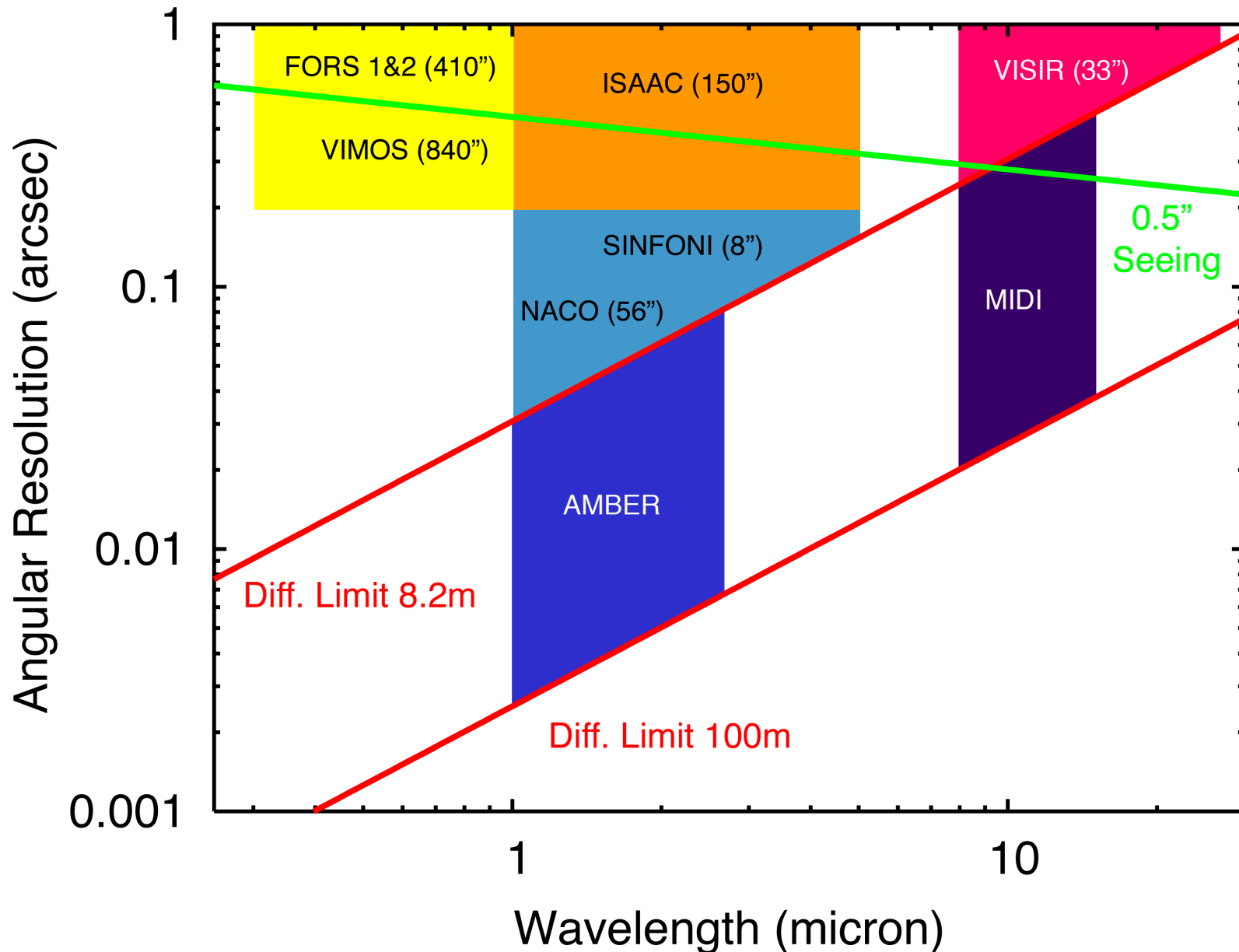
A.Kaufer, JENAM 2010, SPS1
Lisbon, September 7, 2010

XSHOOTER

European South

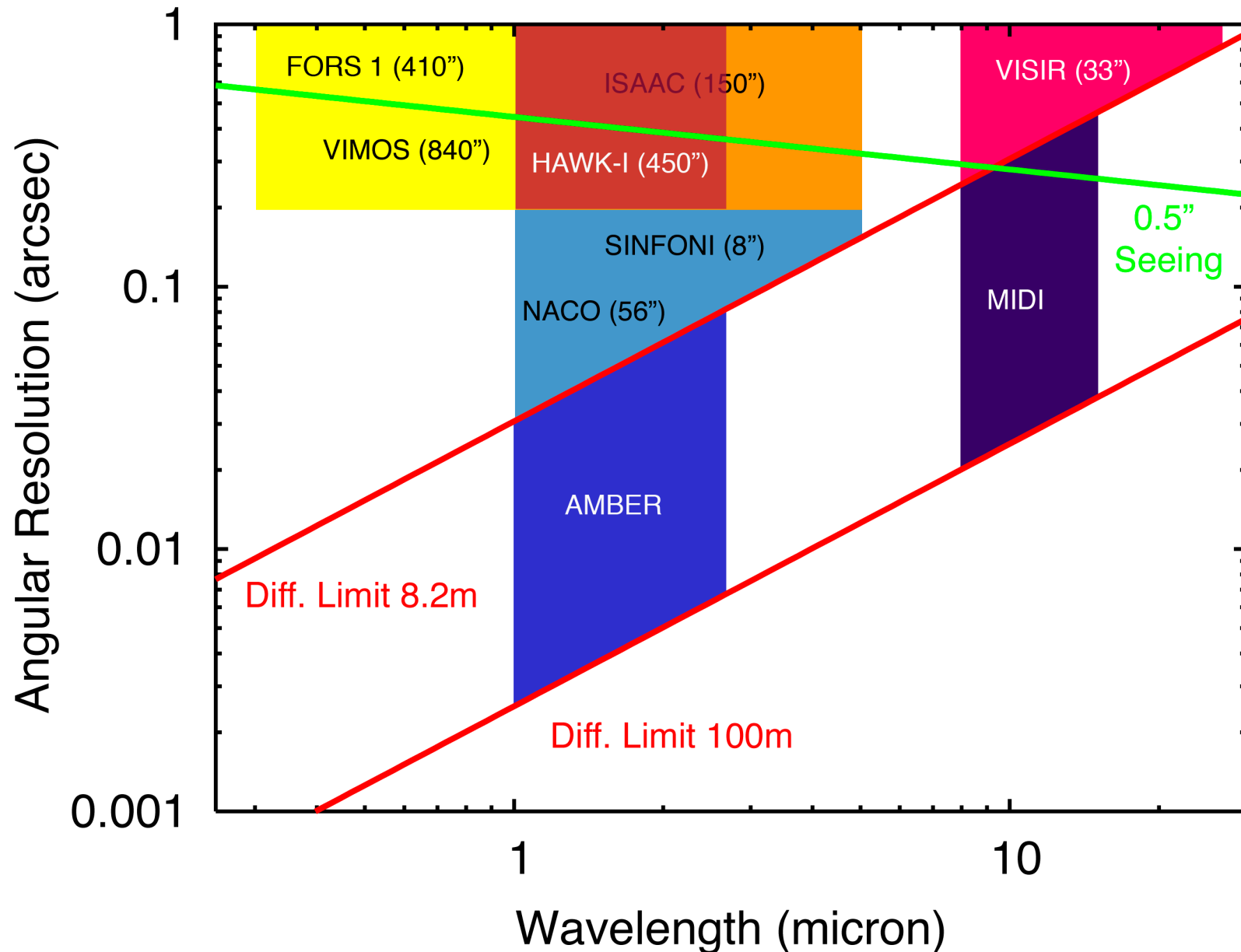


Operational VLT(I) Instruments 2008





Operational VLT(I) Instruments 2010



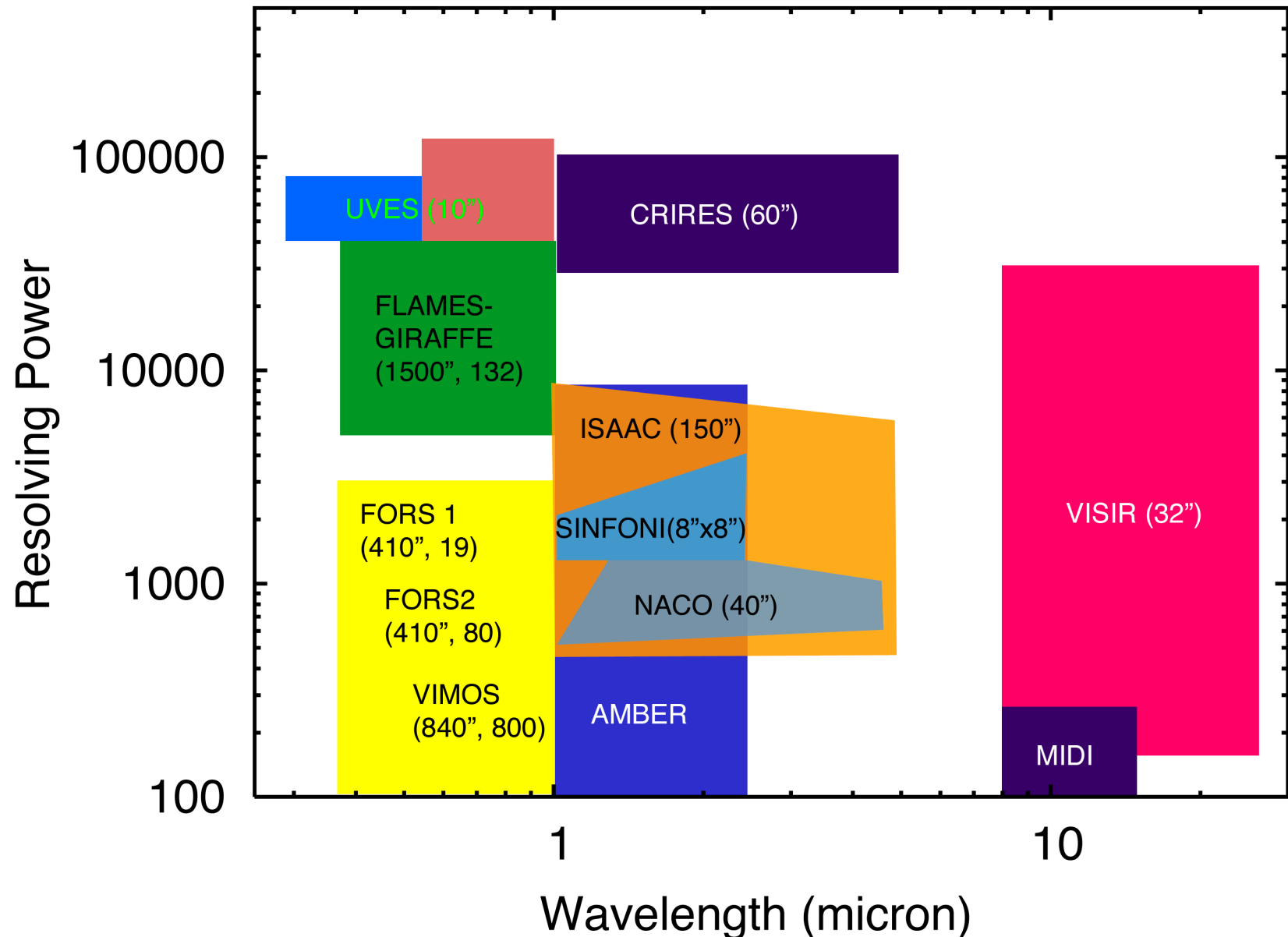
Instruments with AO

- 5 instruments are supported by adaptive optics to work (close to) the diffraction limit:
 - NACO (optional w/ LGS)
 - SINFONI (optional w/ LGS)
 - CRIRES
 - MIDI
 - AMBER

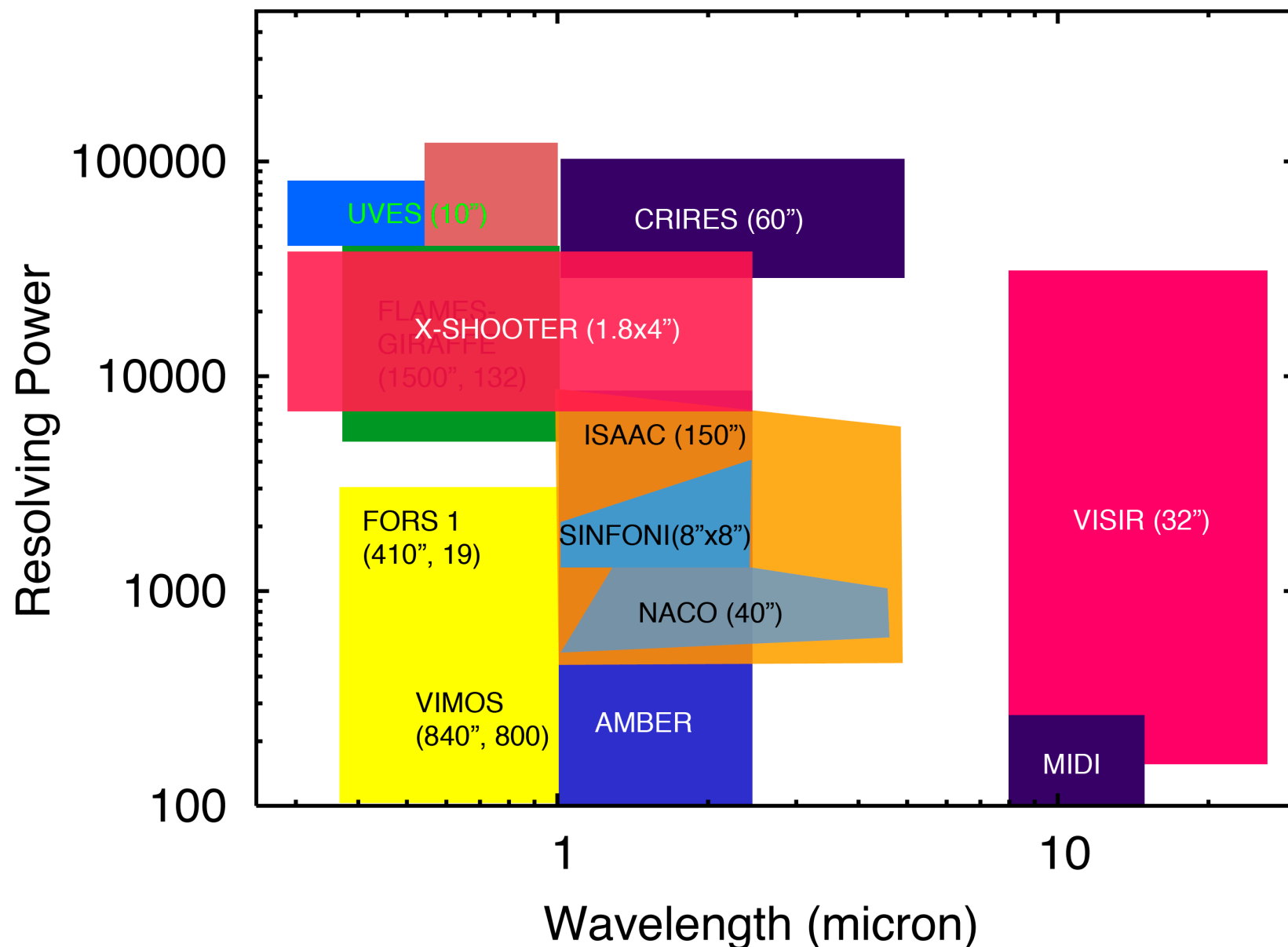




Operational VLT(I) Instruments 2008



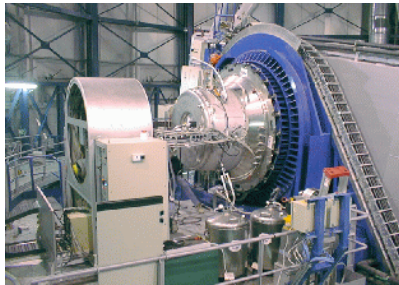
Operational VLT(I) Instruments 2010





Very Large Telescope Paranal

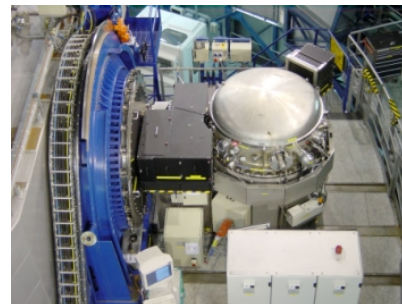
13 instruments in operations



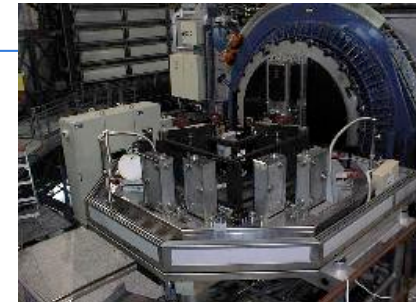
ISAAC



FORS



CRIRCS



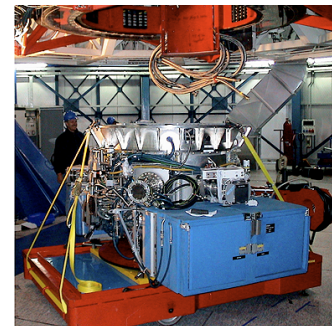
UVES



FLAMES



VIMOS



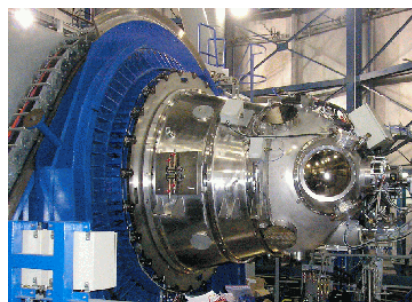
VISIR



SINFONI



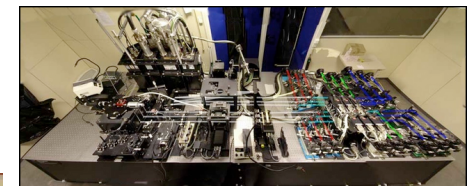
NACO



HAWKI



MIDI



AMBER

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XSHOOTER

European South

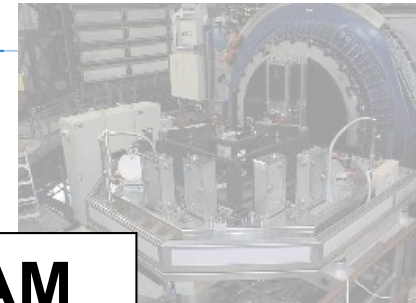




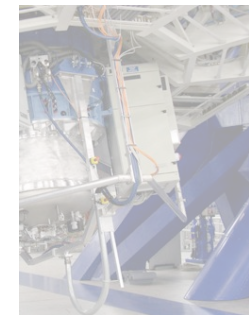
Very Large Telescope Paranal

13 instruments in operations

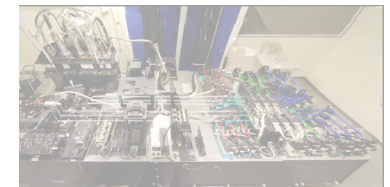
Since December 2009: VISTA/VIRCAM



UVES



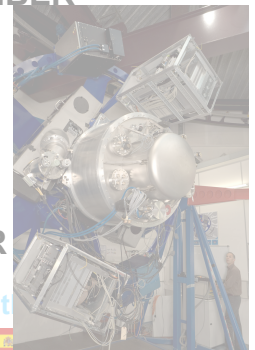
SINFONI



AMBER

VIRCAM

MOOTER



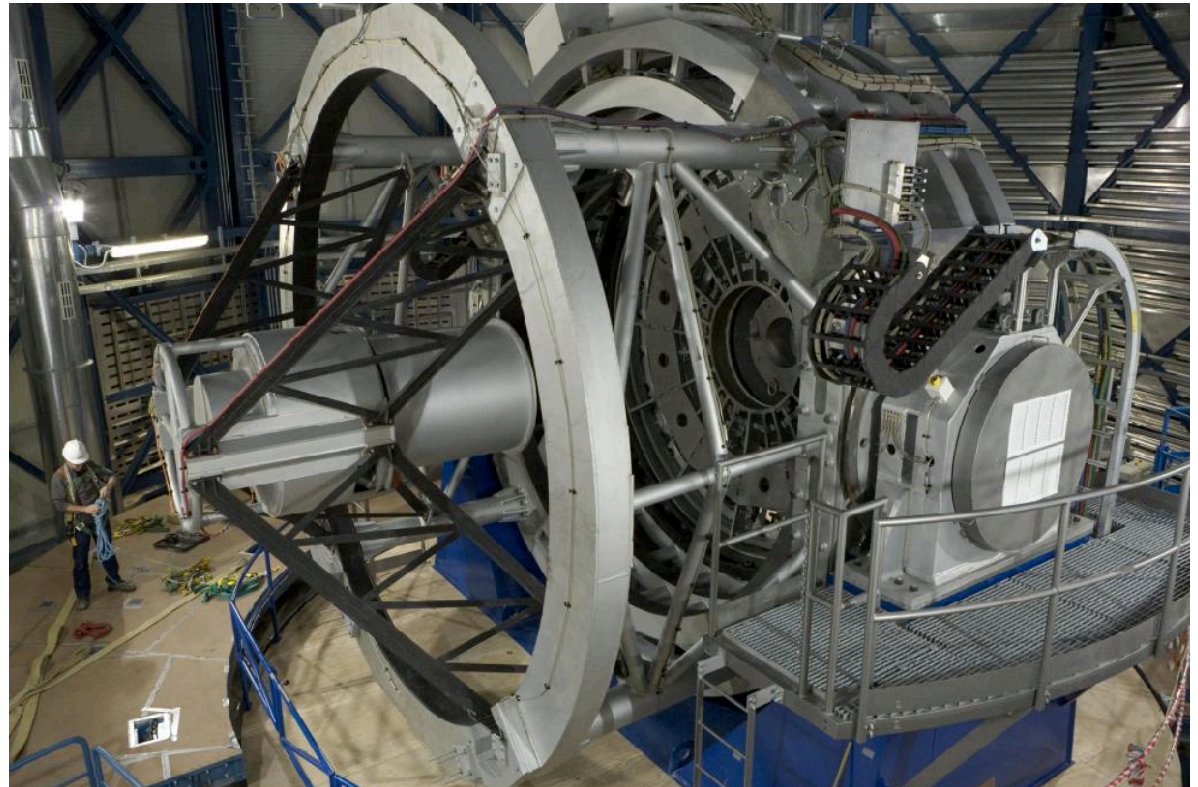


Survey Telescopes- VST/VISTA



VST 2.4m optical surveys in 2011

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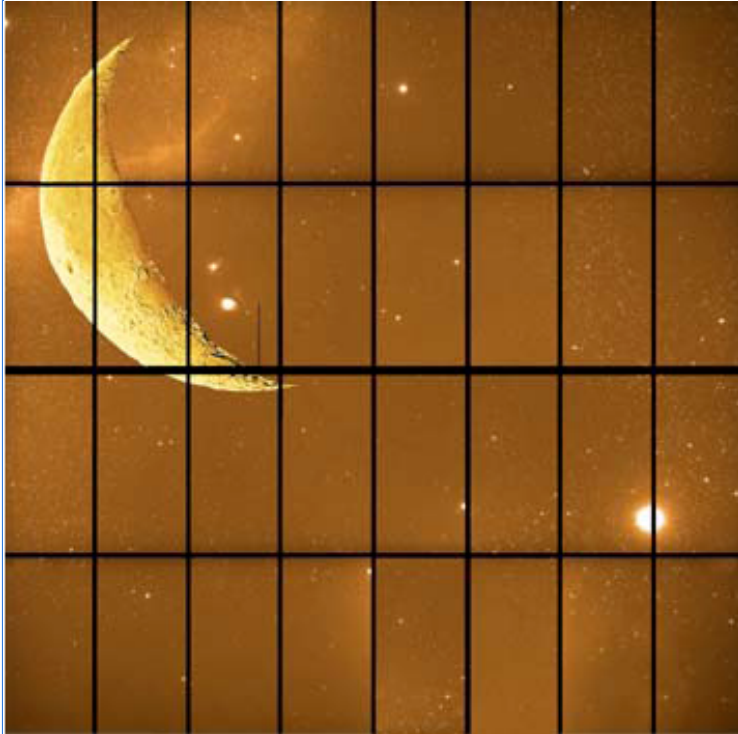


VISTA 4m IR surveys –
since end of 2009

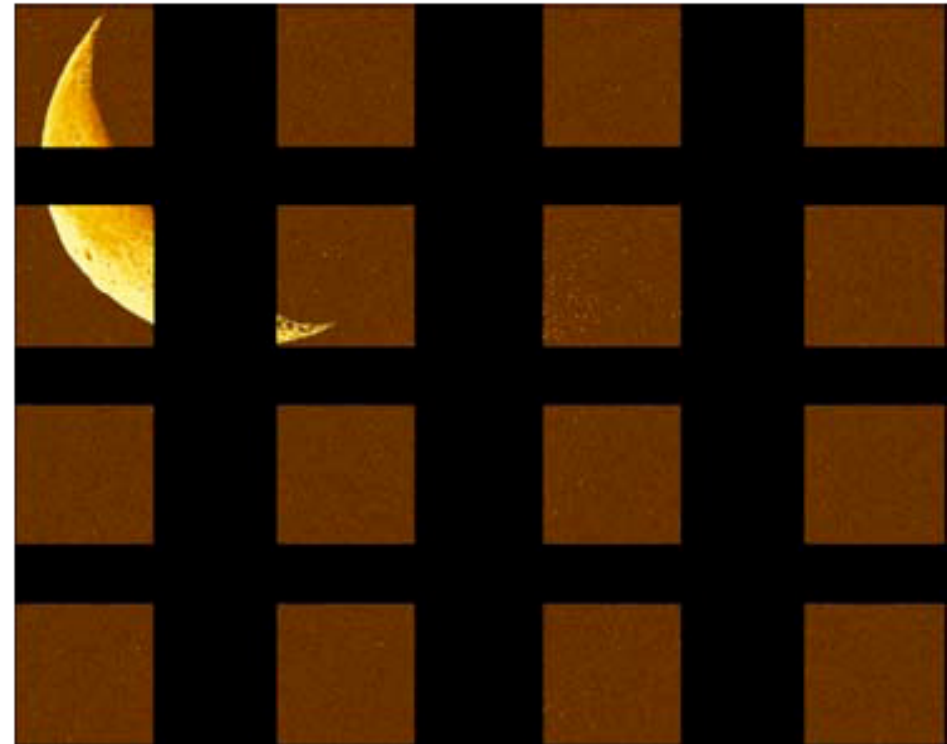
European Southern Observatory



Imaging – VST/VISTA



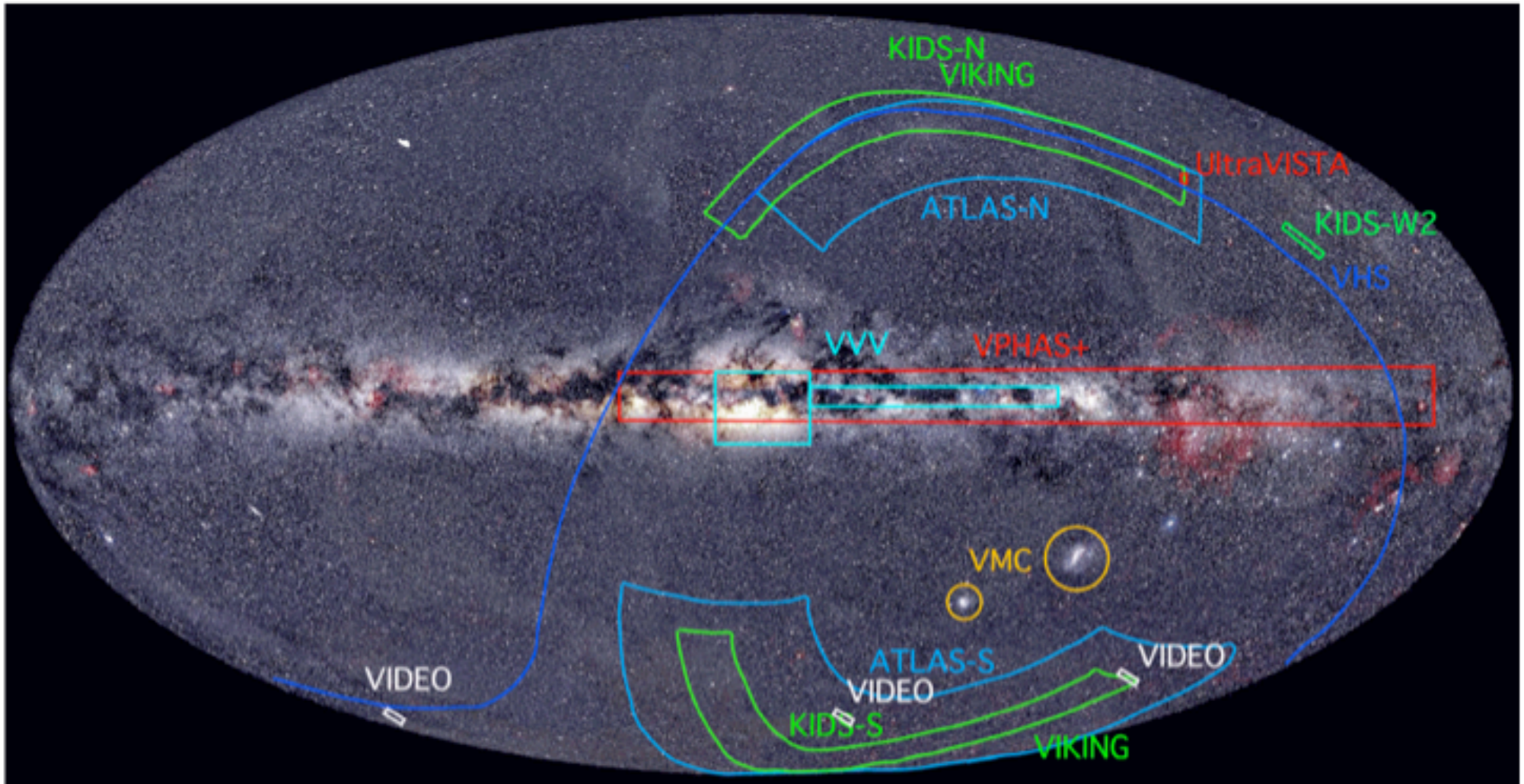
OmegaCam
32 2kx4k CCDs
u',g',r',i',z',
H α ,B,V



VIRCAM
16 2kx2k IR detectors
Z,Y,J,H,K

Survey Operations

■ ESO Public Surveys (VISTA & VST)

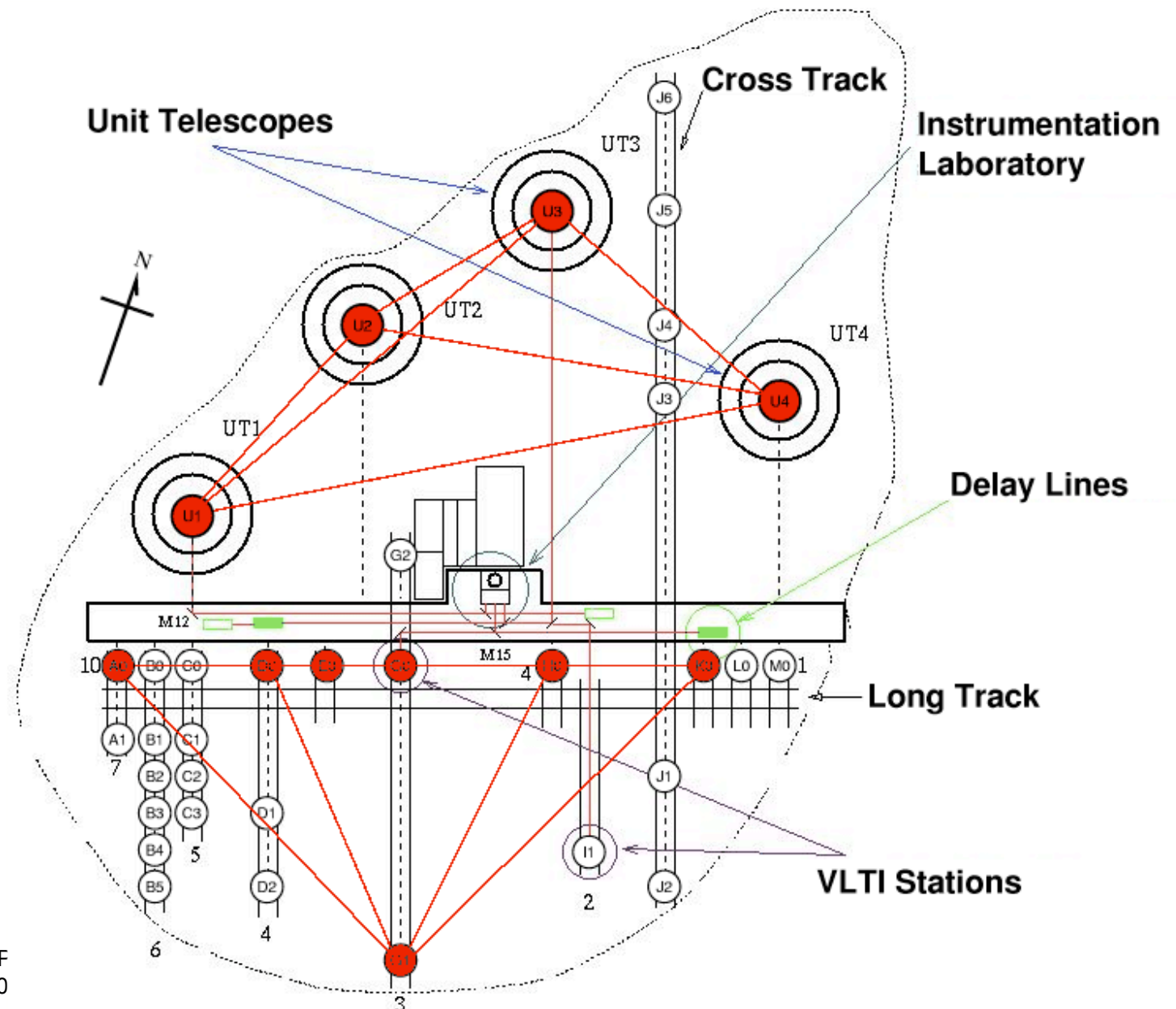




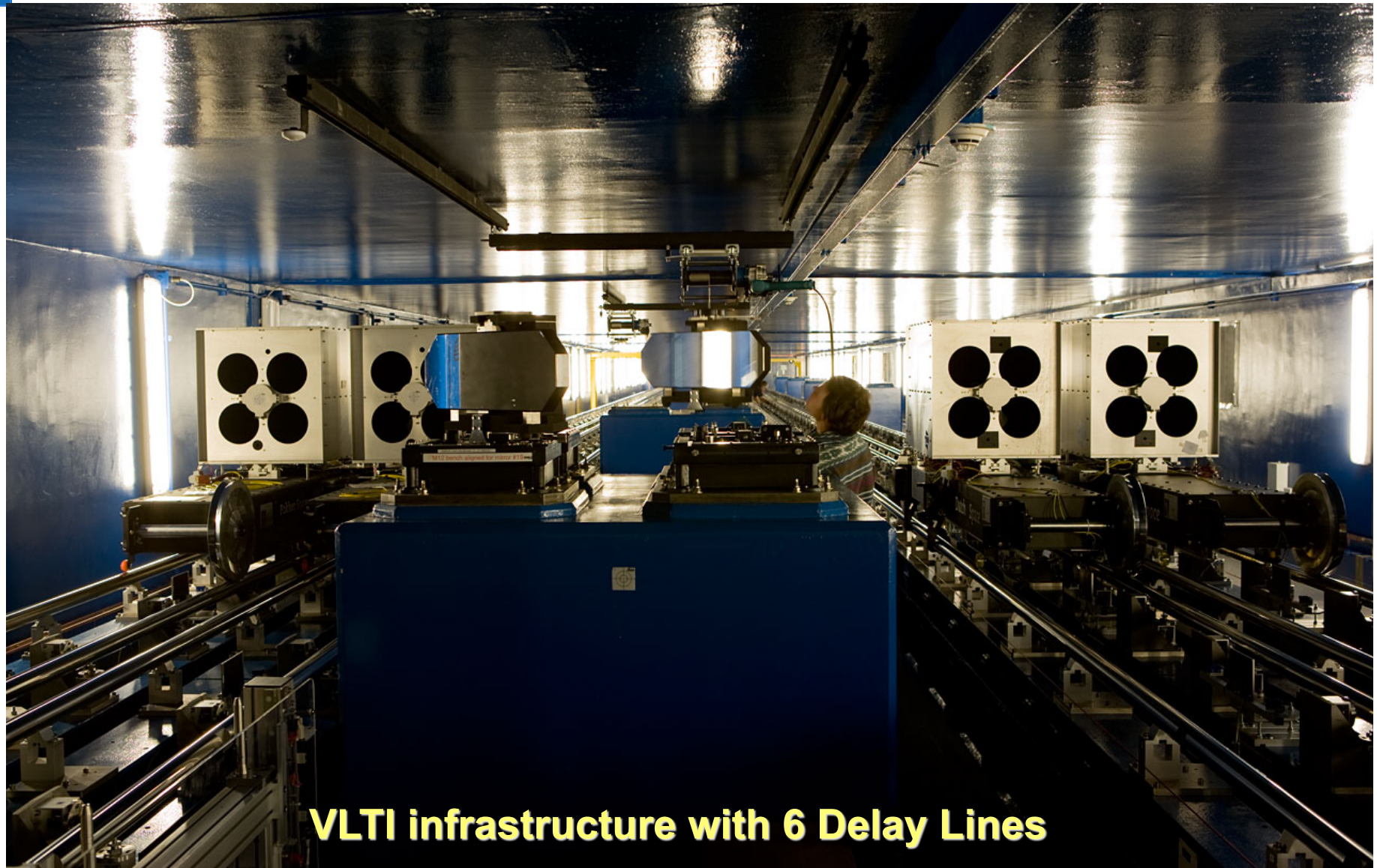
VLTI Infrastructure

- 4 relocatable 1.8-m Ats
- 4 8.2-m UTs with MACAO Coude AO systems
- 6 Delay Lines
- 1 Fringe Tracker (FINITO, max 3 beams)
- 2 Science Instruments
 - MIDI, N 2-beam combiner
 - AMBER, JHK 3-beam combiner
- PRIMA Astrometric Facility ongoing AIV+Comm

VLT Infrastructure



VLTI Infrastructure

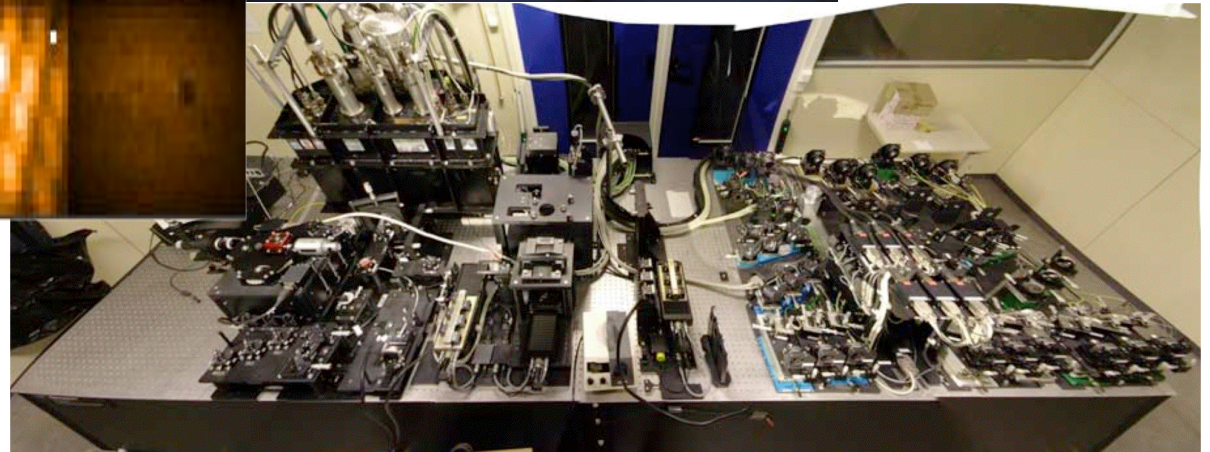
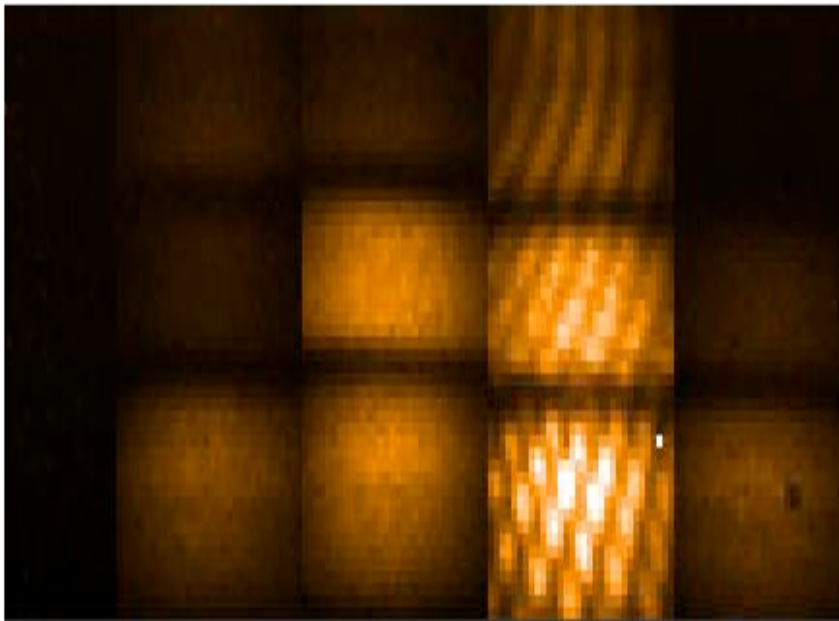


VLTI infrastructure with 6 Delay Lines



VLTI Infrastructure

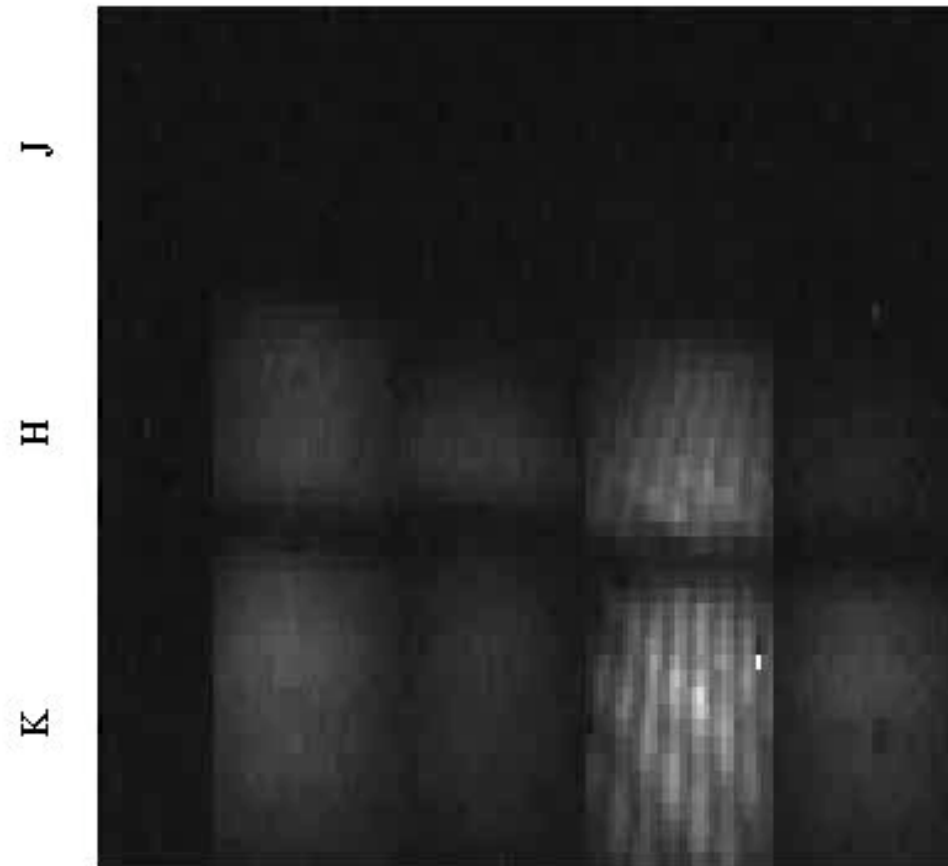
AMBER (JHK) is in Science Operations with FINITO with 3 UTs or 3 ATs using Manhattan2 and VTK vibration compensation systems.



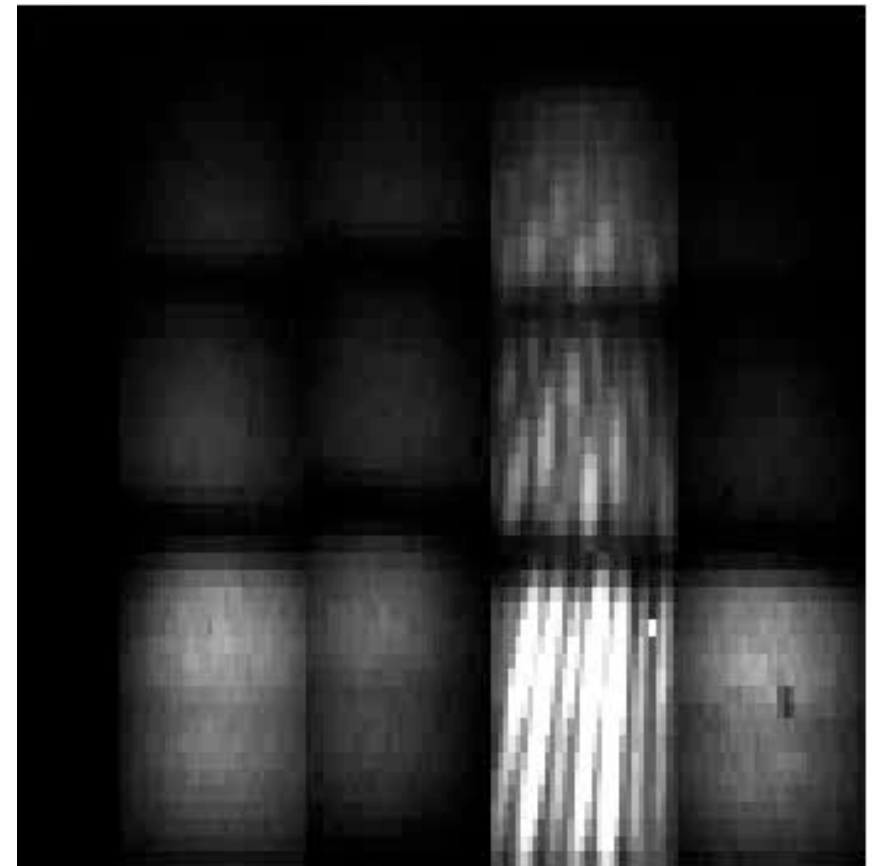


VLTI Infrastructure

Amber 3T JHK LowResolution Fringes !



Amber 3T JHK LowResolution Fringes !



Beam1 Beam2 Fringes Beam3

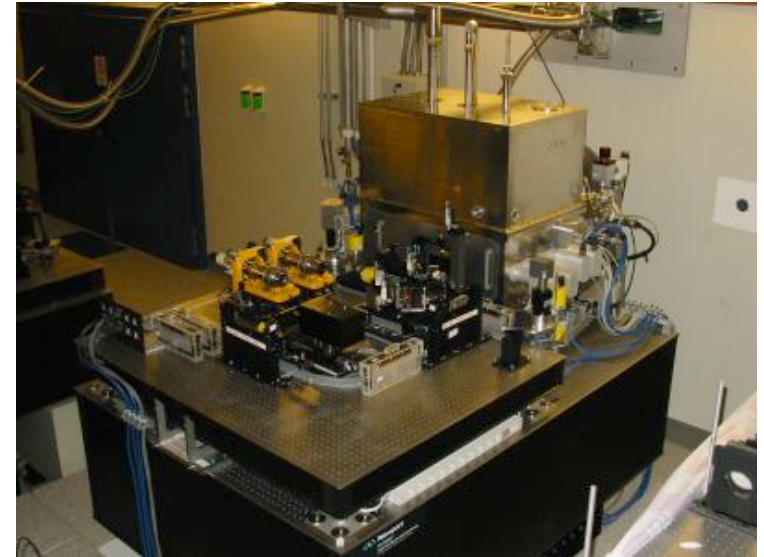
Beam1 Beam2 Fringes Beam3



VLT Infrastructure

■ MIDI

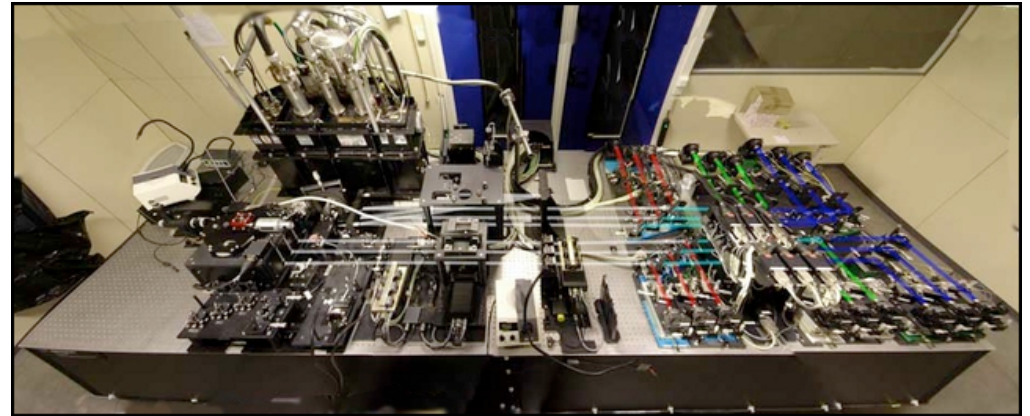
- MIDI is the mid-infrared (N-band = 8 to 13 μm) instrument of the VLT interferometer.
- It combines two beams (either from the 8.2-m Unit Telescopes or from the 1.8-m Auxiliary Telescopes) to provide visibility moduli in the (u,v) plane.
- MIDI features spectroscopic optics to provide visibilities at different wavelengths within the N-band.



VLT Infrastructure

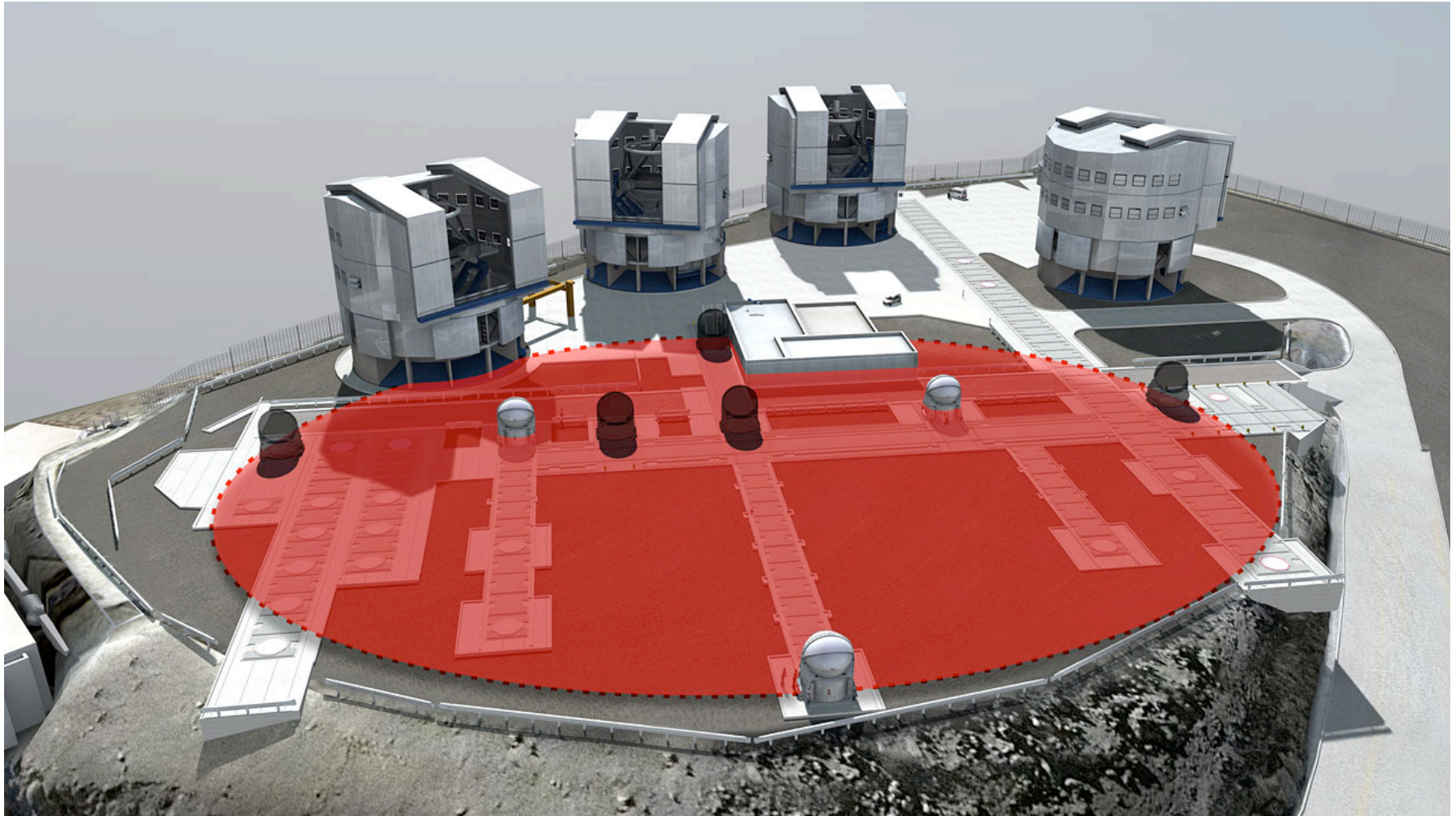
■ AMBER

- AMBER, the near-infrared/red focal instrument of the VLT, operates in the bands J, H, and, K (1.0 to 2.4 μm)
- The instrument has been designed to be used with two or three beams, allowing to measure the closure phase.
- AMBER is able to resolve features between 2mas (milli-arcsecond) and 50mas with the UTs, and between 2mas and 140mas with the ATs.



VLTI: the Sharpest Views

VLTI allows for the first time to 'image' stars

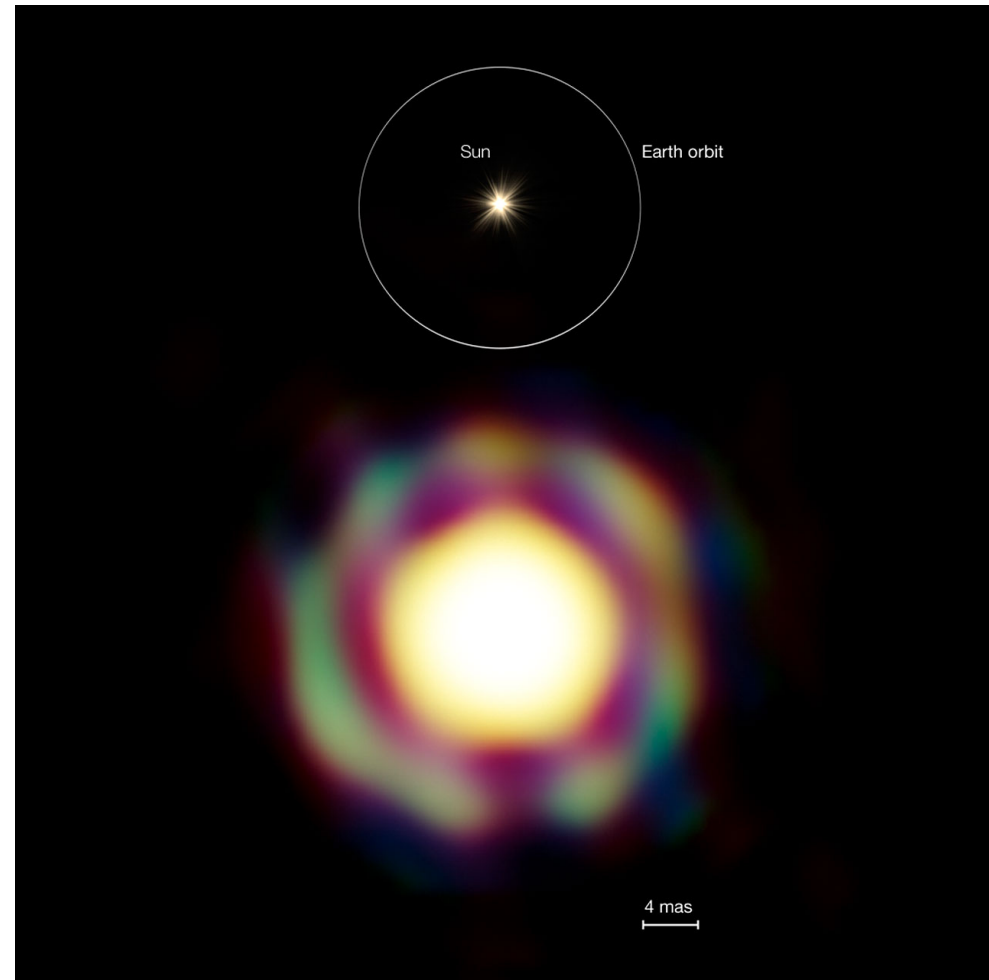


VLTI: the Sharpest Views

VLTI allows for the first time to 'image' stars

Comparison between the VLTI image of the Mira-like star T Leporis and the size of the orbit of the Earth around the Sun.

The VLTI observations reveal the presence of a spherical molecular shell surrounding the star, which is about 100 times as large as the Sun.





The VLT/I Future (~2015)

- VLT/PRIMA
- Survey Telescopes:
 - VISTA (operating since end of 2009)
 - VST (operation expected in 2011)
- 2nd Generation VLT Instruments:
 - X-Shooter (operating since 2009)
 - KMOS
 - MUSE
 - SPHERE
 - ESPRESSO
- 2nd Generation VLT/I instruments
 - MATISSE
 - GRAVITY



10+ years of VLT

The First VLT UT1 Call for Proposals

Period 63



European Southern Observatory 1998



ESO Call for Proposals – P83

Proposal Deadline: 1 October 2008, 12:00 noon CEST



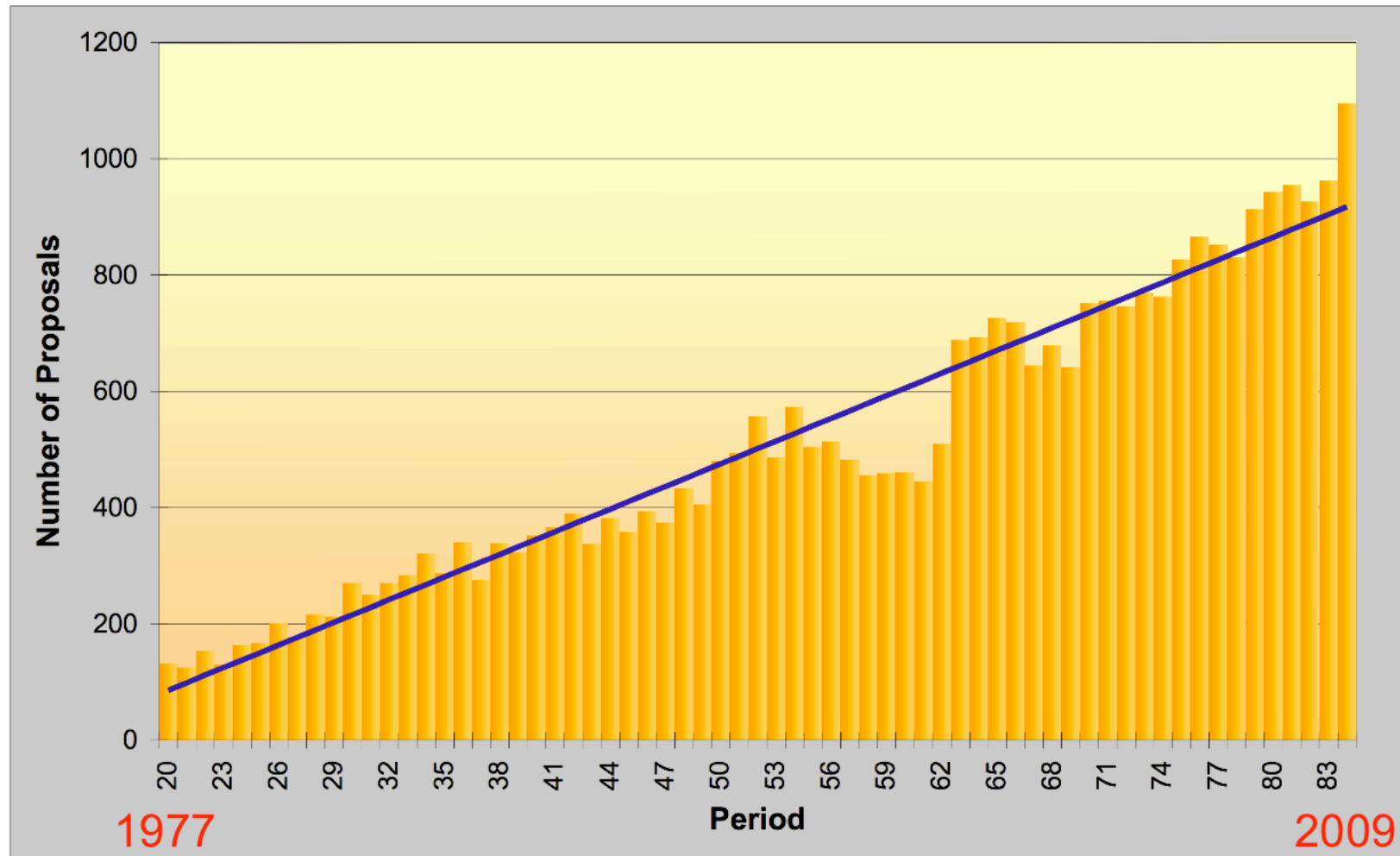
10+ years of VLT Operations

■ After 10 years:

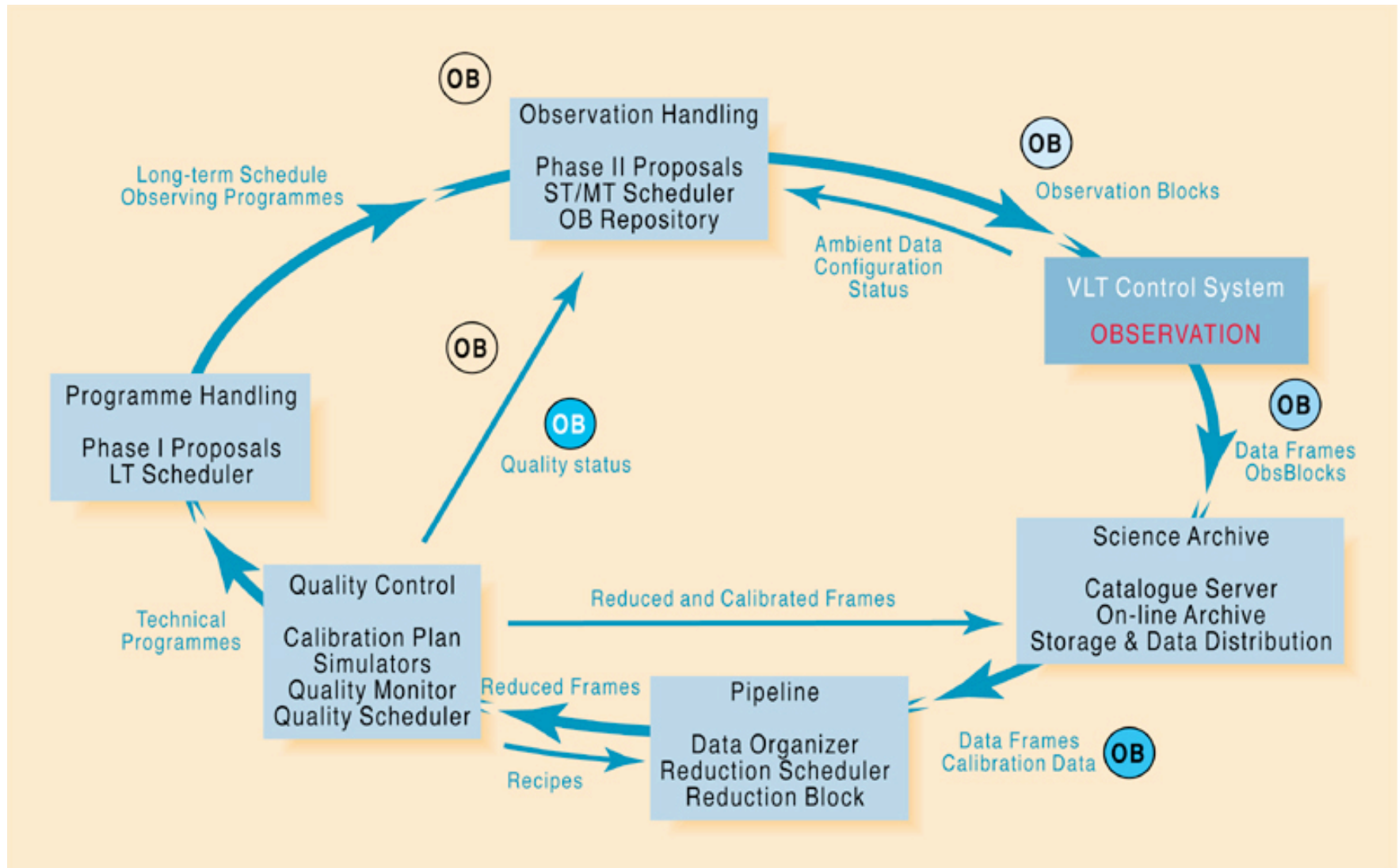
- 4 VLT Unit Telescopes
- 4 Auxiliary Telescopes and VLTi facility
- 13 science instruments, including 2 VLTi instruments
- ~1000 proposals per semester (6 months)
- Service Mode / Visitor Mode pressure ratio ~3:1
- Operations in Service Mode ~60% of the time
- ~500 VLT/VLTi runs supported per semester
- ~3500 Observing Blocks successfully executed per semester, ~2000 hours of execution time (not including calibrations)
- Archive holds ~200TB of raw data (~14 million frames)



ESO Observing Proposals



VLT Science Operations Model

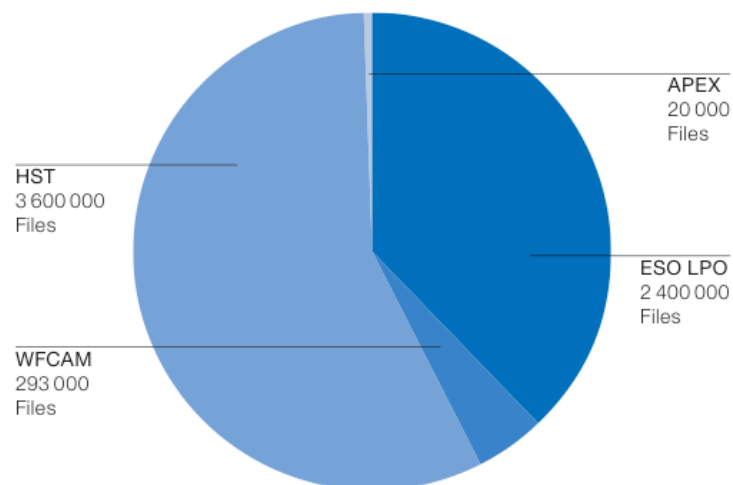
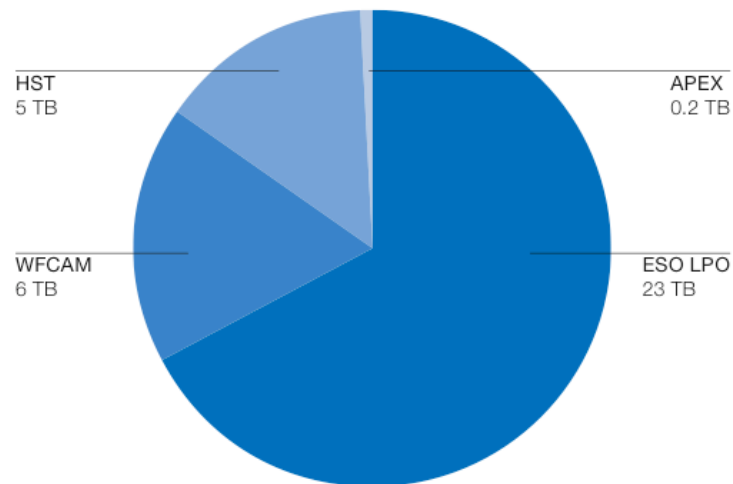


PR June 1999

[illegible]

ESO Science Archive

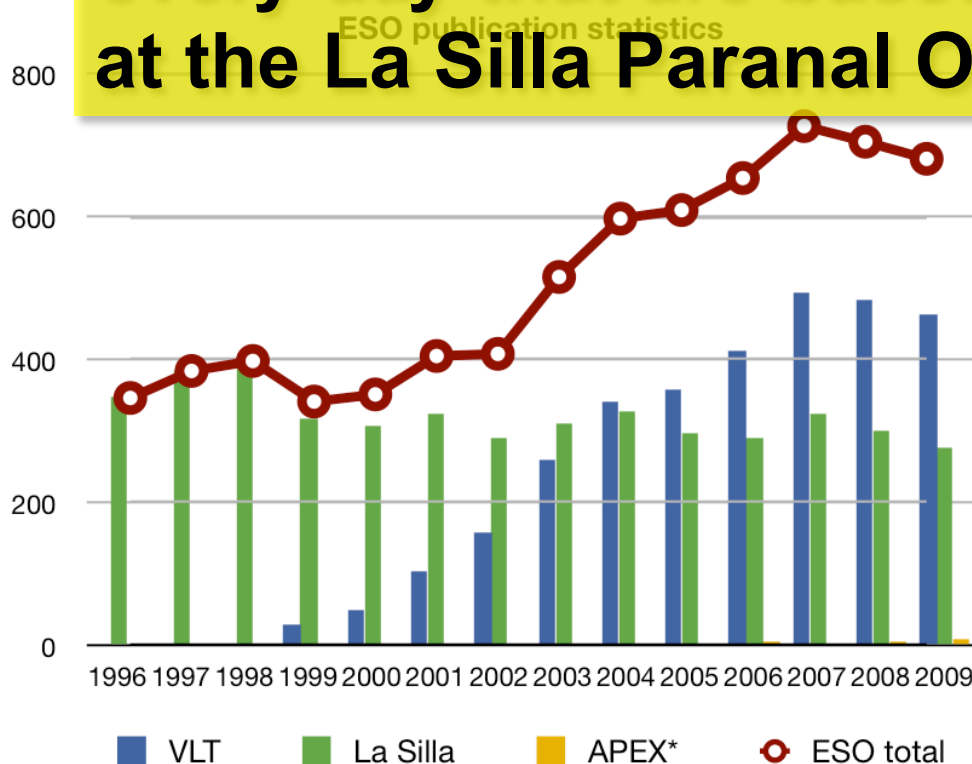
Raw Data Volume (size/files) ingested in 2009





Publication Statistics

2 refereed scientific papers are published every day that are based on data produced at the La Silla Paranal Observatory.



Publications by observing site

	VLT	La Silla	APEX*	ESO total
1996		348		348
1997		386		386
1998		400		400
1999	29	319		343
2000	52	310		353
2001	105	324		407
2002	159	290		410
2003	260	312		518
2004	341	329		600
2005	360	298		612
2006	412	292	6	657
2007	494	327	1	730
2008	484	302	7	708
2009	466	277	11	684

* APEX: includes only papers that use ESO data

3162 publications based on VLT from 1999-2009



Bar chart showing the number of nights for different telescope activities across various telescopes. The Y-axis is 'Nights' (0.0 to 180.0). The X-axis lists telescopes: UT1, UT2, UT3, UT4, VLT1, 3.6m, NTT, 2.2m, and APEX. The legend includes: Science time (blue), Engineering time (maroon), Commissioning time (yellow), Technical Downtime (orange), and Weather Downtime (purple).

Telescope	Science time	Engineering time	Commissioning time	Technical Downtime	Weather Downtime
UT1	175	7	3	5	10
UT2	168	17	2	6	9
UT3	174	11	2	8	11
UT4	173	8	5	7	10
VLT1	101	45	30	8	9
3.6m	165	17	4	9	9
NTT	174	11	2	3	12
2.2m	181	4	2	3	10
APEX	87	99	11	4	5



Operations Statistics

■ Period 84 Operations Statistics in numbers

- 685 nights of UT observations
 - 4.9% weather losses
 - 3.0% technical downtime at Uts
 - 1 week for UT2 M1/M3 coatings
- 99 nights with VLTi on UTs and ATs
 - 6.6% technical down with VLTi
 - 28 nights commissioning of PRIMA with ATs
- 517 nights of La Silla operations
 - 2.1% technical downtime (mostly due to faulty LCU in 3.6m)
 - 5.1% weather downtime
- 85 day+nights of APEX operations (no ops Jan-Mar)
 - 2.8% technical downtime
 - 3.7% weather downtime



Paranal Maintenance

■ Objectives:

- Operation of the Paranal Warehouse
 - Reception of goods (observatory-wide)
 - Stocking of consumables
 - Transport dispatch
- Inspection of the UTs (Enclosure, M1 cell, hydraulic bearing system)
- General **preventive** maintenance of installations
- Execution of delegated tasks from Engineering
 - Delay line adjustments on VLTi
 - Liquid Nitrogen distribution
 - VIMOS/FORS2 mask manufacturing
- Participate with Engineering in corrective maintenance



Paranal Maintenance

■ VLT maintenance scheme

- First adaptation of industrial maintenance processes to an astronomical observatory

■ Methodology:

- CMMS based
- Focus on preventive maintenance
- Work-order system
- Data gathering via inspections, monitoring and logging
- Application of reliability analysis
- Continuous training and learning



Paranal Maintenance

■ Metrics:

- Key Performance Indicators (KPI)
- Vibration analysis
- Hydraulic and lubrication oil analysis
- Cooling liquid sample analysis
- Thermal imaging
- ...

■ Reliability Centred Maintenance (RCM)

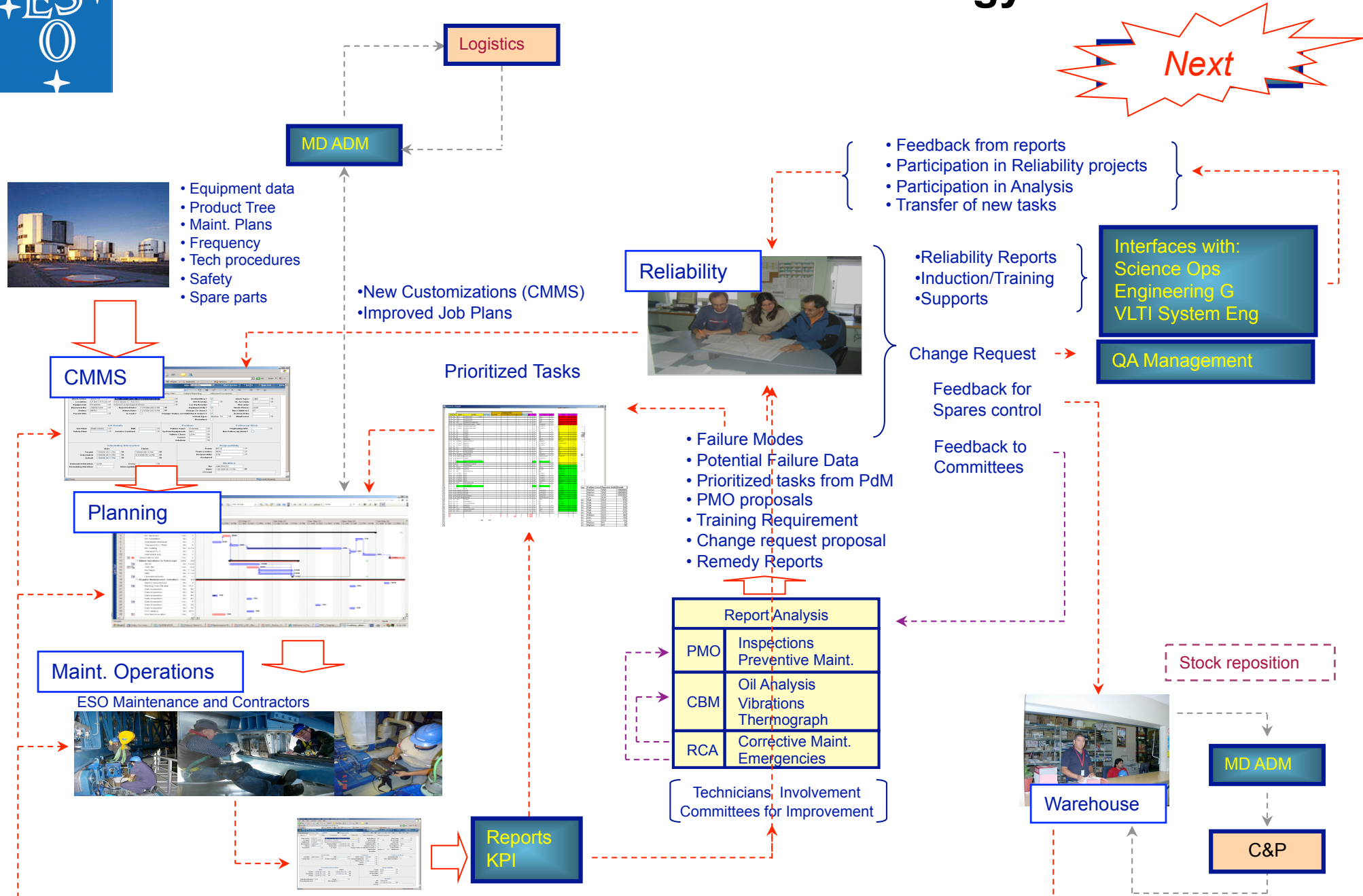
- Under development

■ Root Cause Analysis

■ Preventive Maintenance Optimisation



Paranal Maintenance Strategy



Atacama Pathfinder Experiment

■ Atacama Pathfinder Experiment (APEX)

- A 12-m radio telescope for the observation of sub-mm wavelengths to observe the cold Universe.
- Located at 5100 m on Llanos de Chajnantor.
- Operated from the base station in Sequitor in San Pedro de Atacama.
- The project is a joint venture between MPIfR (50%), ESO (27%), and Onsala (23%).





APEX Operations – High Site





APEX Operations – Basecamp



A.Kaufer, JENAM 2010, SPS1
Lisbon, September 7, 2010

52



APEX: 3 Facility Instruments

■ SHeFI (Swedish Heterodyne Facility Instrument)

- Band 1: 211-270GHz SSB, Trec ~ 80K
- Band 2: 275-370GHz SSB, Trec ~ 135K
- Band 3: 375-500GHz SSB, Trec ~ 180K
- Band T2: 1250-1385GHz DSB, Trec ~ 1200K

■ LABOCA (Large Apex BOlometer CAmera)

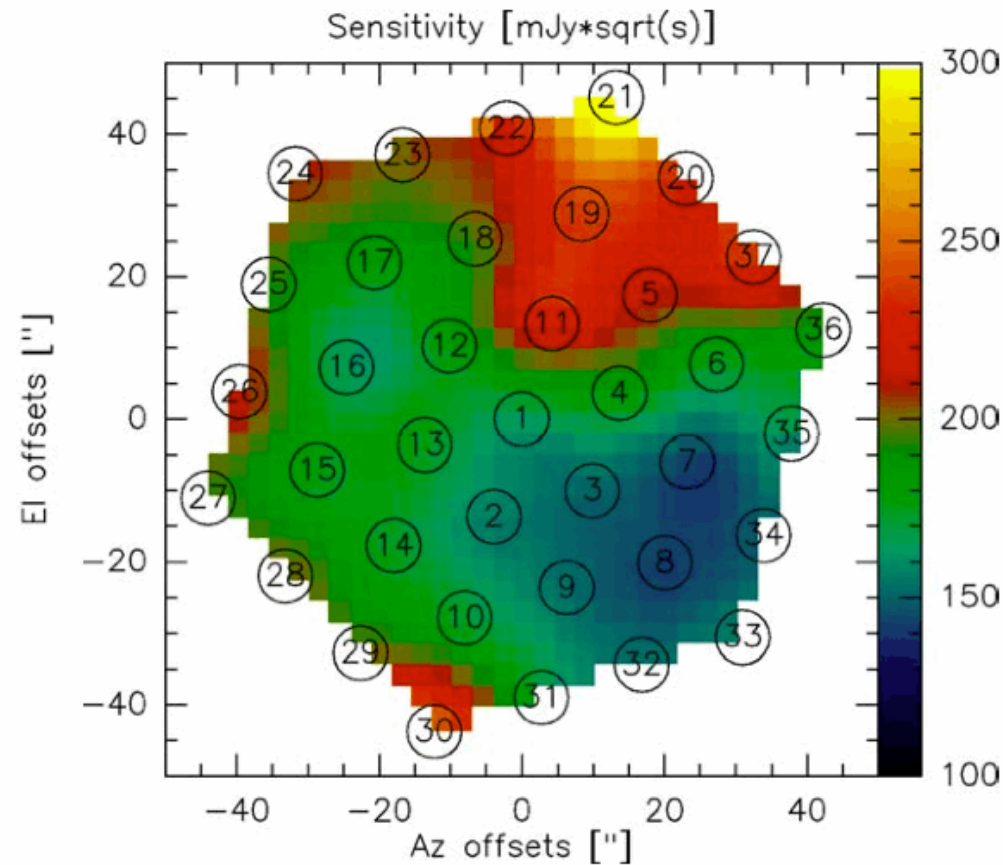
- 295 semiconducting pixels, liquid Helium cooled
- 870 microns atmospheric window
- FOV 11 x 11 arcmin²
- 18.6" pixel size on sky (FWHM)

■ SABOCA (Shortwave Apex BOlometer Camera)

- 37 superconducting pixels, liquid Helium cooled
- 350 microns atmospheric window
- FOV ~1 x 1 arcmin²
- 7.5" pixel size on sky (FWHM)

APEX Instrumentation

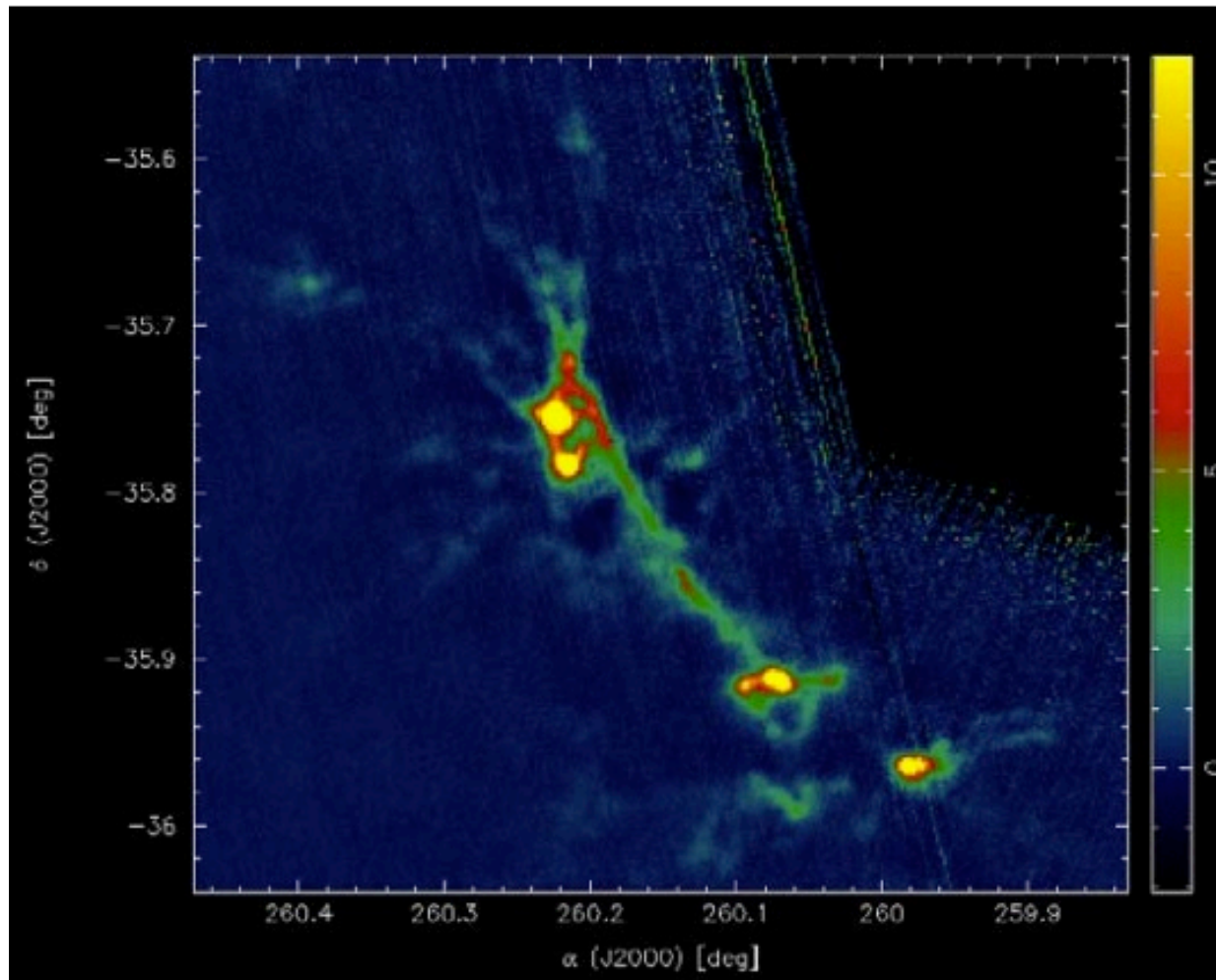
■ SABOCA



Sensitivity of the 37 bolometers determined from a scan on Neptune in March 2009.

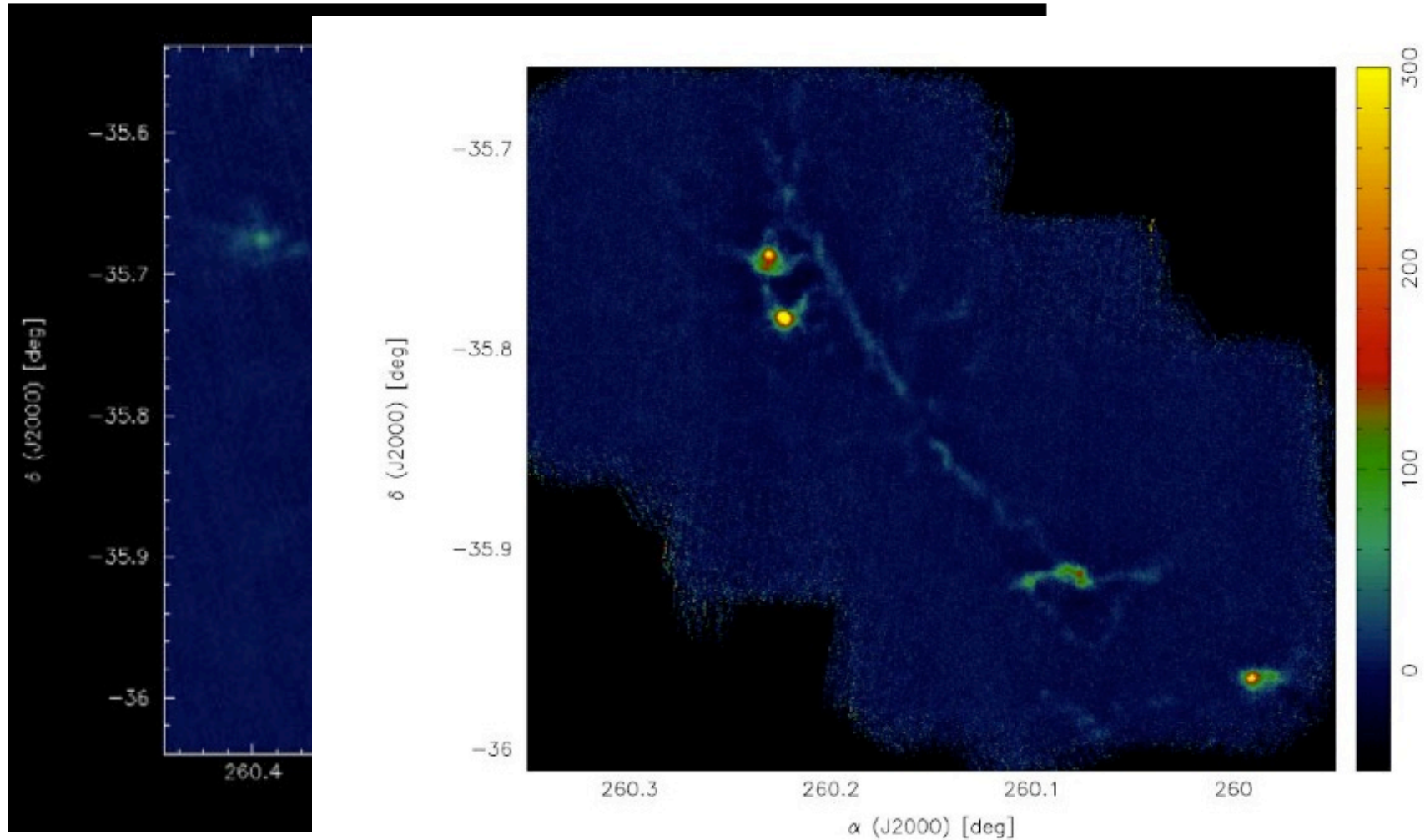
APEX Instrumentation

■ LABOCA: Star forming region NGC6334 at 870 micron



APEX Instrumentation

■ SABOCA: Star forming region NGC6334 at 350 micron





APEX at Chajnantor



A.Kaufer, JENAM 2010, SPS1
Lisbon, September 7, 2010

European Southern Observatory



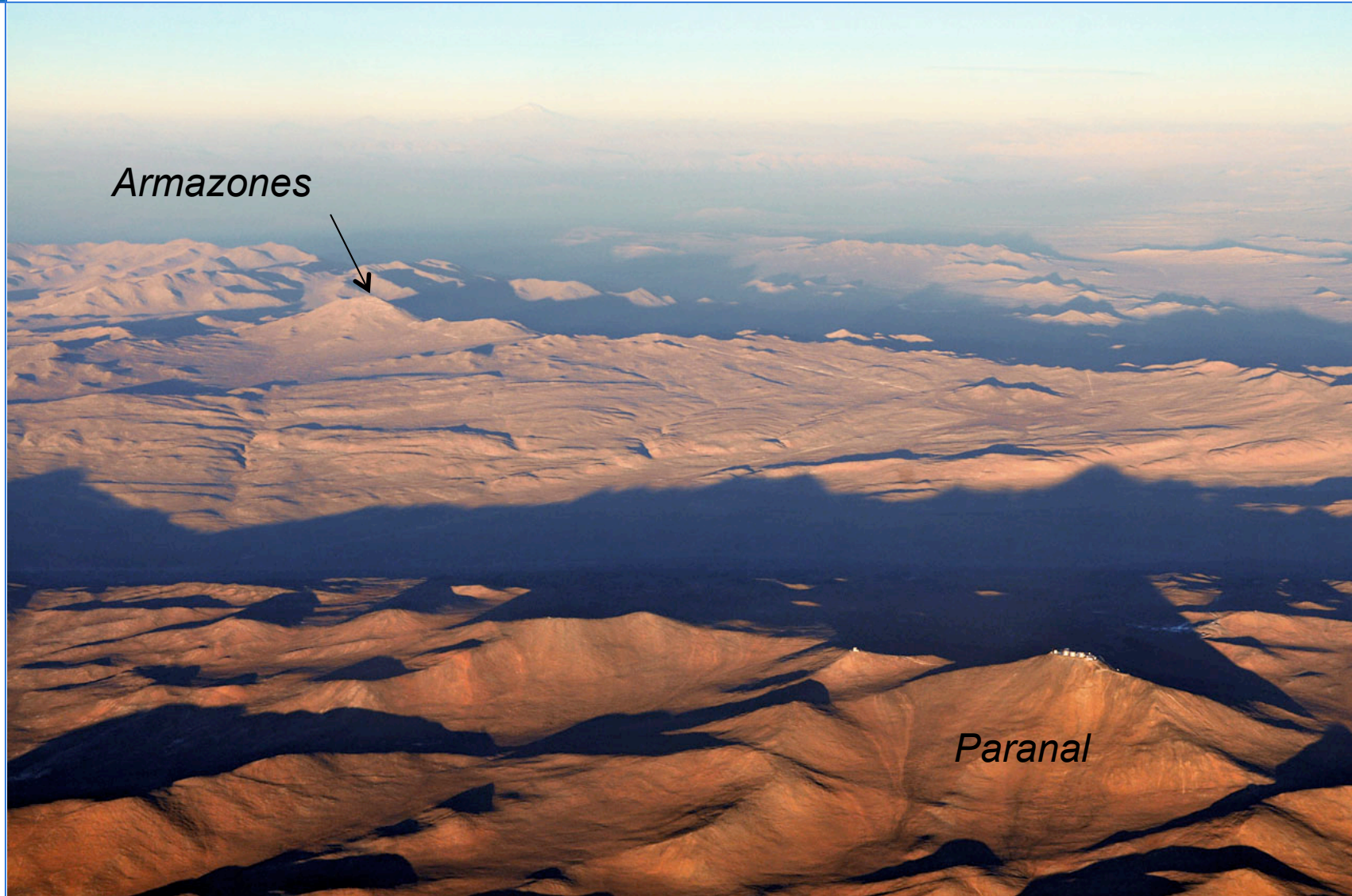


ALMA at Chajnantor



A.Kaufer, JENAM 2010, SPS1
Lisbon, September 7, 2010

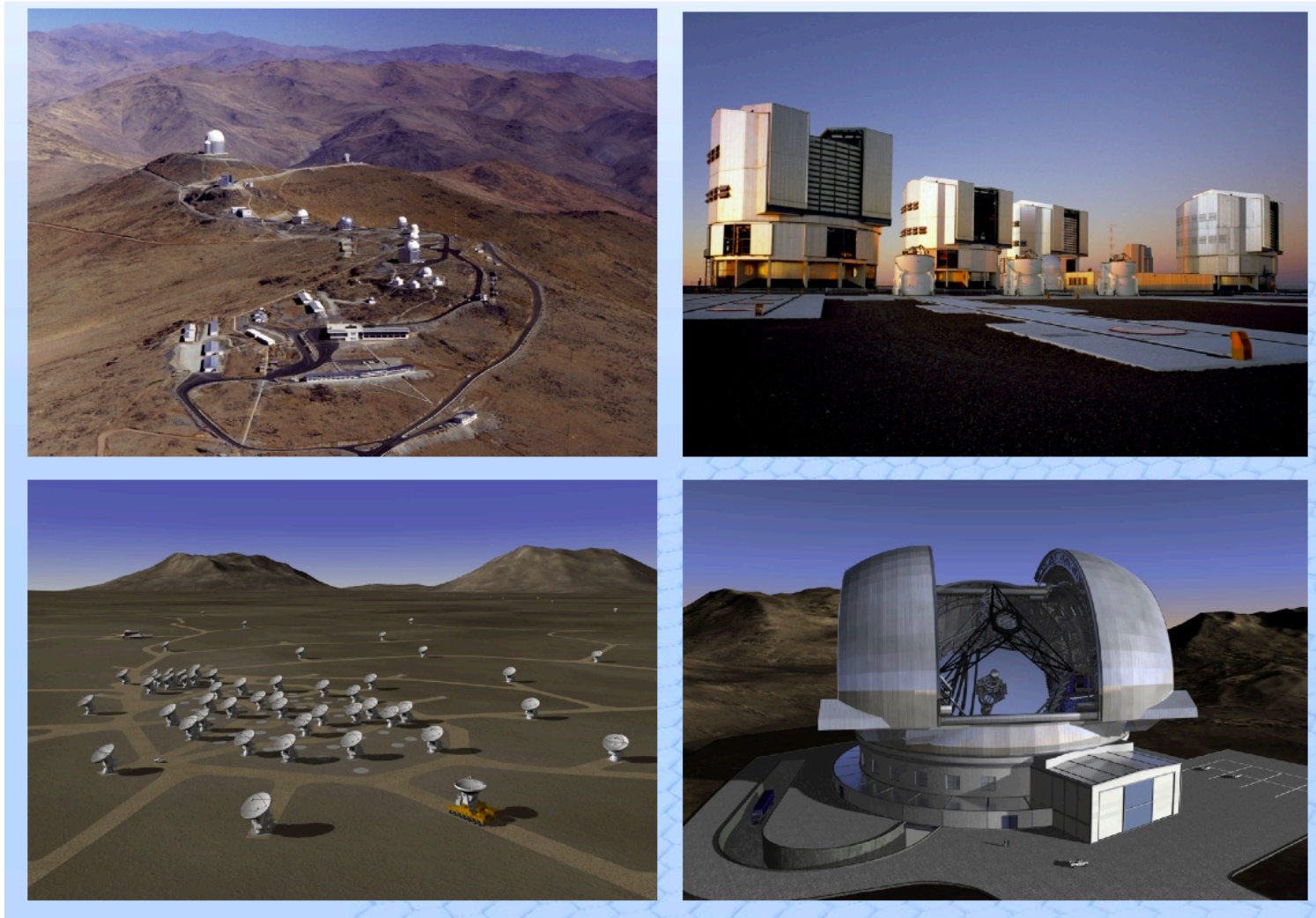
E-ELT at Armazones





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50 years operating leading Observatories



A.Kaufer, JENAM 2010, SPS1
Lisbon, September 7, 2010