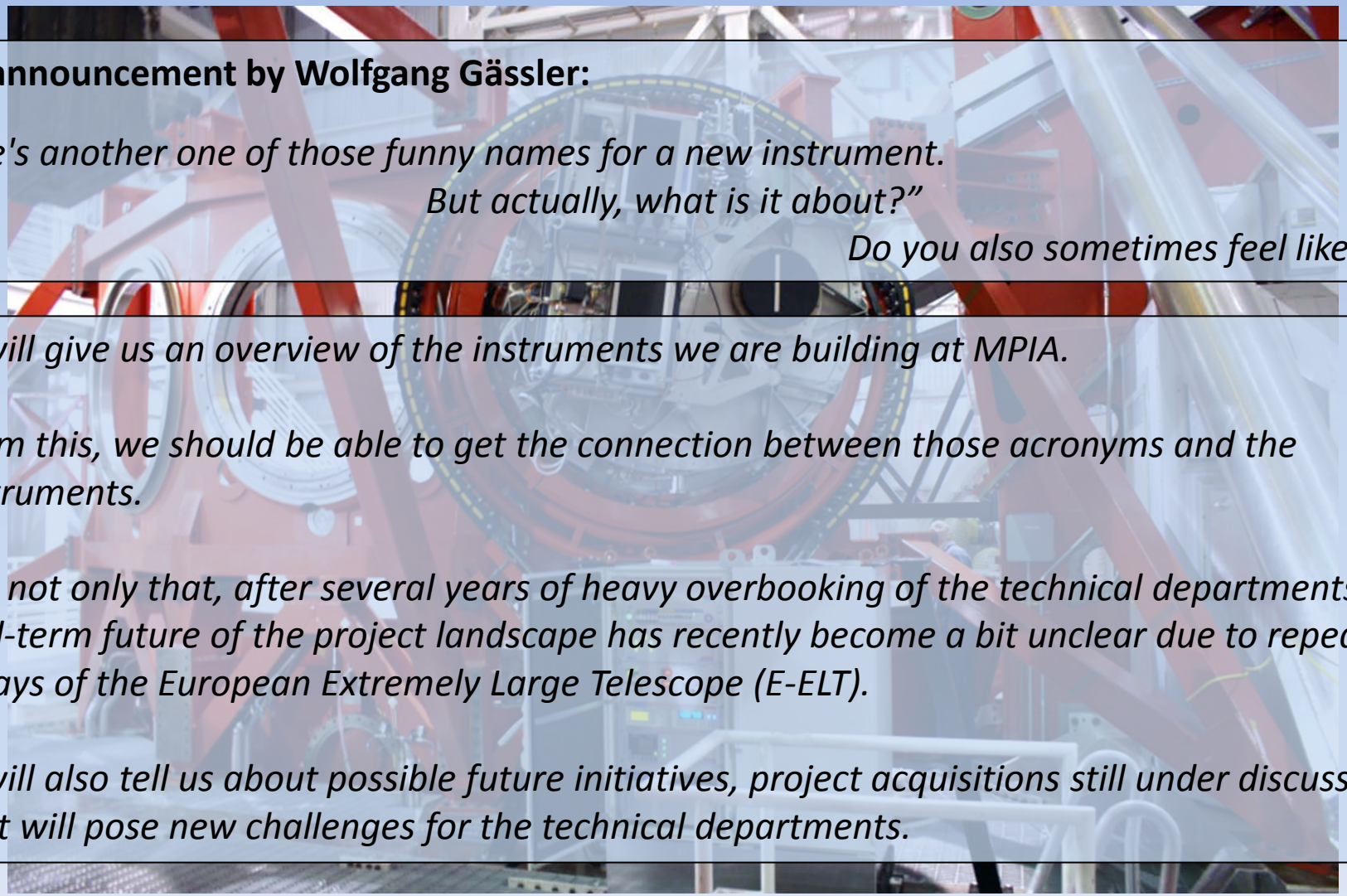
The project landscape of the technical departments

M. Kürster



Talk announcement by Wolfgang Gässler:

"Here's another one of those funny names for a new instrument.
But actually, what is it about?"
Do you also sometimes feel like this?

- *… will give us an overview of the instruments we are building at MPIA.*
- *From this, we should be able to get the connection between those acronyms and the instruments.*
- *But not only that, after several years of heavy overbooking of the technical departments the mid-term future of the project landscape has recently become a bit unclear due to repeated delays of the European Extremely Large Telescope (E-ELT).*
- *… will also tell us about possible future initiatives, project acquisitions still under discussion, that will pose new challenges for the technical departments.*

Acronyms

Was bedeutet <u>MFU2</u> auf Ihrem Zeitplan?

Management-Fehl-Urteil Nr. 2. Tritt für gewöhnlich etwa in der dritten Woche auf.

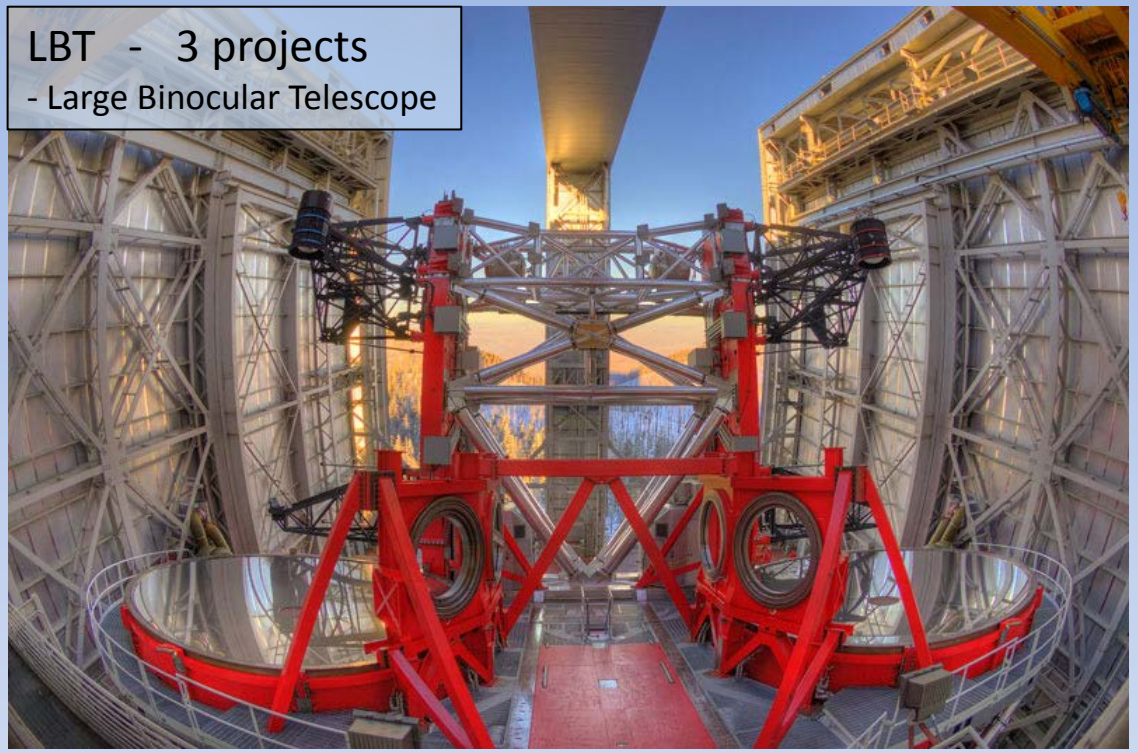
Wir planen keine Management-Fehler ein.

Das ist <u>MFU1</u>.

foul-up:
blamable Panne, Fehler, Schlamassel
auf Grund von Fehleinschätzung

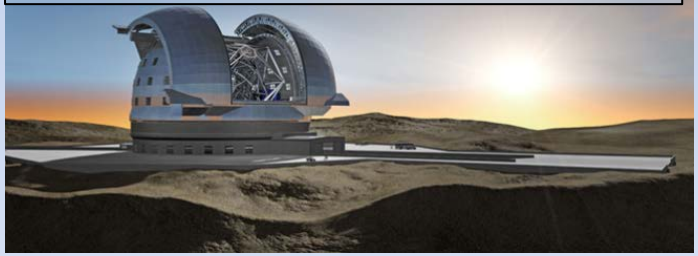
MPIA instrumentation projects: 11 in total

LBT - 3 projects
- Large Binocular Telescope



ESO VLT / VLTI - 3 projects
- European Southern Observatory
- Very Large Telescope / Interferometer

ESO E-ELT - 2 planned projects
- European Extremely Large Telescope



CAHA - 2 projects
- Centro Astronómico Hispano-Alemán

esa space for europe

ESA - 1 project
European Space Agency

… plus 3 more projects under discussion → later

Presentation scheme

Instrument

Facts:

- …
- …
- …

Science:

- …
- …
- …

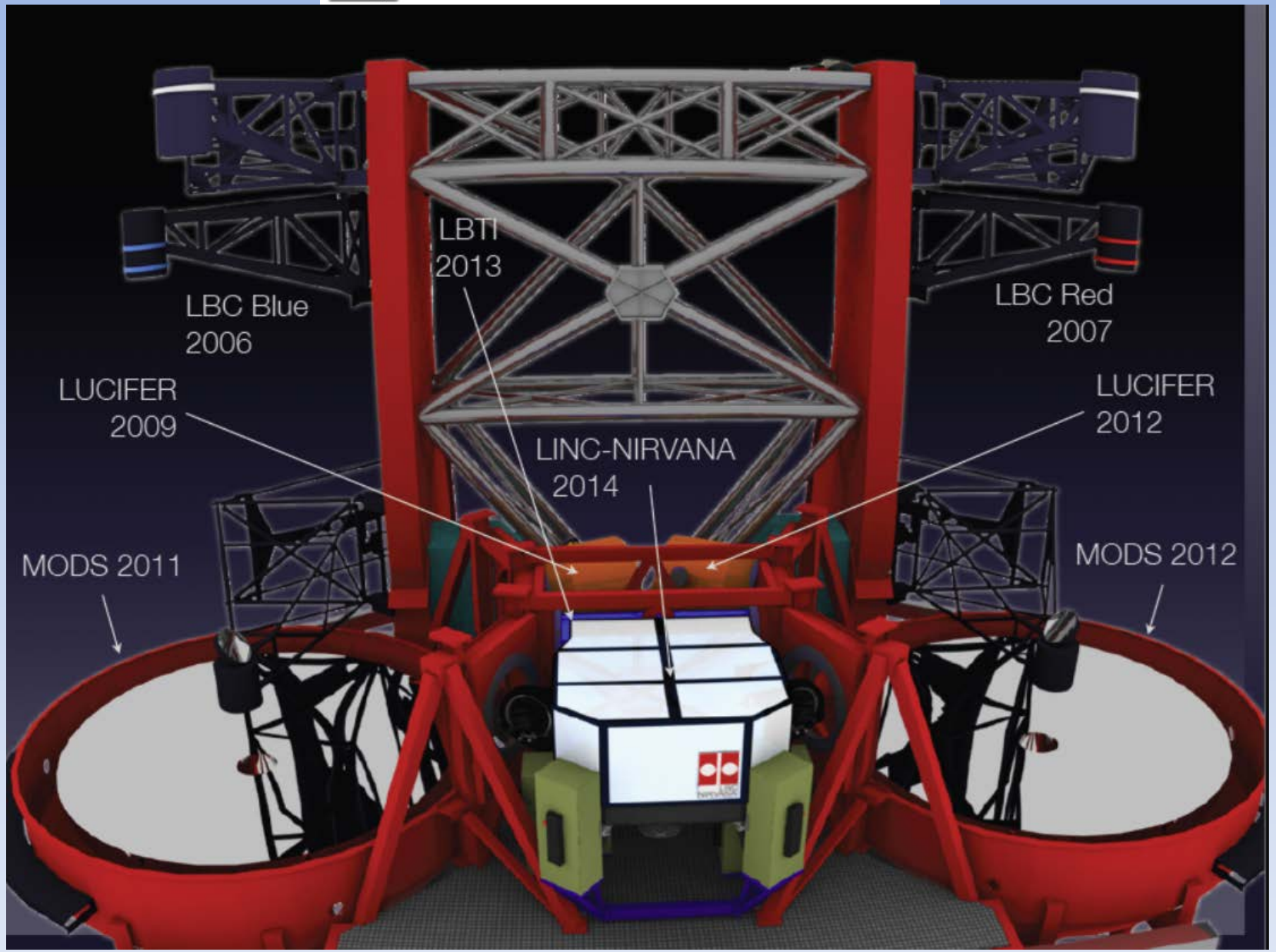
MPIA:

- …
- …
- …

Schedule:

- …
- …
- …

LBT

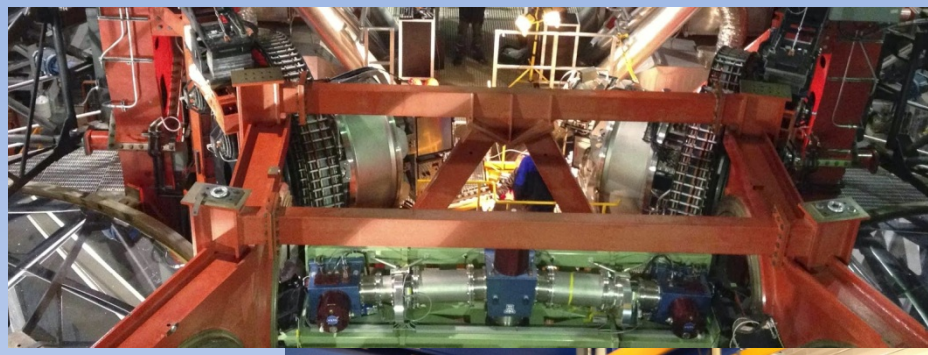


ARGOS 2013

PEPSI 2014

LARGE BINOCULAR TELESCOPE OBSERVATORY

LUCI ~~FER~~ 1 + 2 - LBT NIR spectroscopic Utility with Camera and Integral-Field Unit ~~for Extragalactic Research~~



Facts:

- Two identical imagers and multi-object NIR spectrographs, fully cryogenic
- LUCI-1 operational since Dec 2009
- LUCI-2 to become the first LBT facility instrument using AO

Science:

- Multi-object spectroscopy of galaxy clusters and star clusters
- See also project ARGOS
- And talk to MPIA scientists who are already using LUCI-1

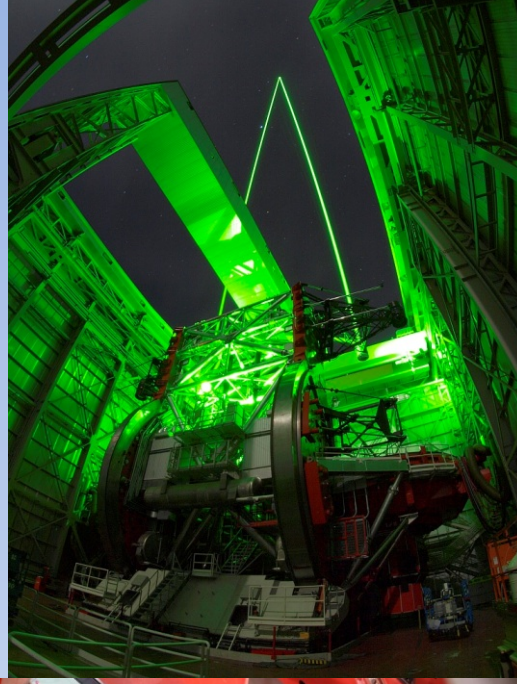
MPIA:

- ICE , ROE, R/O-SW, detectors, cryogenics Integration facility

Schedule:

- Sep. 2014: LUCI-2 refurbishment (camera, gratings)
- Feb. 2015: LUCI-1 refurbishment (detector, optics, camera)
- July 2015: LUCI-1+2 ADCs
- End 2015: End of project for MPIA

ARGOS - Advanced Rayleigh guided Ground layer adaptive Optics System



Facts:

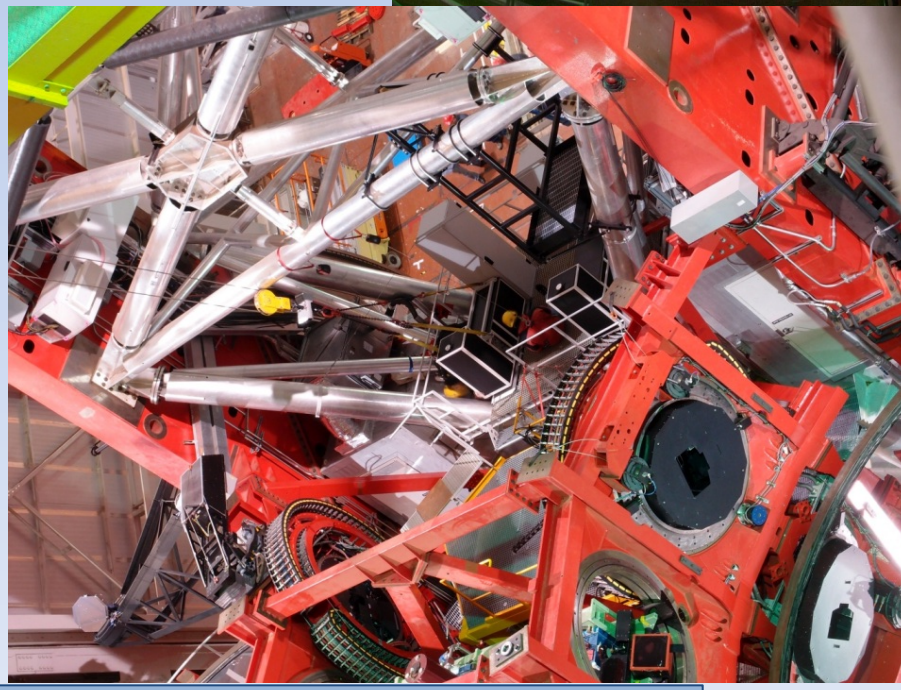
- Installed at the LBT April 2013 – Sep. 2014
- Six Rayleigh lasers for use with LUCI-1+2
- GLAO system
- 2 - 3 × seeing reduction over a 4´ field

Science:

- How did galaxies assemble over time and acquire their morphology?
- How did galaxies grow their stellar mass?
- How did galaxies get their angular momentum?

MPIA:

- Swing-arm testing
- SW development
  – e.g. interface to AOS
- WFS algorithms
- Support for MoCon and calibration unit alignment

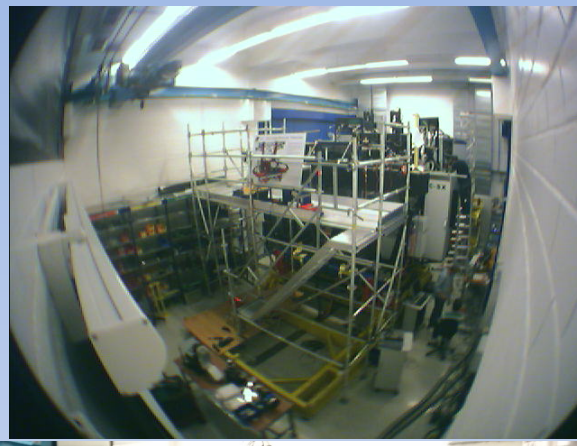


Schedule:

- May 2014: Start of commissioning
- July 2015: Science verification
- Dec .2015: Open use

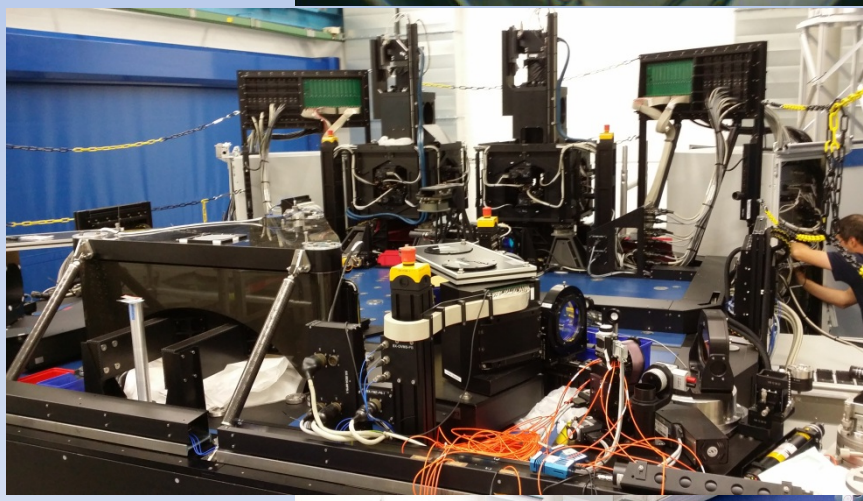
LINC-NIRVANA

- LBT INterferometric Camera – Near-InfraRed Visual Adaptive iNterferometer for Astronomy



Facts:

- Fizeau interferometric beam combiner, NIR imager
- 10.5´´ × 10.5´´ FoV
- Originally for classical AO (``LINC´´) and MCAO (``NIRVANA´´)
- Momentary rescope to non-interferometric ``lean´´ MCAO
- Highly complex – 6 sensor systems
- ``Pathfinder´´ (WFS plus camera) installed and operational



Science:

- General high-res. imaging equiv. to 23m-telescope
- Initially only 8.4m resolution
- Dynamics+composition of globular+star clusters
- Black hole search in globular clusters
- Protoplanetary disks
- etc., etc. …

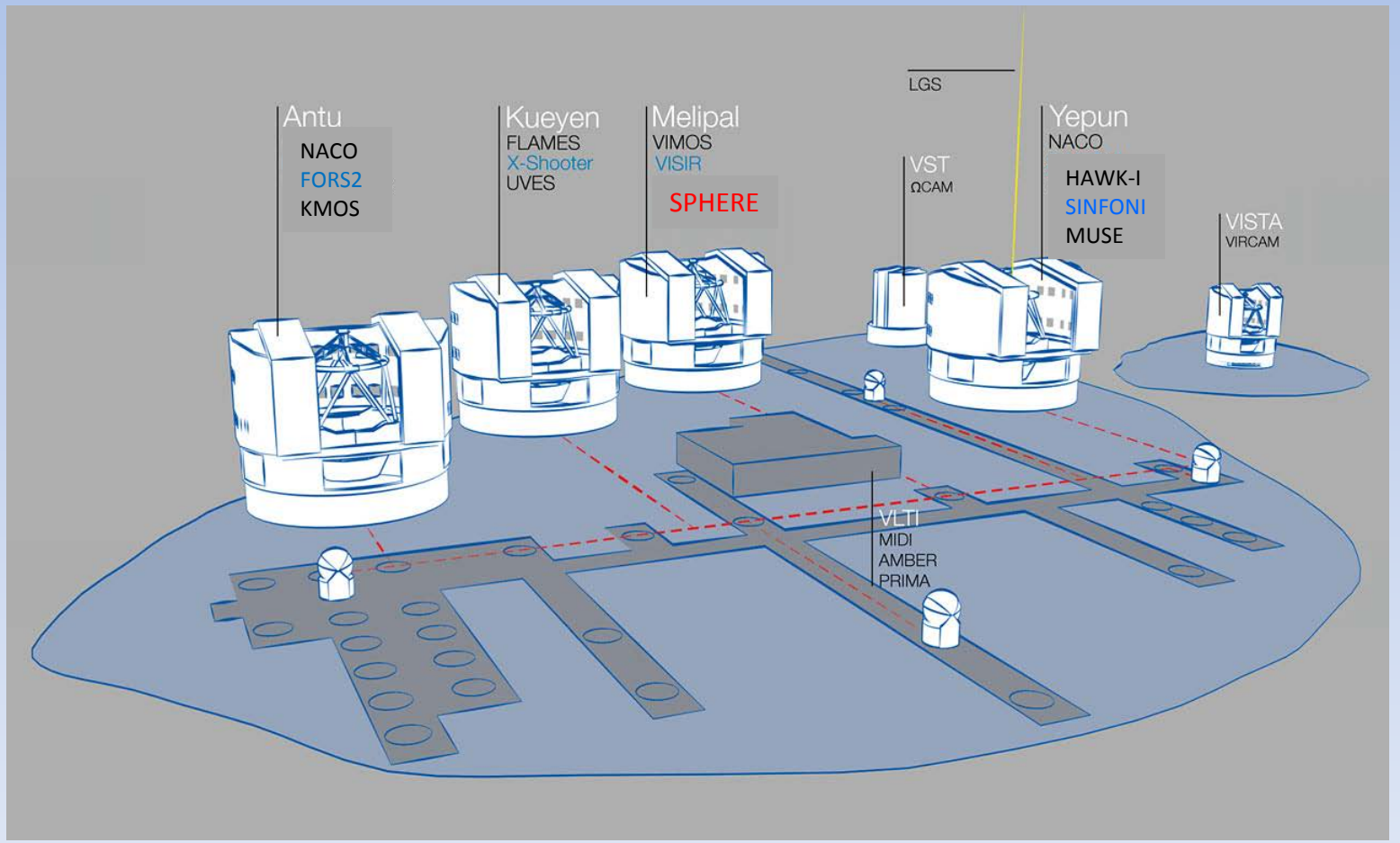
MPIA:

- PI institute: project lead & management
- (Cryo-)mechanics, optics, cryogenics, ICE, ROE, science detector, R/O-SW, ICS, OPS, AIV, shipping

Schedule (under revision):

- May 2015: Acceptance Europe
- Summer/fall 2015: Shipping
- Late 2015/early 2016: Re-integration in mountain lab
- Spring 2016: Installation at the telescope

VLT / VLTI


Antu
NACO
FORS2
KMOS
Kueyen
FLAMES
X-Shooter
UVES
Melipal
VIMOS
VISIR
SPHERE
LGS
VST
OCAM
Yepun
NACO
HAWK-I
SINFONI
MUSE
VISTA
VIRCAM
VLTI
MIDI
AMBER
PRIMA

SPHERE - VLT - Spectroscopic and Polarimetric High-contrast Exoplanet REsearch

Facts:

- Successfully installed at the VLT in early spring 2014
- eXtreme Adaptive Optics (XAO)
- coronography
- and three differential imaging-capable focal plane instruments
  - ZIMPOL - a differential polarimeter at visual to very-NIR
  - IRDIS - a dual band imager working in the NIR
  - IFS - an integral field spectrograph working in J-band for very high contrast

Science:

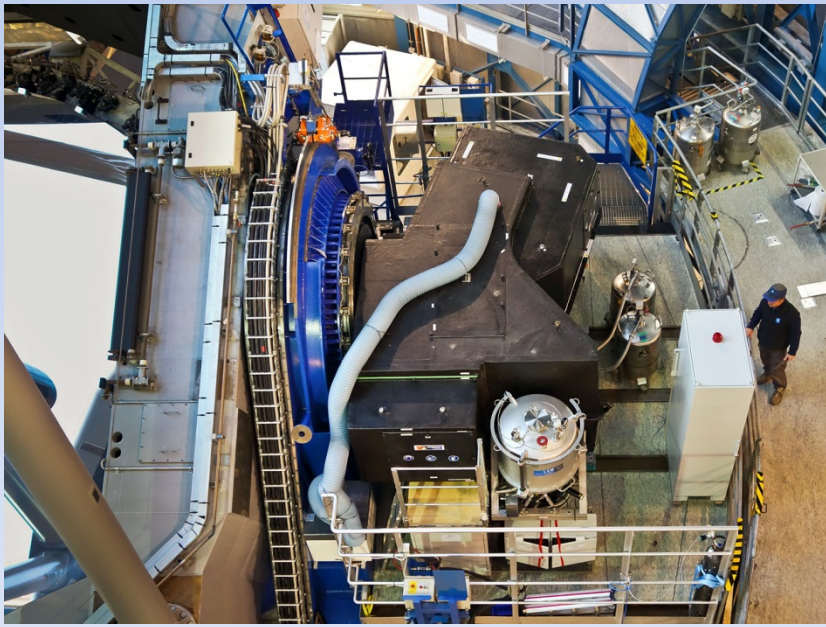
- Imaging of extrasolar planets
- Formation and evolution of planetary systems
- Frequency of planets as a function of mass and separation >5-10 AU where most gas giant planets form

MPIA:

- Co-PI institute
- Data reduction SW – pipeline – science-related SW
- Contributions to HW manufacture and testing, ICE

Schedule:

- Oct. 2014: Commissioning #4
- Dec. 2014: Science verification time



MATISSE - VLTI - Multi AperTure mid-Infrared SpectroScopic Experiment

Facts:

- Mid-infrared instrument with several spectroscopic modes
- L,M,N bands, i.e. 3 – 25 µm
- Will combine up to 4 UTs/ATs
- Image reconstruction via closure phase relations

Science:

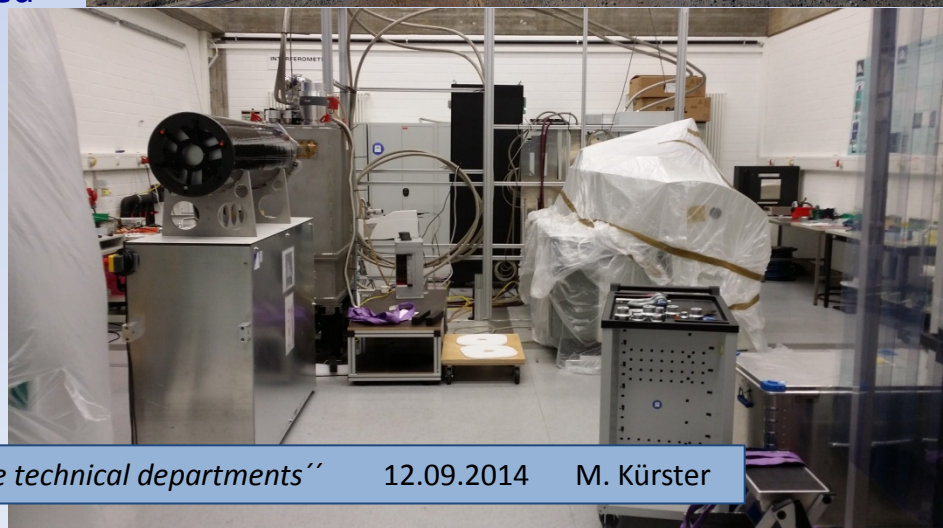
- Active galactic nuclei
- Protoplanetary disks
- Formation and evolution of planetary systems
- Birth of massive stars
- The high-contrast environment of hot and evolved stars

MPIA:

- Vibration tests for pulse tube cooler
- AIV of the cryostats (L, N bands) with integrated cold optics and detectors, AIV of the ICE
- Detector tests

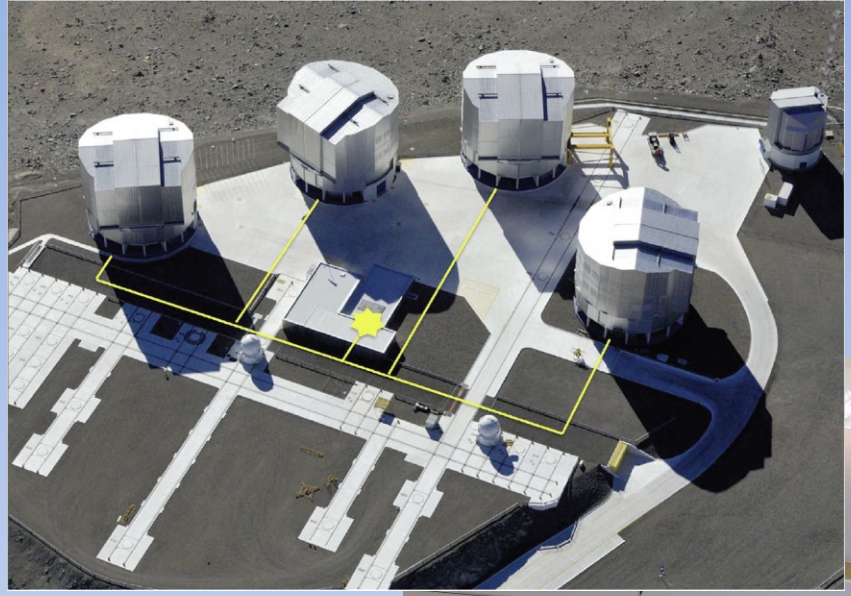
Schedule:

- Until Nov 2014: AIV in MPIA integration hall
- Nov. 2014: AIV in Nice
- March 2016: Acceptance Europe
- May 2016: Integration on Paranal



GRAVITY - VLTI -- not an acronym:

``AO assisted, two-object, multiple-beam-combiner´´



Facts

- Will combine up to 4 UTs
- AO assisted NIR instrument for 10 µas astrometry and interferometric phase referenced imaging (4mas)

Science:

- The central black hole of the Milky Way
- Planets & brown dwarfs in binary systems
- Disks and jet of young stellar objects
- Active galactic nuclei

MPIA:

- 4 WFS – detector, ROE, ICE, SW, mechanics, cryogenics, cryo-AIV

Schedule:

- Mar. 2015: Acceptance AO unit #1 at MPIA
- June – Nov 2015: Commissioning of the four WFS
- End 2015: Open use

Calar Alto

PANIC - PAnoramic Near-Infrared Camera

Facts:

- Wide-field general purpose NIR camera for surveys
- For 2.2m telescope
- 30´ × 30´ field provided by 4 HAWAII-2-RG detectors
- Up to 19 filters
- Fully cryogenic

Science:

- Gamma-ray bursts
- Distance scale
- Star formation & evolution
- Brown dwarf ejection scenario
- Mapping of nearby galaxies
- Galactic plane and buldge • etc

MPIA:

- PI institute
- Cryo-mechanics, star simulator, detector array, R/O-SW, ROE, AIV incl. cold optics

Schedule:

- Nov. 2014: First light
- April 2015: Open use
- Jul 2015: End of project

CARMENES

- Calar Alto High-Resolution Search for M Dwarfs with Exoearths with Near-infrared and Optical Échelle Spectrographs

Facts:

- A high-res. NIR plus a high-res. optical spectrograph
- For 3.5m telescope
- Precision radial velocities in the NIR and visual
- Monitoring of stellar activity indicators

Science:

- Search for planets around 300 M dwarfs (most abundant type of star)
- Sensitivity for Earth-like planets in the habitable zone

MPIA:

- NIR Science detector and cryostat, R/O-SW, ROE,
- Integration hall for the optical spectrograph

Schedule:

- Oct. 2014: Delivery of NIR detector cryostat to IAA Granada
- Sep. 2015: Shipping of NIR spectrograph to CAHA
- Oct. 2015: Start of operations visual spectrograph
- Jan. 2016: Beginning of survey (both spectrographs)

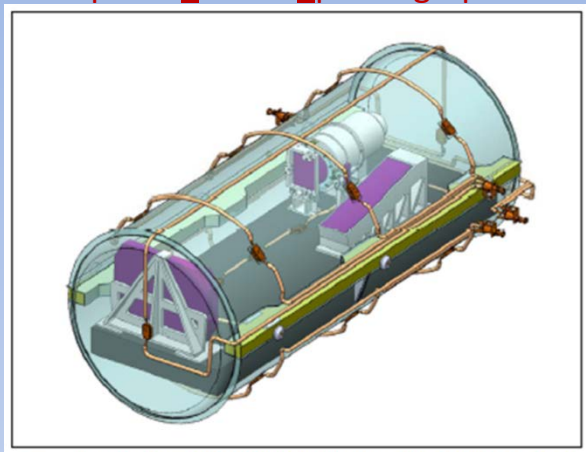
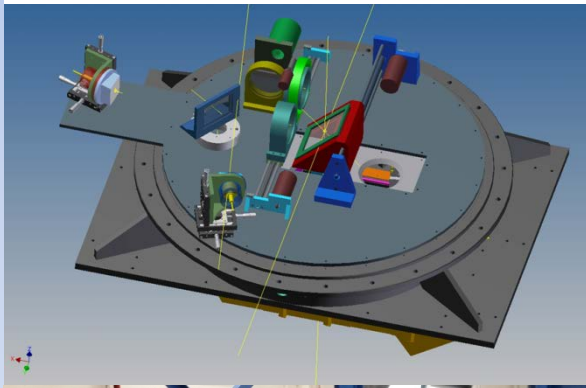
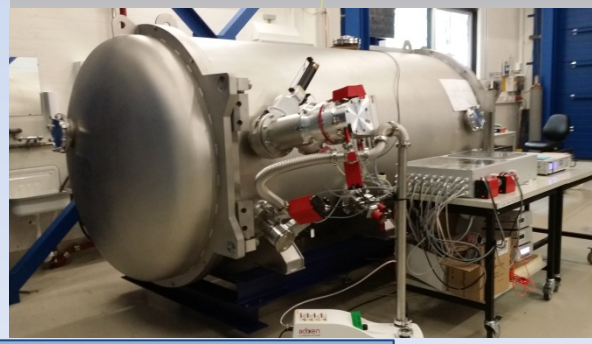


Figure 2. General view of the CARMENES NIR Optical Bench fully assembled.





European Extremely Large Telescope (E-ELT)

… story of delays, delays, delays

MICADO

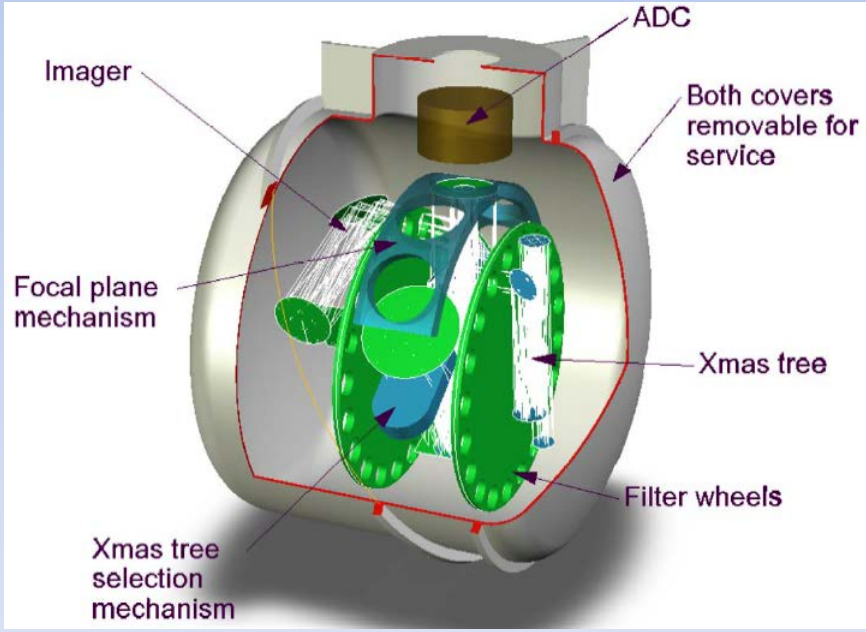
- Multi-AO Imaging Camera for Deep Observations

Facts:

- Adaptive optics NIR imaging camera (J,H,K)
- Diffraction limited imaging over 1´ × 1´ field
- High sensitivity, resolution
- Precise astrometry, high-throughput spectroscopy

Science:

- Stellar proper motions in the GC and other galaxies
- Masses of intermediate mass black holes
- Proper motions of globular clusters
- CDM structure formation (dwarf spheroidals)
- Derive the ages and histories of distant galaxies
- Obtaining spectra of the first supernovae



MPIA:

- Participated in Phase A study
- Cold filter wheel
- Astrometric calibration unit

Schedule:

- Jul 2015 ???: Start of 1 year of trade-off studies (TOS)
- Jul 2016 ???: Start of the 2-year PDR phase

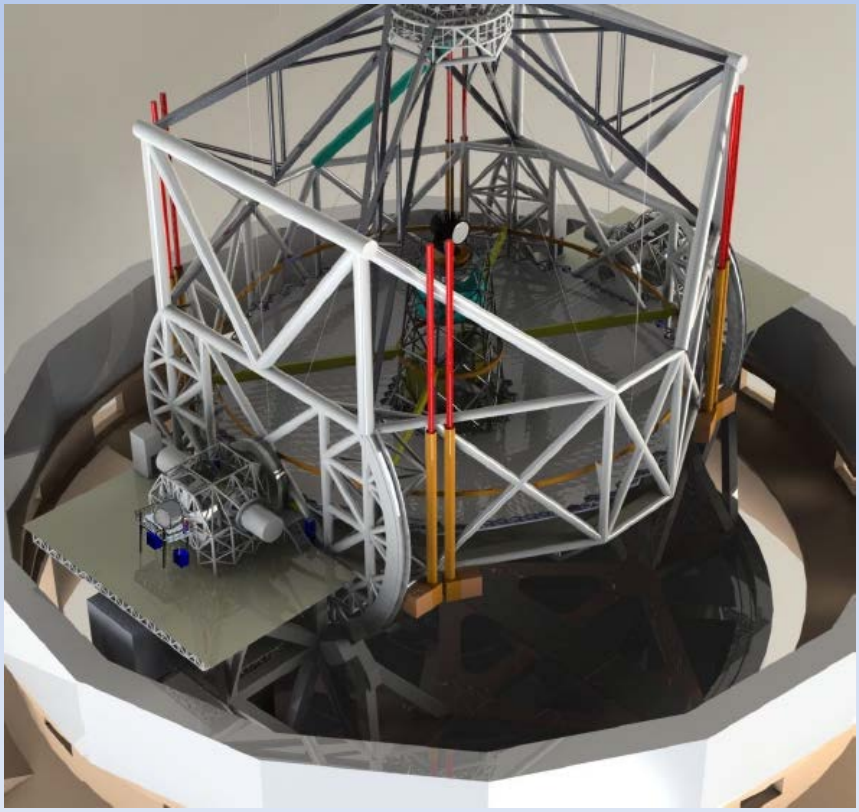
METIS - Mid-infrared E-ELT Imager and Spectrograph

Facts:

- Imaging and medium-res. spectroscopy in L,M ,N bands (3 – 14 µm) over 18´´ × 18´´ field
- Coronoraphy in L,M, polarimetry in N band
- High-res. (R=100 000) IFU spectroscopy in L,M (3 – 5.3 µm) over 0.4´´ × 1.5´´ field
- Two parts: imager and spectrograph, fully cryogenic

Science:

- Proto-planetary disks and planet formation
- Physical and chemical properties of exoplanets
- Formation and history of the solar system
- The growth of supermassive black holes
- Morphologies & dynamics of high-redshift galaxies



MPIA:

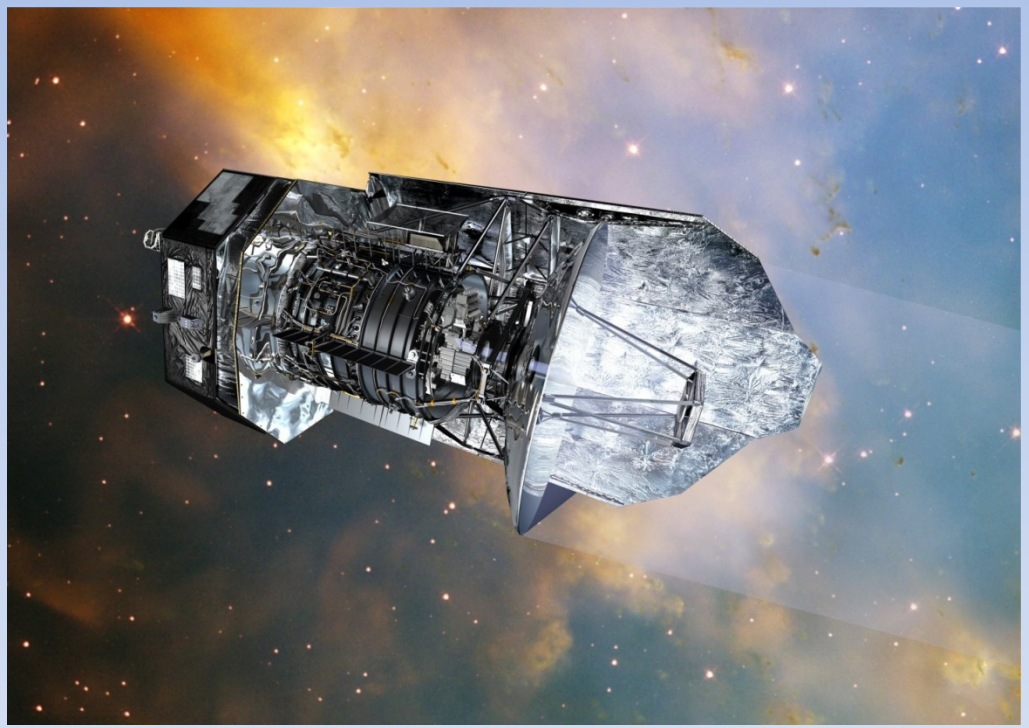
- Extensive Phase A design work
- Mechanics, cryo-mechanics

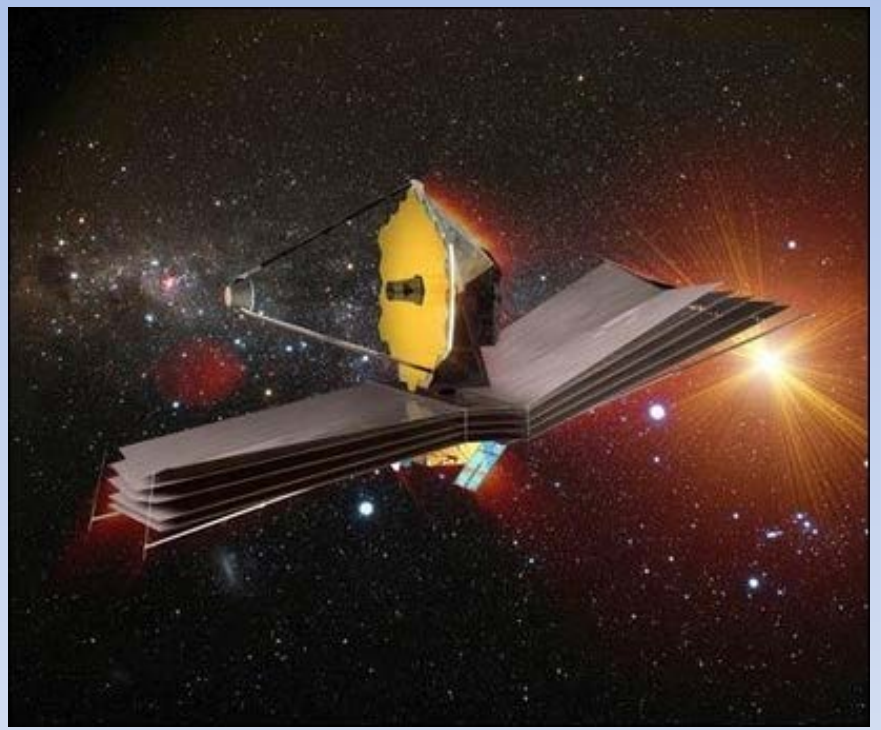
Schedule:

- Jan. 2016 ???: Beginning of PDR phase
- Jan. 2018 ???: Beginning of FDR phase
- Jan. 2020 ???: Beginning of MAIT phase

esa space for europe

European Space Agency





EUCLID: -- not an acronym: ``Mapping the geometry of the dark universe´´

Credit: ESA

Facts:

- Imaging in the visible and near-infrared
- 1.2m telescope
- Soyuz ST 2-1b from Kourou → L2 halo orbit

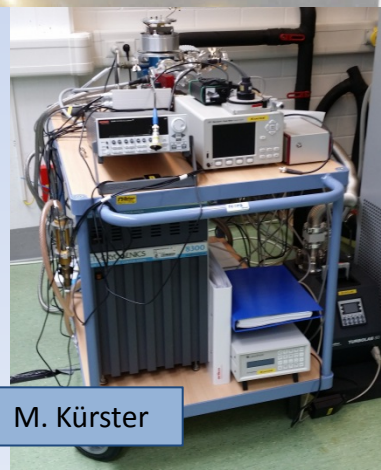
Science:

- Cosmic acceleration (``Dark energy´´)
- Mapping the large scale structure of the universe

Credit: ESA

MPIA:

- Presently only small contributions from the technical departments are foreseen
- Design and manufacture of opto-mechanics are done by an DLR-funded engineer and by companies



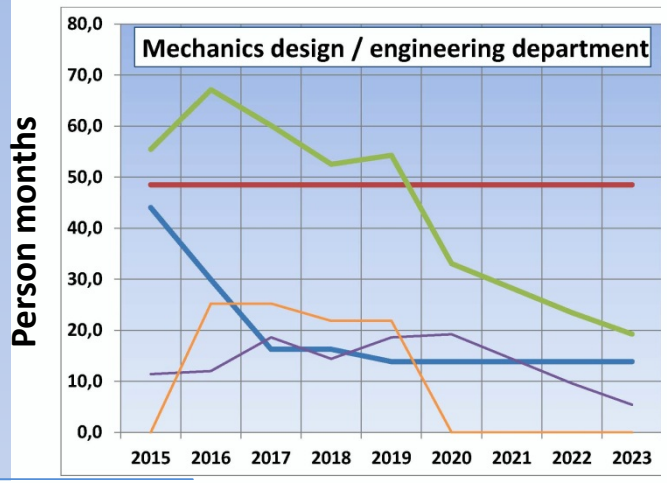
Schedule:

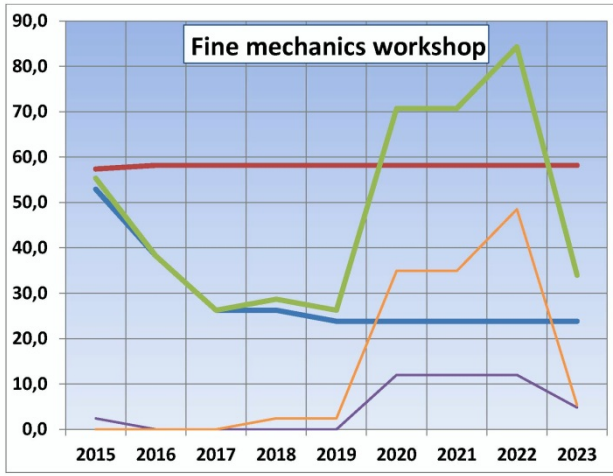
- Dec 2015: Flight models manufactured by industry
- Dec 2016: Flight models and spare tested and delivered to LAM Marseille
- 2019: Launch

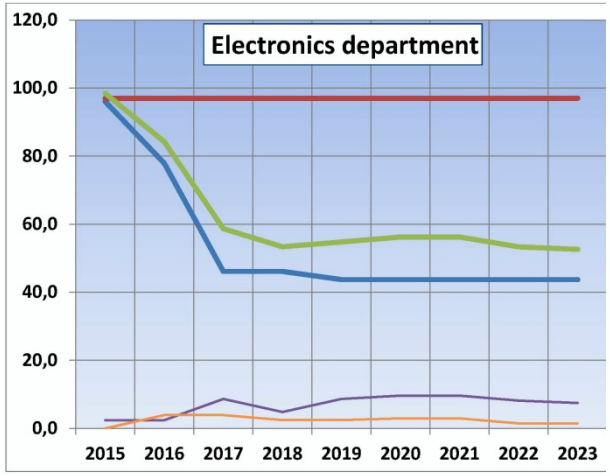
Workload of the technical departments 2015 - 2023

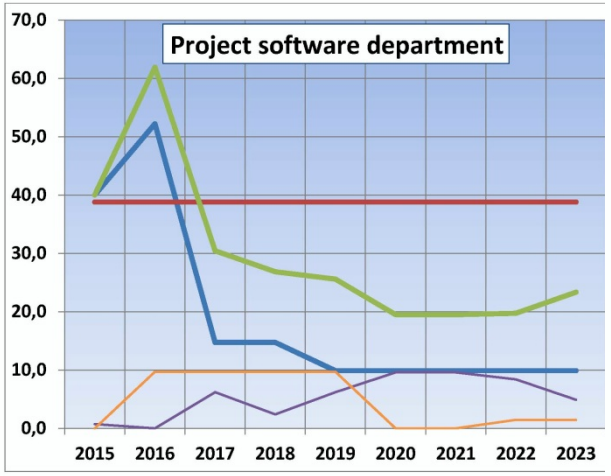
Long-term estimate

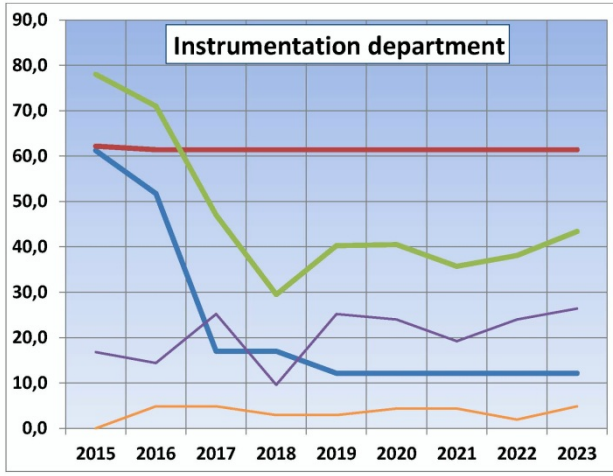
- Available
- Total workload
- Miscellaneous / Other
- MICADO
- METIS









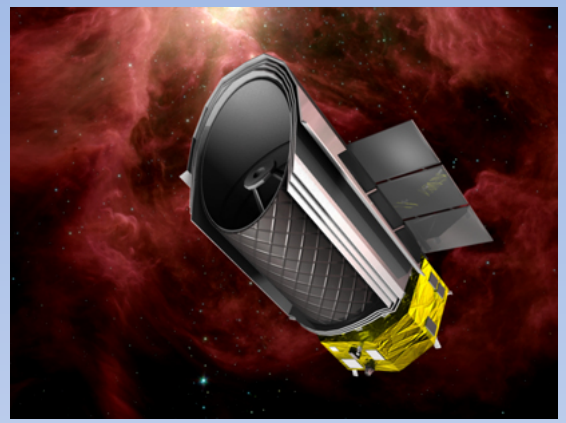


Options for the future

JAXA+ESA: Japan Aerospace Exploration Agency
+ European Space Agency

SPICA Space Infrared Telescope for Cosmology and Astrophysics (3.2m)

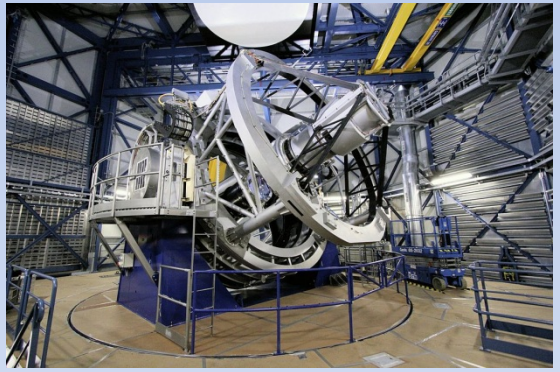
+ SAFARI + SpicA FAR-infrared Instrument



ESO Paranal: European Southern Observatory @ Paranal

VISTA Visible and Infrared Survey Telescope for Astronomy (4.1m)

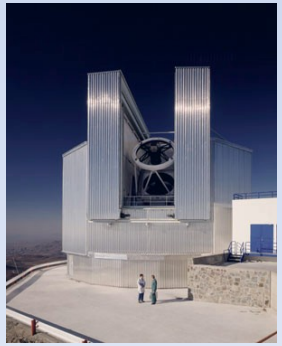
+ 4MOST + 4-m Multi-Object Spectroscopic Telescope



ESO La Silla: … @ La Silla

NTT New Technology Telescope (3.58m)

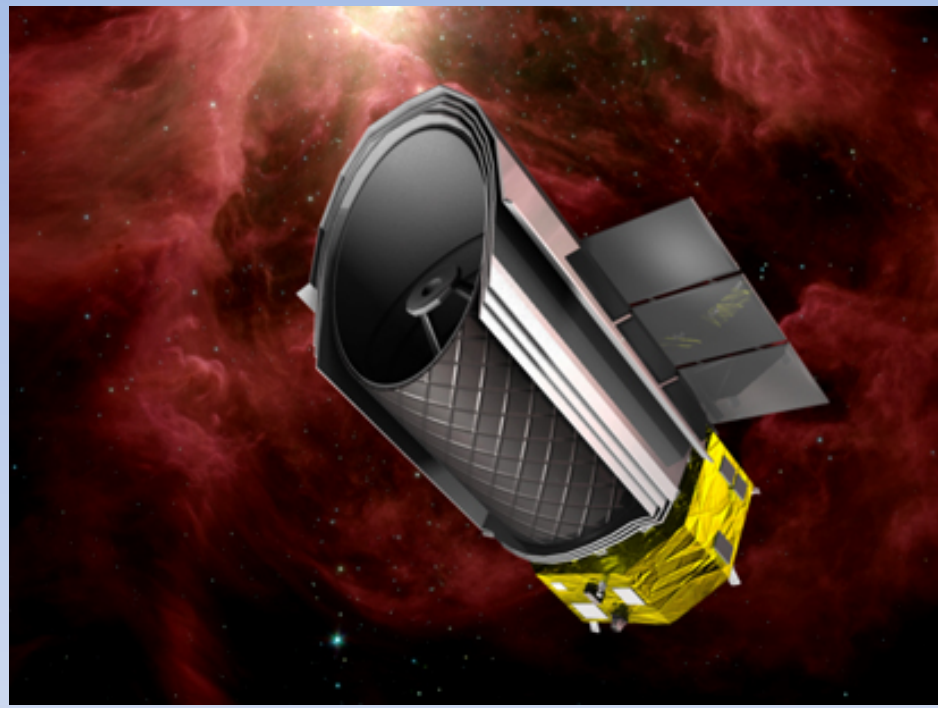
+ ExoMOS + Exoplanet Multiple Object Spectrograph



SPICA + SAFARI

Facts:

- SPICA:
  - Cold 3.2m mirror
  - Project lead shifting: JAXA → ESA
- SAFARI
  - FIR spectrograph for 50 – 240 µm
    – similar to Herschel-PACS



Science:

- Formation of galaxies, stars, and planets
- The interaction between the processes forming the solar system
- Deep cosmological surveys

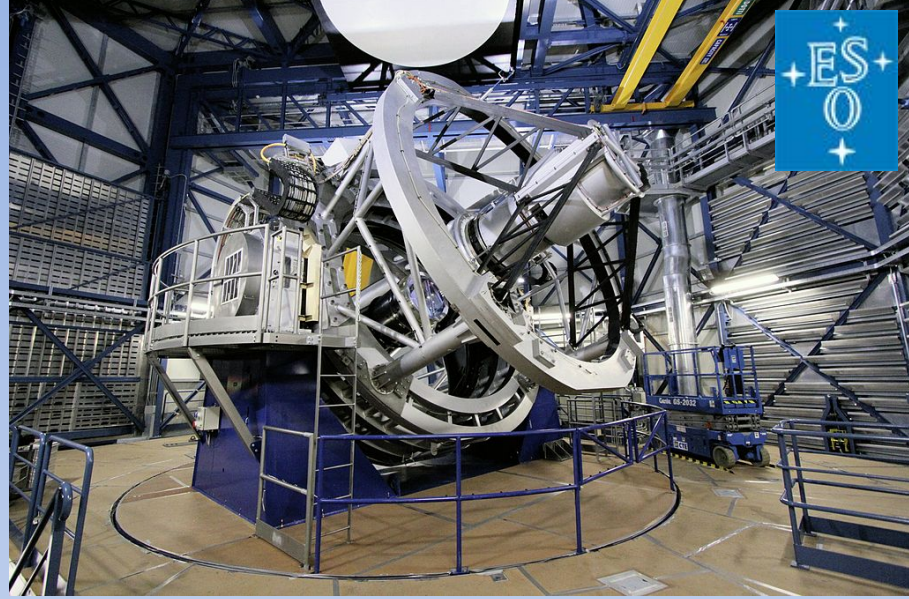
MPIA:

- Possible MPIA workpackages:
  - Filter wheels – development and manufacture
  - Characterization of the camera
    – a detector array of transition-edge bolometers cooled to 40 mK with He^3/He^4

Schedule:

- Launch 2028

VISTA + 4MOST



Facts:

- VISTA:
  - 4.1m telescope
- 4MOST
  - Project lead AIP (Astroph. Inst. Potsdam)
  - Visible multi-object spectrograph
  - ~2400 fibres over 4 square degrees
  - R = 5000 – 20000

Science:

- Origin of the Milky Way
- Chemical and kinematic substructure in Milky Way constituents
- Evolution of galaxies and structure of the cosmos
- Complement to the Gaia, EUCLID, and eROSITA surveys

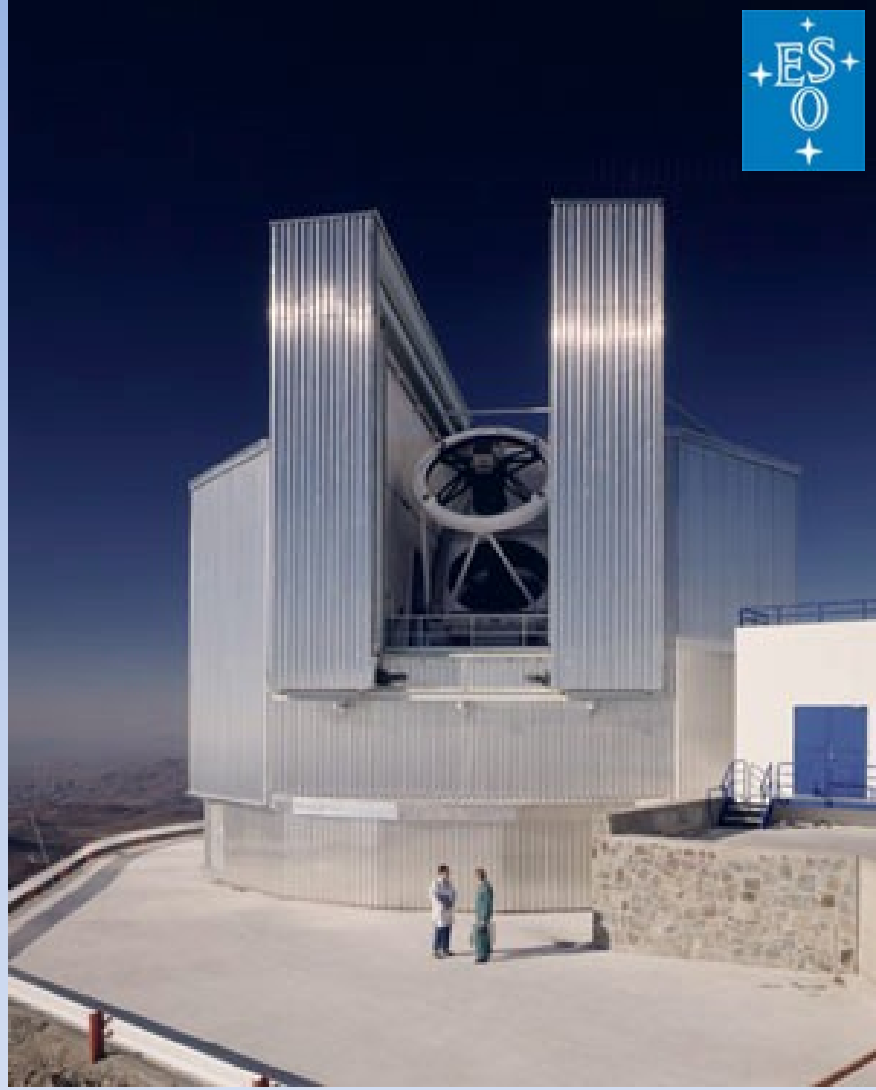
MPIA:

- MPIA is currently joining the consortium
- Workpackage ICE will be taken over from LMU München
  - Motion control for filters/ADCs/WFSs, Interlocks for 4 cryostats, Housekeeping
- Not involved in fibre positioning
- Option to also take over ICS is currently not being followed up

Schedule:

- Operational ~2020

NTT + ExoMOS



Facts:

- NTT:
  - 3.58m telescope
  - VLT precursor from end-1980s/early 1990s
- ExoMOS
  - Project lead: University of Exeter (England)
  - Multi-object spectrograph
  - Optical + NIR, 0.35 – 2.4µm, R = 1000
  - High spectro-photometric precision

Science:

- Transit spectroscopy
- Characterization of exoplanet atmospheres

MPIA:

- MPIA is defining potential contributions
  - Probably detector characterization
  - and optical design

Schedule:

- ESO call received 19 proposals
- Downselected to 7 proposals – studies for final selection underway
- Final selection will be two instruments with ≤50% of the telescope time
- Operational within ~~2016~~ – 2020, if selected

Final remarks

- **A rich project landscape with state-of-the-art instruments for top observatories**
- **At present the technical departments are heavily overbooked**
- **But from 2016 onwards new projects are needed**
- **This is especially true, if the E-ELT keeps being delayed**

Top science projects:

- **Extrasolar planet search and characterisation – incl. Earth analogs**
- **Dark energy and dark matter**
- Galaxy formation
- Black holes
- Active galactic nuclei
- Star formation
- etc.

Excellent engineers and technicians are making this possible with a lot of effort and dedication !!!

Thank you!