



# Paranal Instrumentation Programme

L. Pasquini  
ESO

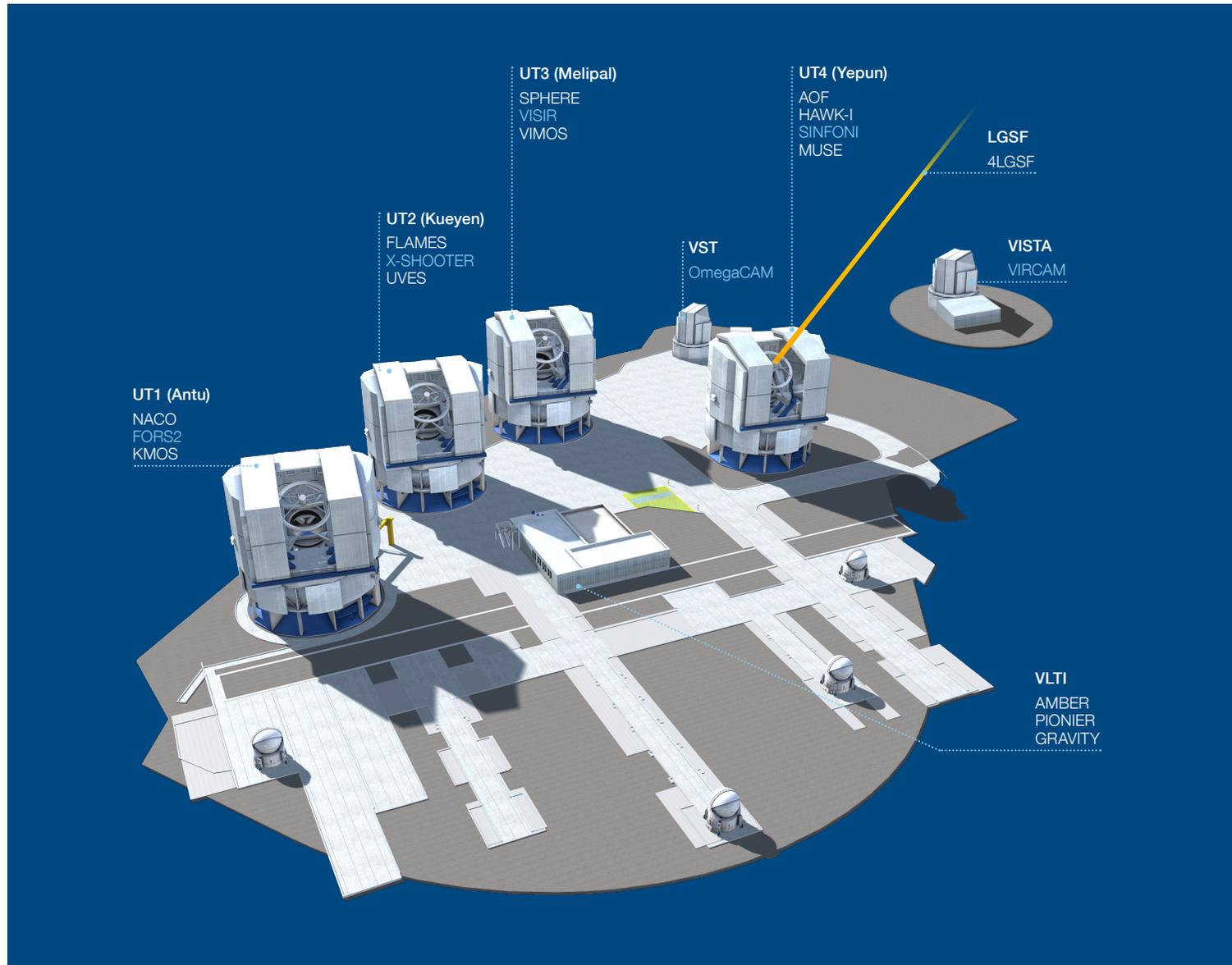


# Outline

- Overview
- Roadmap
- Challenges



# Paranal 2016





# The Projects..

Project Name	Description	Status
1. MUSE	Giant Optical IFU	Operations, PAC pending
2. GRAVITY	VLTI Astrometry	Operations/Commissioning
3. MATISSE	VLTI mid IR imager	Integration Europe/PAE
4. ESPRESSO	High Resolution UT1 & UT4	Integration Europe/Paranal/ PAE
5. ERIS	AOF Imager and Spectrograph	Detailed Design
6. NACO Refurbishment	Spare parts for NACO Survival	Ongoing
7. CUBES	UV Spectrograph	Awaiting Brazilian ratification (suspended)
8. CRIRES+	Upgrade, X-disperser, new detectors	Integration Europe
9. MOONS	IR Multi-Object Spectrograph for VLT	Detailed Design
10. 4MOST	Optical Multi-Object Spectrograph for VISTA	Detailed Design
11. X-Shooter ADC	X-Shooter ADC repair	Integration Europe
<b>VLTI Facility</b>		
12. PR1	AT Service Station	Completed
13. PR2 – PRIMA	PRIMA Astrometry	Discontinued
14. PR3	NAOMI (AO for ATs)	Detailed Design
15. PR4	Infrastructure for MATISSE & GRAVITY	Construction
16. PR5	GRA4MAT Fringe Tracker	Design
17. PR6	Coordination, System	Design
<b>AOF</b>	AO Secondary for UT4 plus its sub-systems:	Commissioning
18. 4Lasers	AOF Lasers & Launch telescope	Completed
19. DSM	Deformable Secondary Mirror	Commissioning
20. GALACSI	AO module for MUSE	Commissioning
21. GRAAL	AO module for HAWK-I	Commissioning
22. UT4 Upgrade	UT4 Preparation & modification	Completed
<b>LA SILLA</b>		
23. LFC for HARPS	Laser Frequency Comb	Testing La Silla
24. SOXS @ NTT	X-Shooter – for NTT	Definition
25. NIRPS@3.6m	IR Planet RV and atmospheres	Definition t/ Preliminary Design



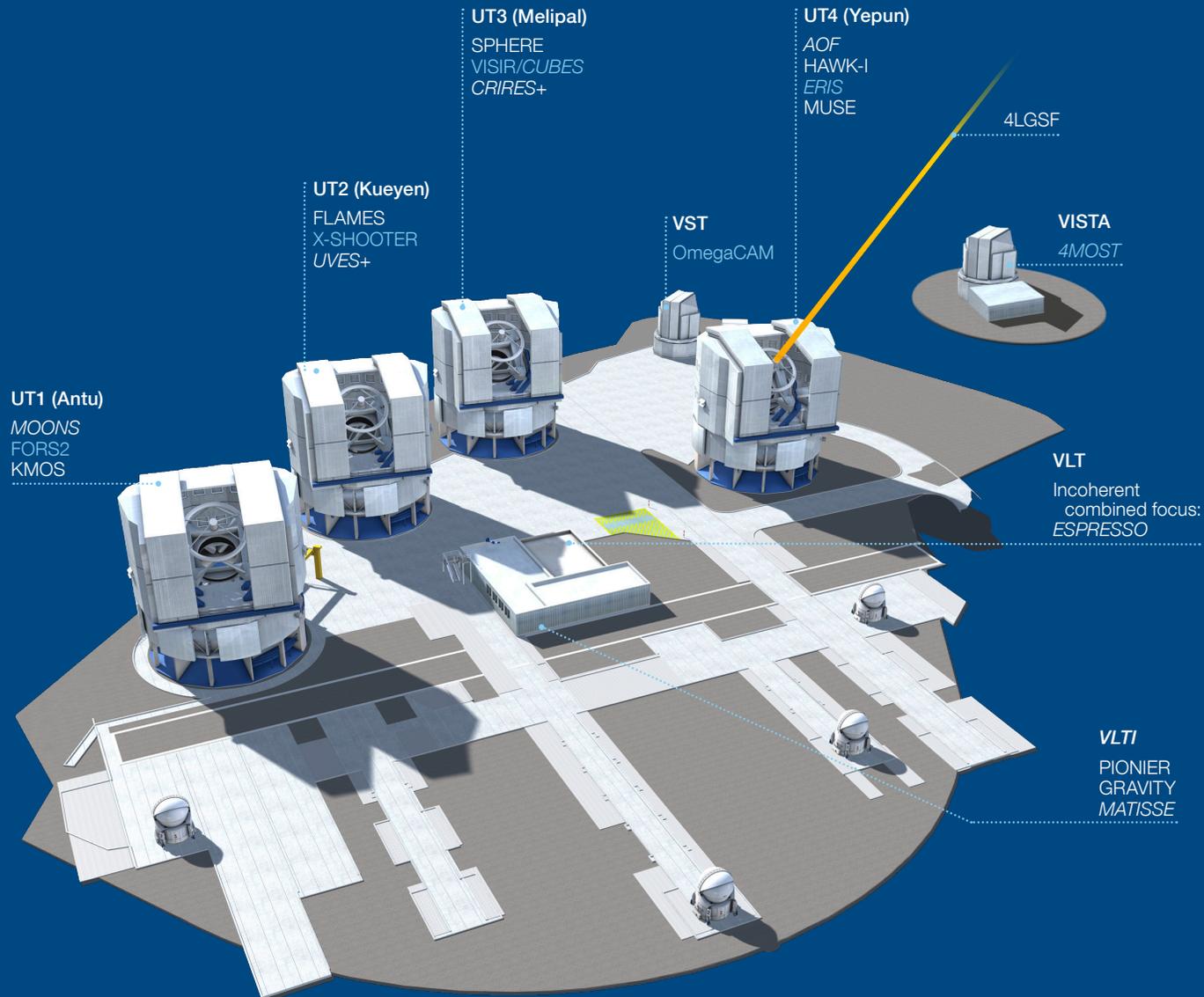


# The Roadmap

Year	Phase A	Design & Construction	Delivered
2013		CRIRES+ MOONS	MUSE
2014	NTT Call for Ideas	4MOST	SPHERE PRIMA Astrometry (discontinued)
2015		NIRPS (New I) NACO Survival	LFC for HARPS VLT PR1 GRAVITY BCI
2016		SOXS (New I) X-Shooter ADC	GRAVITY CIAO VISIR Upgrade VLT PR4 NACO Survival
2017	New II (for UT4)	CUBES(?)	ESPRESSO X-Shooter ADC MATISSE CRIRES+
2018	New III (Upgrade)	New II (for UT4)	AOF VLT PR3 & PR5
2019	New IV	New III (Upgrade)	NIRPS & SOXS(?) MOONS
2020	New V	New IV	ERIS CUBES(?)
2021	New VI	New V	4MOST

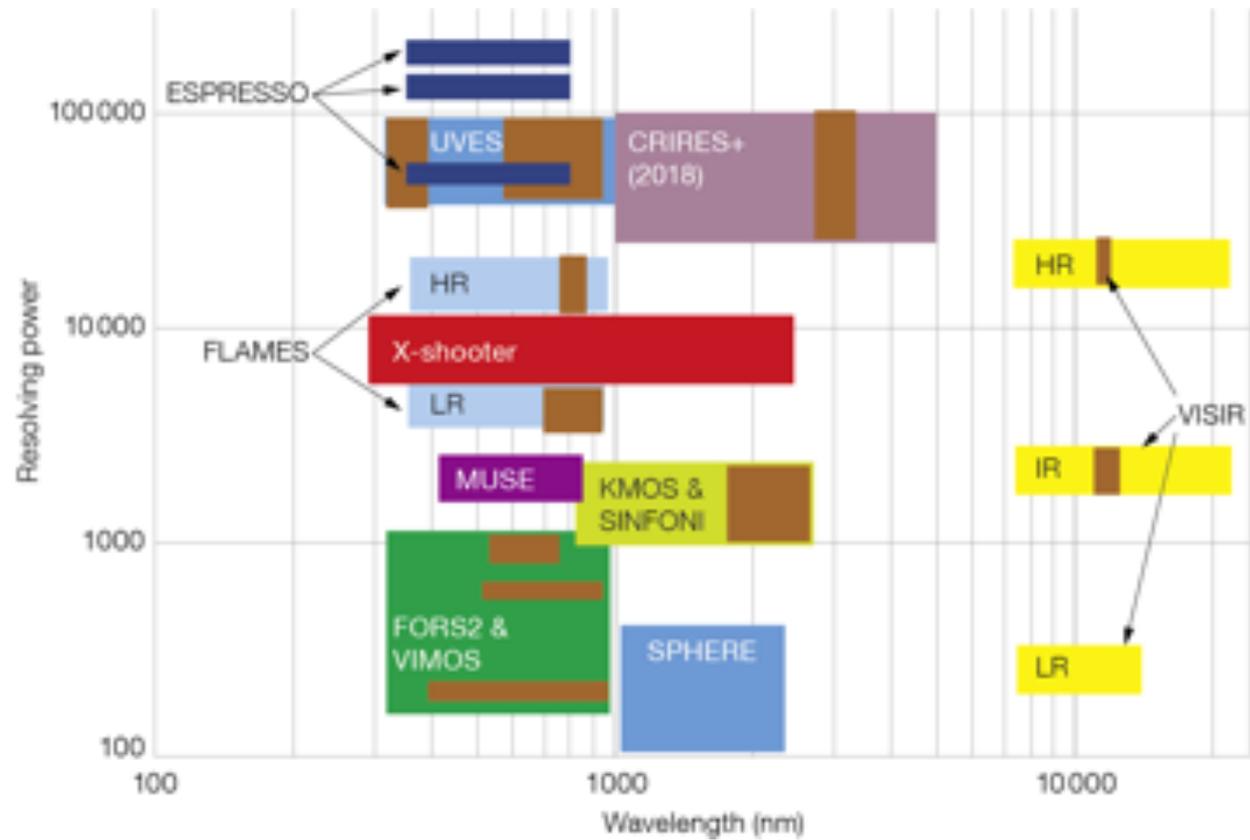


# Paranal in 2021

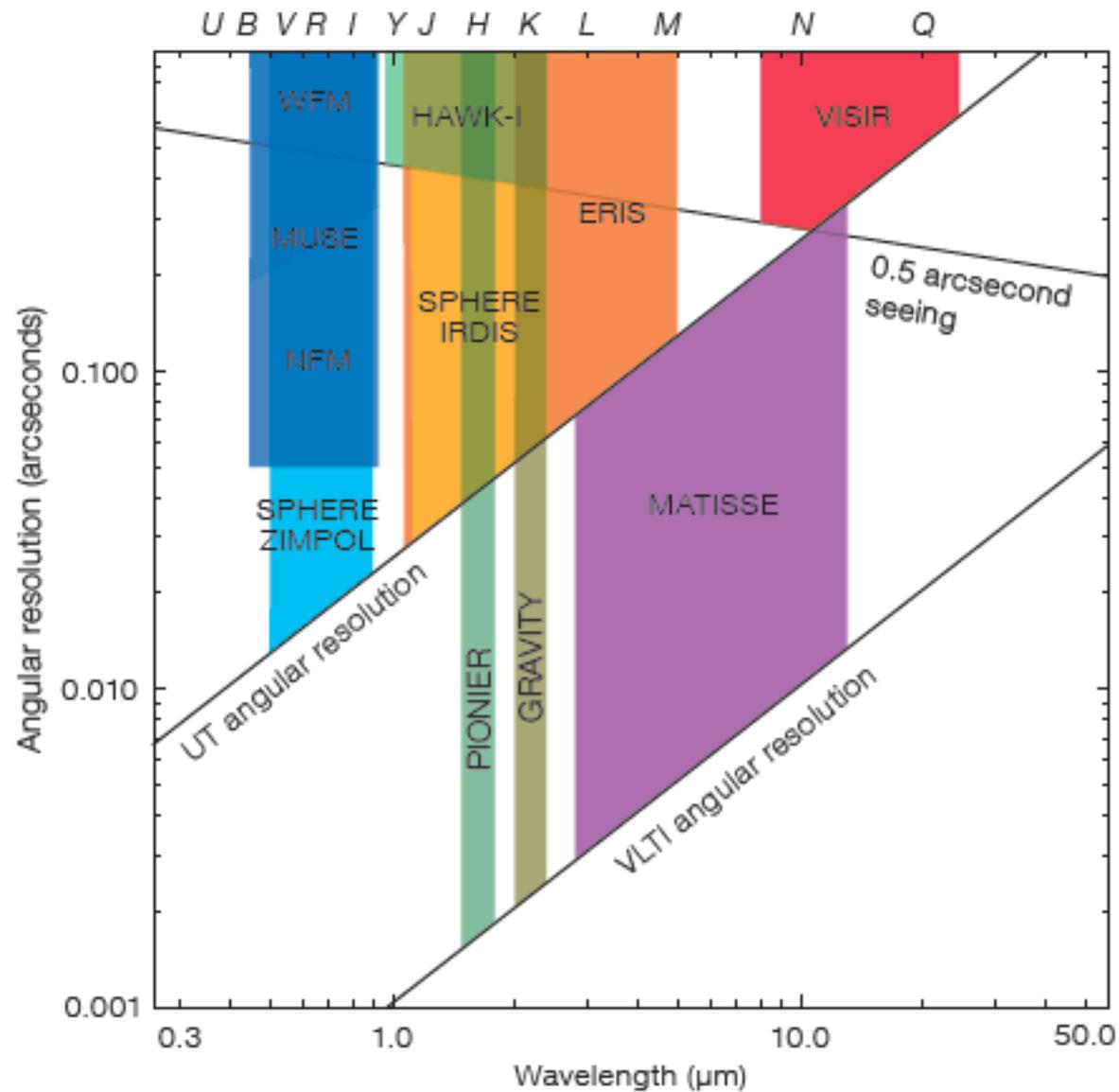




# Spectroscopy...



# Imaging...



# Beyond the Figures

- High precision spectroscopy: (HARPS, ESPRESSO, CRIRES+, NIRPS)
- IFUs: MUSE, FLAMES, SPIFFI, KMOS..
- High Contrast Imaging: NACO, SPHERE, VISIR, ERIS
- Polarimetry: FORS, HARPS, CRIRES+..
- VLTl...
- Powerful mixture of work-horses and more specialized instruments
  - ALL NEED TO BE CALIBRATED



# New II (Nasmyth AOF)

- AO community workshop in September 2016 (STC581)
- Recommendation for a Visible AO (MCAO based), large FoV (up to  $\sim 1$  arcmin), (post-HST era)
  - Stellar Populations in resolved objects: GC and Local Group dwarfs, including astrometry and time-domain photometry
- Start a Pre-Phase A study in 2017, Goal
  - First Science cases
  - Broad Top level Requirements
  - Develop possible concept(s)
  - Study feasibility
  - Set up a WBS, individuate missing expertize/effort at ESO

# Upgrades (2018+)

- FORS2 – initiated by IOT – mainly detector plus survival at the front edge for 15+ years. First in the line
  - Revitalize FORS1? (UT3 Cass.... Optimization ...)
- UVES – survival at the front edge for 15+ years
  - Fix format ? Limit R range ? ....
- CUBES – stopped but UV need remains...
  - Discuss potential avenues with PI
- SPHERE: Pyramid WFS, higher frequency corrections, fibre coupling to CRIRES+ and/or ESPRESSO



# Calibrations Challenges

- **CRIRES+** (several today)
  - Attaining radial velocities at un-precedent precision in IR
  - Aiming at high spectral fidelity – also rather new in IR
  - Lamp Calibration Line List..
  
- **MOONS (4MOST)** (Drass, Rodriguez)
  - Sky subtraction (IR)
  - Fibre stability (operational efficiency)
  
- **Science Data: Calibrating the surveys (GES experience..)** (Gonzales-Fernandez, Lupton for photometry)
  - MOONS-4MOST synergies ?



# Calibrations Challenges

- Accuracy, beyond Precision (Tuesday Morning)
  - ESPRESSO RV & GRAVITY astrometry aim at precisions which cannot be simply proven by observing objects in the sky
  - Some ESPRESSO science cases require high wavelength accuracy (e.g. physical constant variability)
  - How far are we to have a fully working LFC?
  - Th-A lamp availability ?
- Extended/increased use of external Metrology ?
  - Can we find the equivalent of a laser frequency comb for astrometry?
  - Observatory-wide facilities (e.g. comb??)

# New challenges?

- AO related (see also later today this morning)
  - Astrometry – stability PSF – shape PSF etc..
  - Photometry – PSF control
- The large number of AO-supported instruments, and AOF is likely going to require a novel effort to understand and control AO – fed instruments.
  - This is propedeutical to E-ELT as well
- Astrometry in my opinion is going to play an increasing role in VLT science in the future.



# Couple of Questions

- To which extent we calibrate instruments and not only data ?
  - Which further steps in this direction?
  - Is it worth to go beyond the present state?
- What feedback to the instruments builders/providers ??



**THANK YOU !**

