# Paranal in the era of E-ELT

A white paper for discussion

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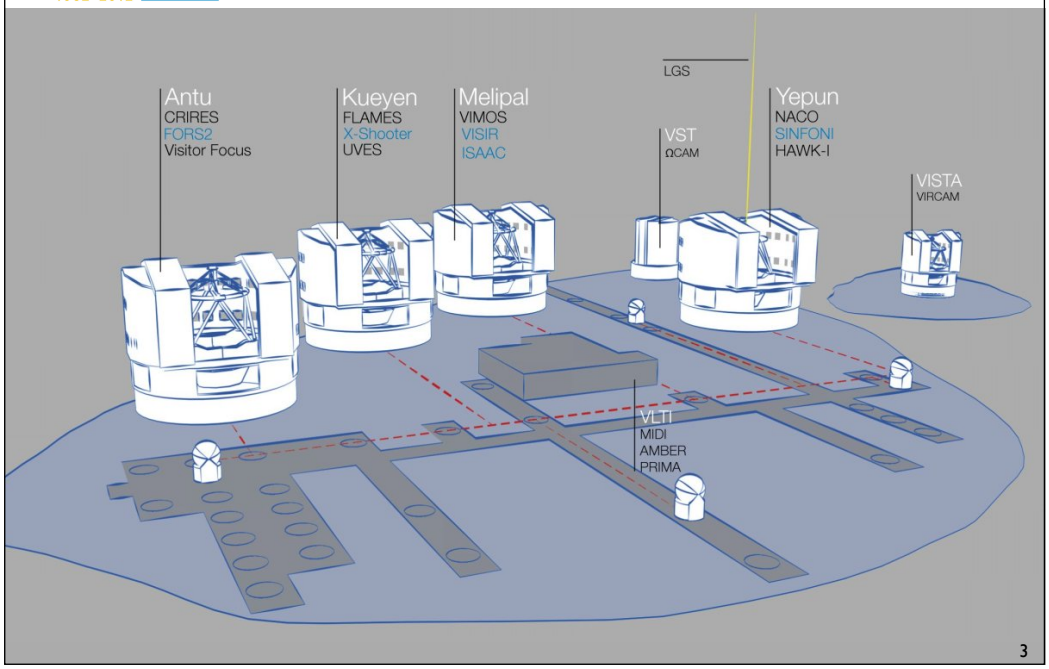
# Introduction

- Questions:
  - Is the VLT operations model suitable for the E-ELT?
  - What is the future of the VLT in the next decade (2020-30)?

# Integrated system




# Science strategy

- How do we make maximal use of the existing facilities while working to break new ground with new projects?
- Do we have a scientific advantage, and how do we exploit it?
- Should we be formulating the science questions rather than responding to them?



# Formulating the questions

- Yes with the E-ELT!
  - Being better vs first, or both
- What about Paranal:
  - Need to be first in instrumentation
    - Shorten our instrumentation cycle
    - Go to sky sooner and with greater ambition
      - Accept risk of occasional failure
  - Lead from the front rather than from the rear!

# Facilities circa 2030

- JWST warmed up
- ALMA in its second decade
- EUCLID flying or mission completed
- 4th gen CMB mission (polarization)
- IXO operational
- Cherenkov Telescope Array in operations
- GAIA legacy
- LSST fully functional
- ...



# Science scene

- Most ASTRONET questions answered (?)
- Possibly remaining (out on a limb...):
  - Dark energy ≡ Λ
    - ➡ What was the Universe like before the big bang?
  - Earth analogs in habitable zones found
    - ➡ Observation of signatures of life
  - Dark matter not found (!?)
    - ➡ New theory of gravity

# Paranal circa 2025

- Will have reached 25-year design lifetime
- AOF, MUSE, HAWK-I+AO, KMOS, SPHERE, ESPRESSO, (ERIS): operational for years
- VLTI: long term PRIMA programs, GRAVITY, MATISSE
- VST/VISTA second generation surveys
- Regardless of speed of E-ELT Paranal will still be required to satisfy the community



# Options

- Box thinking
  - A tactical view (requires faster instrumentation cycle)
    - Expand/open parameter space
    - Synergy with E-ELT
- Strategic view
  - Reevaluate Paranal and its operations at a fundamental level
  - Breaking the paradigm (change in observatory configuration)
  - Good track record for successful aging facilities
    - 3.6+HARPS, 2dF@AAT, megaCAM@CFHT, wfCAM@UKIRT
- Both would require discussion in wide forum

*Note: it is not implied that either is better or that they cannot be combined*

# Tactical options

- Operations
  - E-ELT ops based on VLT paradigm — early 20s
    - Evolution: remote service mode*
  - Extremely large programs (200-300 night/year) — early 20s
    - On 4 UTs to solve specific problems (not surveys!)
  - Change allocation process — soon?
    - Rapid turn around: immediate response to new results
  - Keck-style remote visitor mode* — soon?
    - Savings in cost/time; reduce carbon footprint
    - Extremely appreciated by community

* *Need to address risk of disconnection between staff and community*



# Tactical options (II)

- Instrumentation
  - AO in the blue ($res_{VLT@4000A} = res_{E\text{-}ELT@K}$) — late 20s
    - Use E-ELT technology + powerful lasers
  - NGS-only MCAO — early 20s
    - Support community R&D, test on NTT (?), deploy at VLT and eventually at E-ELT
  - MOS followup of LSST and GAIA — mid-late 20s
    - Simplified instrument at each UT, 200+ nights/year, $>10^6$ spectra/year
  - Become nimble (rapid deployment, 3-4 years) — now?
    - Expand on concept of visitor instrument, more ESO support*
    - Potentially narrow scientific goals

* *However, no resources foreseen/available if started now*

# Tactical options (III)

- New facilities
  - Possible hosting of external projects — 20s+
    - New synergies, or exploit existing infrastructure
  - Specialize one or more telescopes — late 20s
    - Not necessarily UTs
    - If UTs, effects on VLTI?
  - Medium sized programmes — mid-late 20s
    - React to new requirements from community



# Strategic options

- Close VLT if nothing new found to do — >2030
  - Release 300 M€ in10 years for new projects
- Operate at much reduced costs — mid-late 20s
  - UT+single instrument for period of years
    - e.g. X-Shooters@CasUT1/2/3, UVES-like@UT2, MOS@UT3, HAWK-I@UT4
- Switch to interferometry — late 20s
  - Two more ATs & DLs, shorter λ, 6-8 beam combination
- Create new imaging interferometer — late 20s
  - Back to original homothetic mapping

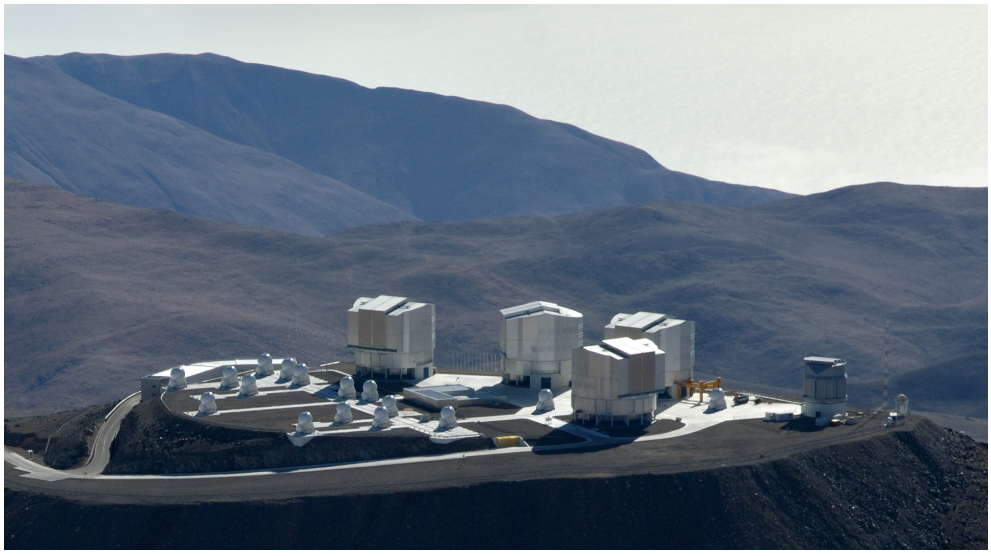
# Conclusions (I)

- The immediate and medium term future of the observatory contains many of the elements that have been successful in the past
- Process/resources in place to continue on the same path past 2020
- A strategic redirection of the observatory would have profound sociological impact on the community and would create a transition that could require or even impose big community changes
- An evolutionary model would be likely to succeed but the lifecycle of deployments would have to be accelerated if we are to move to science driven capabilities rather than capabilities driven science



# Conclusions (II)

A possible future for the VLT...



# Process

- The initial ideas have been presented to STC, Council and internally to the ESO astronomers
- Feedback will be incorporated, with the aim of producing a white paper on the future of Paranal in the E-ELT era
- Subsequent iterations will be presented to the ESO committees in the Fall and Spring meetings
- Community input is solicited. Preliminary discussions with the VLTI community took place last year. The discussion today will be a first step leading to a community-wide workshop in 2013
- The aim is to finalize the white paper by end 2013



# Discussion

- Questions on presentation
- Possible items to start the discussion
  - Strategic solutions: consequences/process
  - Specialization or non specialization
  - What mixture of "fast" and "slow" instruments
  - Should offloading E-ELT be a driver
  - What have we missed