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THE EUROPEAN ELT: STATUS REPORT

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Abstract. This paper provides a brief status report on the European Extremely Large Telescope (E-ELT) as presented at the annual meeting of the French Astronomical Society (SF2A) held in Marseille in June 2010. The project is now proceeding to the end of its Phase B that lasted four years, the results of which will form the basis of the proposal for construction that will be submitted to the ESO council for approval. The decision is expected to be taken in 2011. In parallel to the Telescope Phase B, Instrument Phase A studies have been completed from which a comprehensive instrumentation plan could be drawn.

Keywords: telescope, instrumentation

1 Introduction

The last report on the European Extremely Large Telescope (E-ELT) situation at the Annual Meeting of the SF2A was in 2006, four years ago. Since then the project has been formally kicked into Phase B after the 'Towards the E-ELT' conference that took place in Marseille in November 2006, de facto marking the start of the E-ELT project as we know it today. Since then, this Phase B is about to be completed : several key industrial studies, some of them including the manufacturing of prototypes, have been performed ; ten instrument and adaptive optics phase A studies have been completed ; the site has been selected ; funding scenarios have been elaborated. This paper provides an ultra-short status report on some of these aspects.

2 The E-ELT project

2.1 The telescope

The ASTRONET Infrastructure Roadmap identified the European Extremely Large Telescope (E-ELT) as the first of two top-priority facilities to be implemented in the coming decade. The E-ELT will be a ground-based astronomical observatory with a 42-meter diameter segmented mirror. The design features a filled aperture mirror with an area of 1,300 m^2, and an original 5-mirror design that includes a 6-m secondary convex mirror (M2), a 2.5-m adaptive optics mirror (M4), and a 2.5-m tip-tilt mirror (M5). Adaptive Optics is fully integrated in the telescope design (M4), and by default the telescope will operate in Ground Layer Adaptive Optics (GLAO) mode.

The ESO budget for the Phase B was of the order of 60 M€and further funding was available through the FP6 and FP7 European programmes. This allowed carrying out a number of industrial studies for key elements of the telescope. Two contracts have been placed for the manufacturing of seven prototype segments of the primary mirror (at the extreme edge of the primary mirror). Other studies have been performed and prototype developed for the M4 adaptive mirror which is one of the most delicate elements of the project. Several studies were performed in industry for the telescope structure and for the dome.

The outcome of these studies have allowed to improve the technology readiness level of the project and to accurately estimate its cost and the schedule for its construction.

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2.2 The instruments

Eight Phase A instrument studies have been performed, as well as two studies for the Multi-Object and Laser Tomography Adaptive Optics (MCAO and LTAO) modules. Table 1 shows the instrument names, basic properties and main scientific objectives that have been studied as part of the E-ELT phase B programme.

These studies were performed in the timeframe 2008-2009. The results of these studies should allow to draw a comprehensive instrumentation plan, based on the scientific priorities of the project in its first decade of operations and beyond.

Table 1. Instrument studied in Phase A.

Name	Type	Spectral Range (μm)	Field (linear) and sampling (mas.pix^{-1})	Spectral Resolution	Adaptive Optics mode	Scientific drivers
MICADO	Diffraction Limited Imager	0.8 - 2.4	1' 1–4	10–100	MCAO	Black Holes Galactic Center Globular Clusters Resolved Stellar Pops.
HARMONI	IFU	0.8 -2.4	1" – 10" 4 – 40	4000-20000	SCAO LTAO	Stellar disks Star forming regions Resolved Stellar Pops. Black Holes
EAGLE	Multi-IFU ($\sim$ 20)	0.8 - 2.4	$\sim$ 7' 40	4000-10000	GLAO MOAO	First Galaxies Evolution of Galaxies Resolved Stellar Pop.
CODEX	High Resolution High Stability Spectrograph	0.4-0.7	1"	$>$ 120000	–	Expansion of the Universe Extrasolar twin earths Variability of physical ctes
METIS	Imager & Spectrograph	3.5 – 14	18" 15–30	5 5000 100,000	SCAO LTAO	Solar System Extrasolar planets Planet Formation Growth of SMBHs
EPICS	High Contrast Imager	0.6-1.8	2" - 4" 2	$>$ 50 3,000 20,000	XAO	Extrasolar Planets Stellar Disks Planet formation
OPTIMOS	MOS (>100)	0.4-1.7	$\sim$ 7' 5	1000-10000	GLAO	Resolved stellar Pops. Evolution of galaxies Evolution of galaxies
SIMPLE	High Resolution Spectrograph	0.8-2.4	Slit 0.027"$\times$ 4"	>100000	SCAO	Exoplanets Stellar populations High-z IGM

2.3 The site

Several sites were in consideration for hosting th E-ELT: La Palma in the Canary islands, and Cerro Armazones (see figure 1), Cerro Tolonchar and other sites in the vicinity of Paranal and Armazones in Chile. Other sites were considered in Morocco and in Argentina. A Site Selection Advisory Committee was established to assist ESO in analyzing the data from the site testing campaigns and to make recommendations. Some of the sites were tested by ESO and the others by the Thirty Meter Telescope (TMT) project, and the data were shared between the two teams under the terms of a collaborative agreement.

2.4 Cost and schedule

An internal ESO review took place in the fall of 2010 to review the results and findings of the Phase B. The results of this review will be folded in the proposal for construction that will be presented to the ESO council

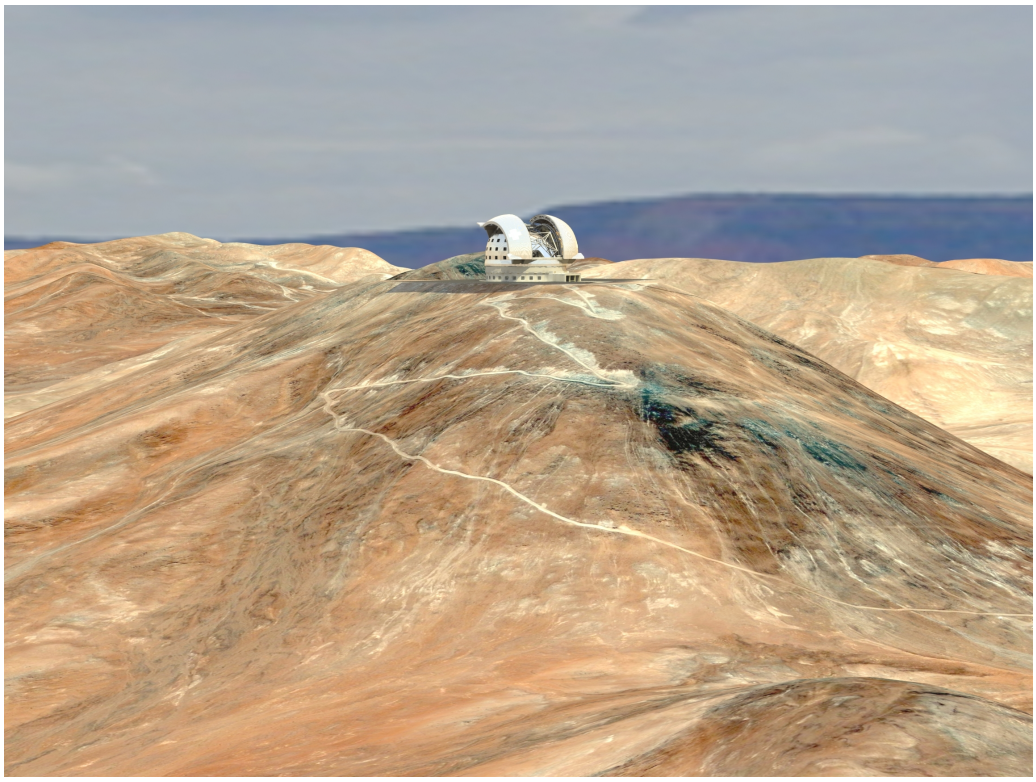

Fig. 1. Impression of the E-ELT atop Cerro Armazones

in 2011 for approval. The anticipated cost of the project is likely to exceed one billion Euros (the precise cost estimate that will be submitted to council is unknown at time of writing this status report). This cost largely exceeds what is available in the long range plan of ESO, and it is therefore necessary to find major partners that would join the project and/or ESO as well as increasing the financial contribution of the current member states. Financing the project is the most outstanding issue remaining to be resolved before the project can be officially launched.

3 French E-ELT activities

A working group was setup by INSU in 2004 to coordinate the ELT activities in France back at a time when the E-ELT project did not exist, with the ESO OWL 100-m telescope project and the Euro50 project promoted in some European countries. With the clarification of the European landscape in 2006 and the launch of the first instrument studies while the project was steadily proceeding into phase B, the activities of the working group were terminated and de facto replaced by the participation into several instrument Phase A studies.

The participation of French institutes in the instrument Phase A studies were:

- The Centre de Recherche Astronomique de Lyon (CRAL) was CoI of HARMONY
- The Laboratoire d'Études spatiales et d'instrumentation en astrophysique (LESIA) was participating as Co-I to MICADO, ATLAS and EAGLE.
- The "Galaxies, Etoiles, Physique, Instrumentation" (GEPI) was PI of one of the two competitive OPTIMOS phase A studies, and was participating as Co-I to ATLAS and EAGLE
- The Laboratoire d'Astrophysique de Marseille (LAM) was PI of EAGLE, PI of the other OPTIMOS Phase A study, participated to EPICS and had a minor contribution to ATLAS
- The Service d'Astrophysique of the Commissariat à l'énergie Atomique (SAp/AIM/CEA Saclay) was Co-I of METIS

- The Laboratoire d'Astrophysique de l'Observatoire de Grenoble (LAOG) was Co-I of EPICS
- ONERA was PI of ATLAS, CoI of MAORY, EAGLE and participated to the studies of HARMONY and OPTIMOS

In September 2010, ESO has announced to the instrument PIs its intentions concerning the selection of the E-ELT instruments. The two first light instruments have been selected, namely HARMONI and MICADO. No decision is taken for the suite of instruments that will follow, and a notional plan indicates that the third instrument could be selected in 2012 or 2013 for a start of construction in 2014, while other instruments would start at approximately 2-year intervals thereafter.

4 Conclusion

The E-ELT is the top priority project for the European community, as clearly expressed in the ASTRONET roadmap. The project Phase B is nearing completion, and a formal proposal for construction will ensue. Major industrial studies have been completed for the sub-systems that are critical to the project, increasing the overall Technology Readiness Level of the whole project and allowing ESO to better estimate the cost and schedule for its construction. Drawing a comprehensive instrumentation plan that would clarify what the scientific priorities of the project are for its first decade of operations remains to be elaborated.