Mem. S.A.It. Vol. 86, 381

Memorie della

E-ELT development status

R. Tamai

European Southern Observatory, Karl-Schwarzschild-Str 2, Garching, D-85748, Germany
e-mail: rtamai@eso.org

Abstract. The European Extremely Large Telescope (Figure 1) is a project of the European Southern Observatory to build and operate a 40-m class optical near-infrared telescope. The telescope design effort is largely concluded and construction contracts are being placed with industry for the various components, and academic/research institutes for the scientific instruments. The siting of the telescope in Northern Chile close to the Paranal site allows for an integrated operation of the facility providing significant economies. The most recent progress of the project in various areas is presented.

Key words. Telescopes

1. Introduction

The E-ELT (Gilmozzi & Spyromilio 2007; Tamai & Spyromilio 2014) was formally approved by ESO Council back in 2012 with the requirement that major spending should be initiated only when the funding level would reach 90% of the total cost to completion. This was expected to be reached soon when Brazil would formally join ESO as a new Member State. However, the accession procedure of Brazil taking more time than originally anticipated, ESO Council decided in December 2014 to give the green-light for the construction of a first phase (Phase 1) that could defer the development of some components while preserving the future science capabilities and synergy with other project such as the James Webb Space Telescope.

Since then, the Programme has been working at full speed to initiate the most time-critical procurements that includes the Dome and Main Structure industrial contract (expected to be the largest contract in ESOs history) as well as a comprehensive suite of first instruments to be developed by consortia of science institutes in ESO Member States. The status of the Programme in mid-2015 is summarised below.

2. Telecope & infrastructure status

The construction of the road and the top platform at Cerro Armazones, about 25-km away from Paranal, is almost complete. This contract was the only exception to the spending constraint mentioned above and was signed with the Chilean company ICAFAL Ingeniera y Construccion S.A. back in late 2013. The ground breaking ceremony was held on June 19, 2014 (Figure 2) in the presence of several distinguished guests and high-level officials from both Chile and the ESO Member States. The flattening of the Platform is now completed to within ±10-cm (Figure 3). Most of the 24-km access road is completed and accepted and asphalt coating (Figure 4) is under execution. This important site preparatory

Fig. 1. Artist impression of the E-ELT

work, crucial for the rest of the construction, is expected to be complete in fall 2015.

Fig. 2. The first blast on top of Armazones during the Ground Breaking Ceremony on June 19, 2014 marked the start of the site preparation activities that include the construction of a 25-km access road and the flattening of the top of the mountain.

In its May 2015 meeting, ESOs Finance Committee approved the final negotiation for two industrial contracts and the agreements with consortia of science institutes for the construction of three science instruments and an adaptive optics module as well as the study of a further adaptive optics module. The approved industrial contracts include the production of the thin shells (Figure 5) of the 2.5-m diameter M4 adaptive mirror (6 petals, only 1.95mm-thick) as well as the final design and construction of the complete M4 Unit (Figure 6) supporting the deformable thin shells and responsible to apply the telescope adaptive optics correction employing about 5600 voice-coil actuators controlled at a frequency of 1-kHz.

3. Instruments

As far as Science Instruments are concerned, the May 2015 Finance committee approved the commitment of almost the complete Phase 1 instrumentation budget by authorizing the preparation of agreements for the design and construction of the first two first light instruments (MICADO and HARMONI) including a multi-conjugated adaptive optics (MCAO) module (MAORY), as well as a third instrument (METIS). Furthermore, the preliminary design study for a laser tomography adaptive optics (LTAO) module was also approved. These are briefly described below:

Fig. 3. The top platform at Armazones after flattening by the company ICAFAL whose workers proudly signed the Chilean flag seen in the foreground at completion of the work.

Fig. 4. Asphalt work on the access road to Armazones

3.1. MICADO

MICADO is the adaptive optics imaging camera for the E-ELT. It has been designed and optimized to be accompanied by the LGS-MCAO system MAORY, and will provide diffraction limited imaging over a wide (about 1-arcmin) field of view. It will be able to measure accurate orbits of stars orbiting black hole in our galaxy and to image individual stars in other galaxies. A key driver for the instrument design is astrometric accuracy. A consortium of institutes in Germany, The Netherlands, France, Austria and Italy will build it.

3.2. HARMONI

HARMONI is a workhorse instrument, operating over a large wavelength range (V to K), with many different spatial scales (diffraction limited to seeing limited) and moderate to high spectral resolving power (5,000 to 20,000). It is designed to work in conjunction with several different AO systems at the E-ELT: GLAO, LTAO provided by a dedicated facility (of which the preliminary design study has been approved), and SCAO incorporated within the instrument itself. HARMONI is an integral field spectrograph with a broad science case ranging from exo-planets to very high redshift galaxies. One example of the potential of such an instrument is that HARMONI will enable us to understand the formation and evolution of galaxies from the earliest times in the history of the Universe right up until the present day. Institutes in the UK, France and Spain form the consortium that will build HARMONI.

3.3. MAORY

MAORY is a Multi-Conjugate adaptive optics (MCAO) module using 6 laser guide stars to correct atmospheric turbulence in 3 separate layers. It will feed sharpened images to the MICADO imager, as well as an auxiliary port for a future instrument. It is built by institutes in Italy and France.

Fig. 5. Prototype of one of the 6 glass ceramic thin-shell petals to constitute the future M4 adaptive optics deformable mirror (2.4-m diameter and 1.95-mm thick).

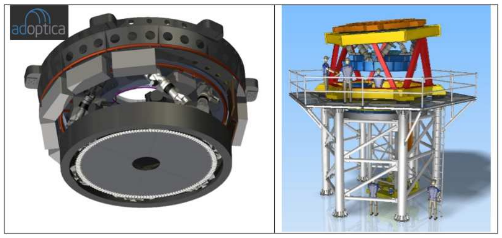

Fig. 6. The M4 Unit supporting and controlling the shape of the 6 thin-shell petals through about 5600 actuators able to compensate for the wave front errors generated by the atmospheric turbulence Left: the M4 Unit on it test tower.

3.4. METIS

METIS is the mid-infrared imager and spectrograph for the E-ELT. Covering the L, M and N bands, METIS will offer imaging and medium-resolution spectroscopy over the full wavelength range (3–14 μm), and high-resolution integral field spectroscopy in L and M bands (3–5.3 μm). METIS is the only instrument to cover wavelengths beyond 3-μm. It will be able to detect cool objects such as young planetary systems still embedded in gas. It will be built by institutes in The Netherlands, Germany, France, UK, Belgium, Switzerland and Austria.

4. Future

In addition to these agreements expected to be signed in fall 2015, the activities in the near future will be dominated by the very last stage of the call for tender for the most important contract in the E-ELT Programme and in ESO history, namely for the Dome and the Main Structure. Furthermore, intense activities are currently going-on for the procurement of the opto-mechanics with the goal to seek Finance Committee approval in 2016 for the M1 segments polishing contract, as well as the M2 and M3 mirror blanks, polishing and respective supports (cells) contracts. As far as the M1 segment support is concerned, two parallel final design contracts including the fabrication of qualification models are currently on-going since early 2015.

5. Conclusions

In summary, the E-ELT programme has entered a very busy construction era following the green light for Phase 1 last December 2014. Major industrial contracts and agreements with scientific institutes in ESO Member States are ready to be placed.

References

Gilmozzi R., & Spyromilio J. 2007, The Messenger, 127, 11

Tamai R., & Spyromilio J. 2014, Proc. SPIE, 9145, 91451E