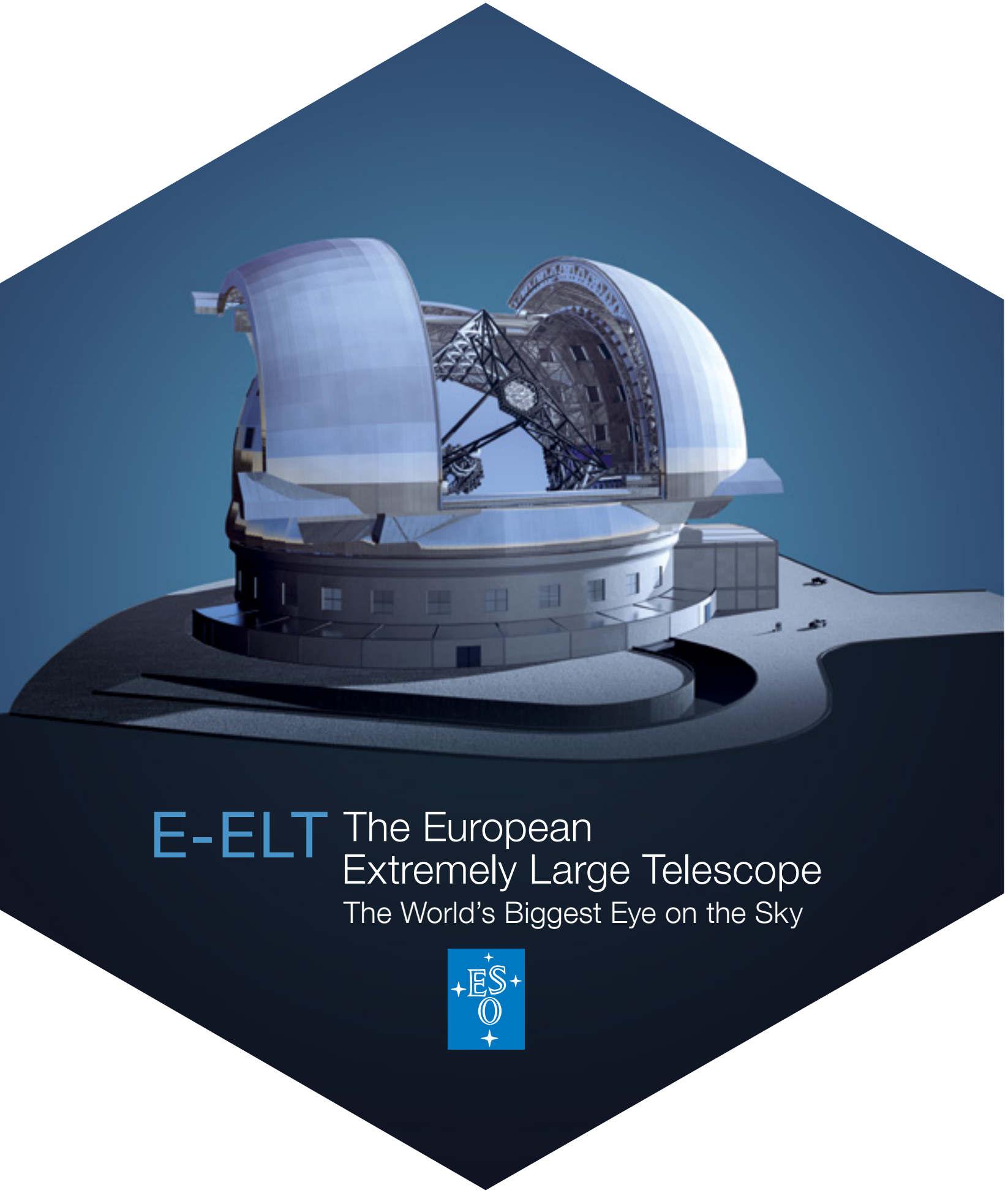


# E-ELT The European Extremely Large Telescope

## The World's Biggest Eye on the Sky

ESO

# Preparing a **Revolution**

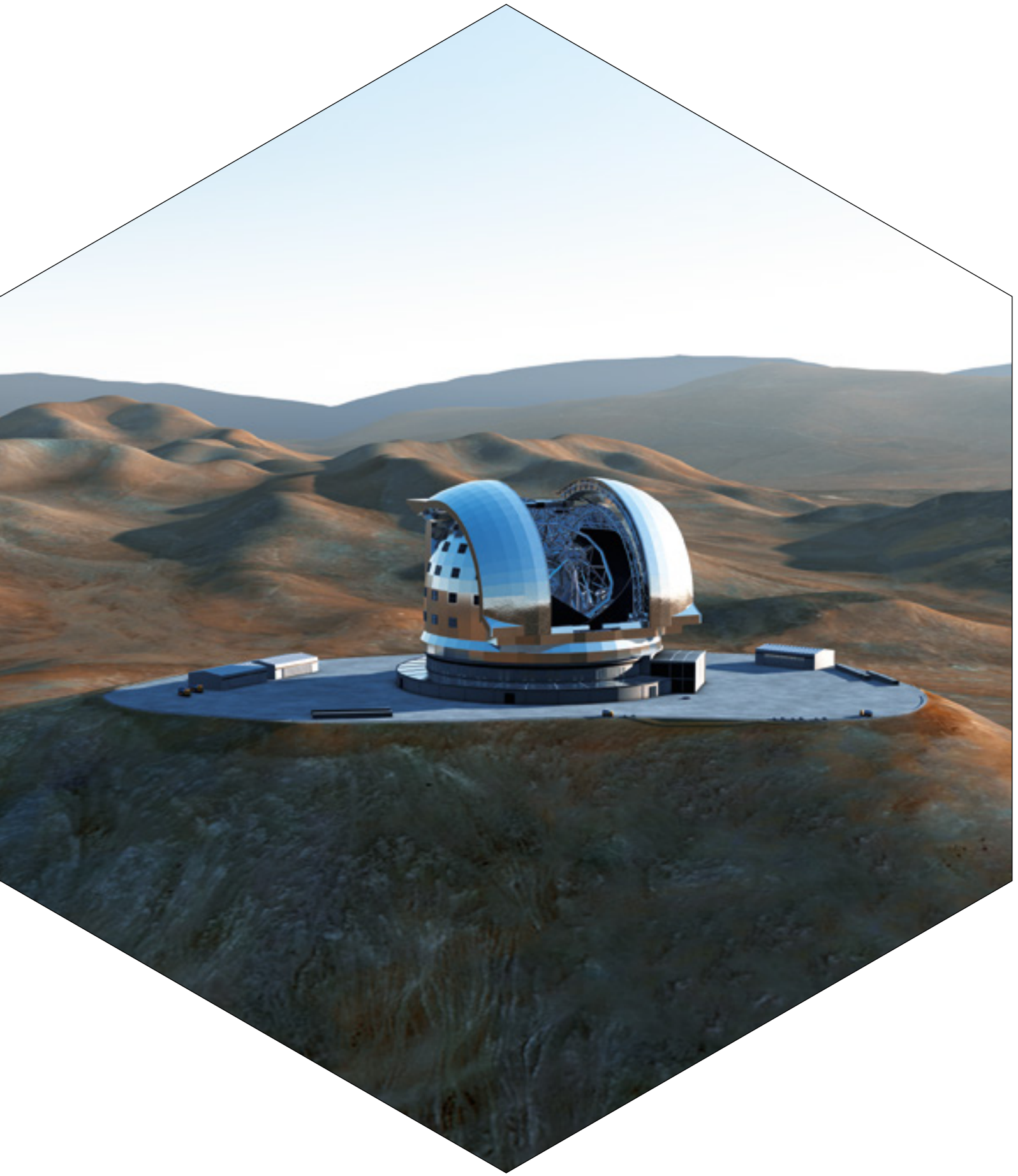
Astronomy is experiencing a golden era. The past decades have brought amazing discoveries that have excited people from all walks of life, from the first planets orbiting other stars to the accelerating Universe, dominated by the still-enigmatic dark matter and dark energy.

Europe is at the forefront of all areas of contemporary astronomy, thanks in particular to the flagship ground-based facilities operated by ESO, the pre-eminent intergovernmental science and technology organisation in astronomy. The challenge is to consolidate and strengthen this position for the future. This will be achieved with a revolutionary new ground-based telescope, the European Extremely Large Telescope (E-ELT), with a performance that is orders of magnitude better than currently existing facilities.

The E-ELT will address many of the most pressing unsolved questions in astronomy. It may, eventually, revolutionise our perception of the Universe, much as Galileo's telescope did, 400 years ago.

The European Extremely Large Telescope is a 39-metre instrument that is currently entering its preliminary construction phase. The full approval of the project is planned for 2012, with the start of operations planned for early in the next decade.

The telescope's "eye" will have a diameter almost half the length of a soccer pitch and will gather 15 times more light than the largest optical telescopes operating today. The telescope has an innovative five-mirror design that includes advanced adaptive optics to correct for the turbulent atmosphere, giving exceptional image quality. The main mirror will be made up from almost 800 hexagonal segments.



# Astronomy
## Making Sense of the **Cosmos**

Astronomers tackle key questions that challenge our minds and our imaginations. How did the planets form? Is life ubiquitous in the Universe? How did galaxies form? What are dark matter and dark energy?

Astronomy is a modern, high-tech science relying on a strong collaboration with industry to realise challenging large-scale engineering tasks. Astronomy explores the space beyond Earth and attempts to explain the incredible processes that take place in this enormous volume. It studies our earliest beginnings and tries to predict the future of our Solar System, of the Milky Way Galaxy, and of the entire Universe.

Astronomy is a science of extremes. It deals with the furthest distances, the longest periods of time, the most massive objects, the highest temperatures, the strongest electric and magnetic fields, the highest and lowest densities and the most extreme energies known.

Astronomy is a physical science based on observations. With the exception of some of the celestial bodies in the Solar System, we cannot touch or visit the objects that we investigate. To enable these observations, astronomy employs some of the most sophisticated instruments and methods ever conceived. Advanced technology plays a very important role in making progress in astronomy.

Astronomy is an integral part of our culture and is a powerful representation of our inherent curiosity and desire to know our surroundings better. Now that we have explored most of the Earth's surface, astronomy deals with the last vast unknown that surrounds us.

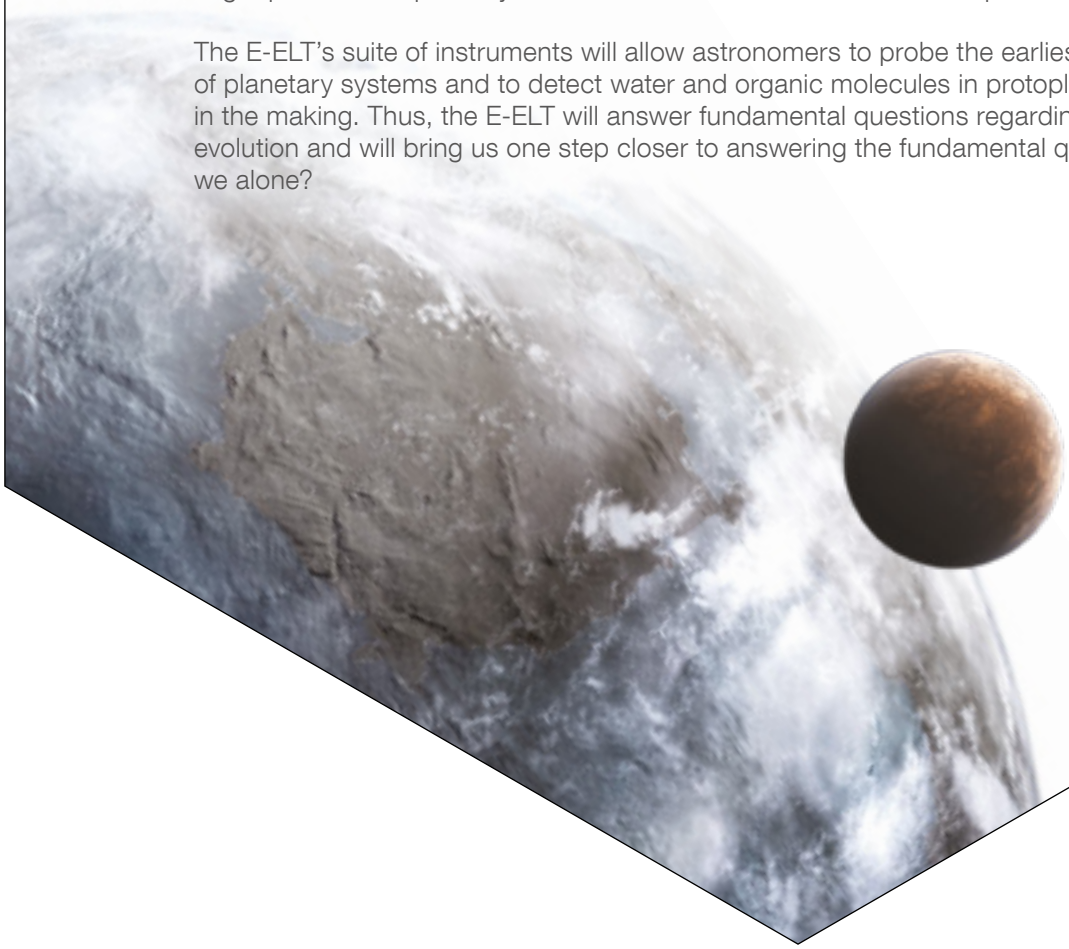
Astronomy contributes to a better understanding of our fragile environment and the intriguing fact that life is possible on Earth. Through astronomy we have been led to appreciate just how precarious and insignificant our position in the Universe really is.

# Are We Alone?

The E-ELT is taking astronomy a step further. As a 39-metre telescope with adaptive optics built in, the E-ELT will lead to many breakthroughs in the field.

The E-ELT has embraced the quest for exoplanets — planets orbiting other stars. This will include not only the discovery of planets with sizes down to Earth-like masses through indirect measurements of the wobbling motion of stars perturbed by the planets that orbit them, but also the direct imaging of larger planets and possibly even the characterisation of their atmospheres.

The E-ELT's suite of instruments will allow astronomers to probe the earliest stages of the formation of planetary systems and to detect water and organic molecules in protoplanetary discs around stars in the making. Thus, the E-ELT will answer fundamental questions regarding planet formation and evolution and will bring us one step closer to answering the fundamental question for humanity: are we alone?



# The First Objects in the Universe

By probing the most distant objects the E-ELT will provide clues to understanding how the first objects formed: primordial stars, primordial galaxies and black holes and their relationships. Studies of extreme objects like black holes will benefit from the power of the E-ELT to gain more insight into time-dependent phenomena.

The E-ELT is designed for detailed studies of the first galaxies and to follow their evolution through cosmic time. Observations of these galaxies with the E-ELT will provide clues that will help us understand how these objects form and evolve. In addition, the E-ELT will be a unique tool for making an inventory of the changing abundances of the elements in the Universe with time, and for understanding the history of star formation in galaxies.

One of the most exciting goals of the E-ELT is the potential to make a direct measurement of the acceleration of the Universe's expansion. Such a measurement would have a major impact on our understanding of the Universe. The E-ELT will also search for possible variations with time of the fundamental physical constants. An unambiguous detection of such variations would have far-reaching consequences for the basic laws of physics.

# The E-ELT Concept

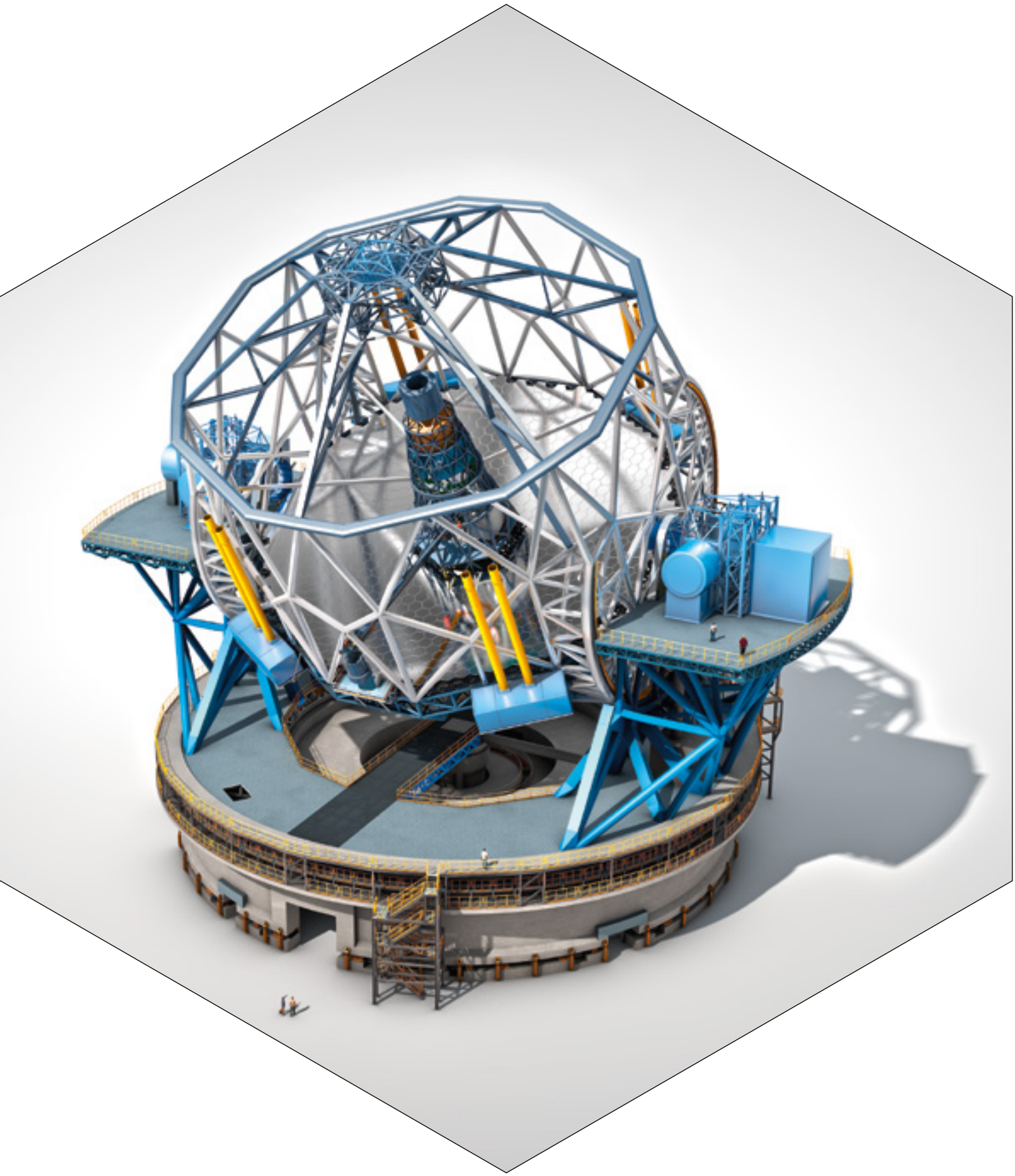
The core concept is for a telescope with a mirror 39 metres in diameter, with a field of view one third of the width of the full Moon.

The telescope is of a revolutionary optical design based on a novel five-mirror scheme that results in an exceptional image quality. The primary mirror consists of almost 800 segments, each 1.4 metres wide, but only 50 millimetres thick. Even the secondary mirror measures an impressive four metres across.

Adaptive mirrors are incorporated into the optics of the telescope to compensate for the fuzziness in the stellar images introduced by atmospheric turbulence. A special correcting mirror in the telescope is supported by more than 6000 actuators that can distort its shape up to a thousand times per second.

The telescope will have several science instruments. It will be possible to switch from one instrument to another within minutes. The telescope and dome will also be able to change positions on the sky and start a new observation in a very short time.

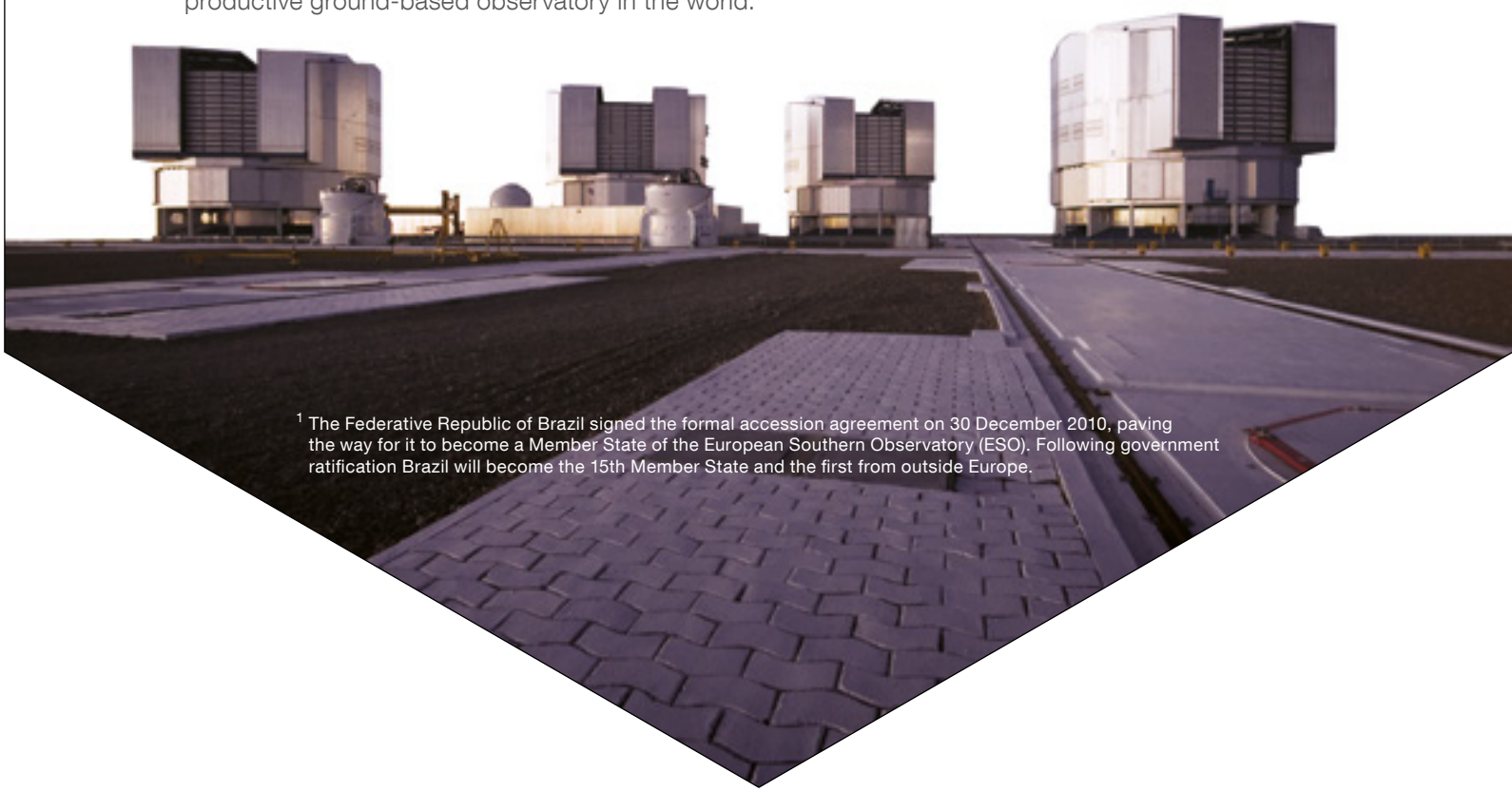
The E-ELT will be able to observe from ultraviolet to mid-infrared wavelengths.



# ESO The Most Advanced Telescopes on Earth

ESO, the European Southern Observatory, carries out an ambitious programme focused on the design, construction and operation of powerful ground-based observing facilities for astronomy to enable scientific discoveries.

ESO, which is supported by 15 Member States[1], operates the La Silla Paranal Observatory at two sites in the Atacama Desert in Chile. La Silla, a 2400-metre-high mountain 600 kilometres north of Santiago de Chile, is home to telescopes in the 3.5-metre class dedicated to high profile long-term programmes. The flagship facility is the Very Large Telescope on Paranal, whose design, instrument complement and operating principles set the standard for ground-based optical and infrared astronomy. The VLT Interferometer enhances the capabilities of this unique facility even further, as do the survey telescopes VST (optical) and VISTA (infrared). Publication statistics show that ESO is the most productive ground-based observatory in the world.



[1] The Federative Republic of Brazil signed the formal accession agreement on 30 December 2010, paving the way for it to become a Member State of the European Southern Observatory (ESO). Following government ratification Brazil will become the 15th Member State and the first from outside Europe.

ESO is also the focal point for Europe's participation in the Atacama Large Millimeter/ submillimeter Array (ALMA), an intercontinental collaboration with North America, East Asia and Chile. The ALMA partners are constructing this unique facility at the high altitude site of Chajnantor in the Chilean Altiplano. ALMA started operations in 2011, and promises to be as transformational for science as the Hubble Space Telescope.

European Southern Observatory

Karl-Schwarzschild-Straße 2, 85748 Garching bei München, Germany
Phone: +49 89 320 060 | Fax: +49 89 320 2362 | E-mail: information@eso.org

www.eso.org