First Light of the VLT Unit Telescope 1

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The VLT represents a major new step forward for world astronomy. The new concept of active control of a thin monolithic large mirror, embodied in the design, yields, even at this early stage, an angular resolution among the finest ever achieved in optical and infrared wavelengths from the ground. The full realisation of the VLT array (which will include four 8.2-metre and three 1.8-metre telescopes) will result in a combination of area and angular resolution which will permit us to achieve sensitivity comparable or superior to any on Earth. When the array is used in the interferometric mode, it will result in angular resolution superior to that yet achieved in space.

This formidable new observational capability will provide astronomers a new opportunity for the study of the Universe. In particular we will be able to probe the great questions of modern astrophysics:

• The beginning, evolution and future of the Universe we live in.

• The formations in the most remote past of large structures, galaxies and stars and their life cycle.

• The formation and evolution of planets and of the physical and chemical conditions for the development of life.

In each of these fields, VLT will give astronomy new capabilities for greater in-depth investigation and understanding, thus further enhancing the great prestige which astronomy is now enjoying in the world. The combination of high technology and deep scientific and philosophical questions is fascinating to young and old and to the general public, touching as it does on the sense of awe and wonder that accompanies our quest for the origins of the cosmos and our place in it.

For Europe this event marks the realisation for the first time in this century of a facility for ground-based optical and IR astronomy which equals or surpasses any available in the world.

Institutes of research and industries from all European member states have contributed to this effort which clearly exceeds what any European nation could achieve using its own resources. It would be impossible to recognise each contribution on this very large programme which has extended over more than a decade and represents literally more than ten thousand man years of effort.

The VLT programme has been executed within planned schedule and cost. Even at this very early stage of evaluation we can state with confidence that the technical performance of the first of the four identical 8.2-m telescopes meets or exceeds our expectations in all respects.

I should emphasise that while this moment is very significant, it is only a beginning. It marks the start of operations for a very powerful new observational facility which will be completed in 2003. The full scientific utilisation of VLT and VLTI will occur over a period of at least two decades. The new design of the telescopes, their truly exceptional realisation by industry and their excellent performance will present the astronomers with the challenge of taking full advantage of this new instrument and of inventing new ways to do their research and maximising its effectiveness. The enormous amount of data which will become available over this period will require archiving capabilities much greater than hitherto used in astronomy. Marvellous as this machine is, it will not hold its competitive edge forever, and ESO and the scientific and industrial community it represents are already at work to prepare new technology for the next round of observational facilities.

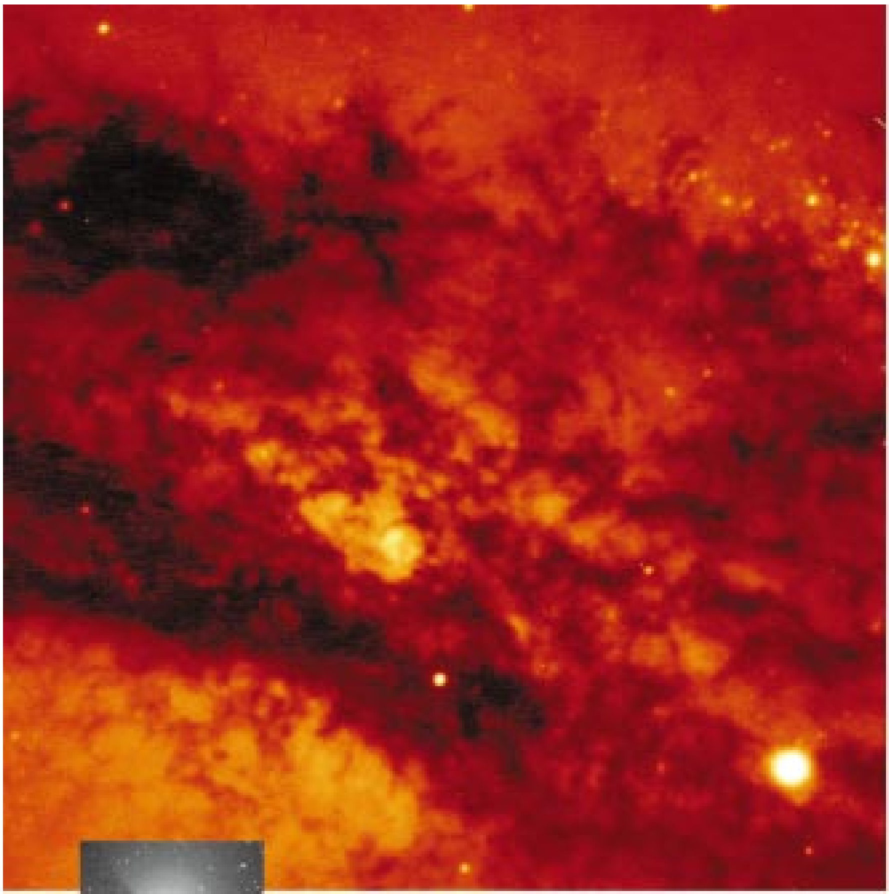
Finally I wish to recognise the united and extraordinary contributions of the ESO staff in Garching, La Silla, Paranal and Santiago. This great success of VLT of which we are all so proud is due in large measure to your competence, enthusiasm and dedication.

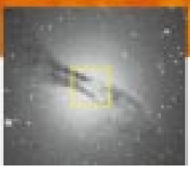
This colour image of a famous southern Planetary Nebula, the Butterfly (NGC 6302), was obtained by combining blue, yellow and red images obtained on May 22, 1998, with 10-minute exposures and an image quality better than 0.6 arcseconds.

Towards the end of their life, some low-mass stars expand to giant dimensions. They shed most of the hydrogen in their outer layers as a strong “stellar wind”, before they contract towards a final compact stage as “white dwarfs”. After this ejection process, the star remains thousands of times brighter and also much hotter than the Sun during a few thousand years. Its strong ultraviolet radiation has the effect of ionising the previously ejected gas, which then shines before it disperses into interstellar space. The resulting nebulae (traditionally referred to as Planetary Nebulae, because of their resemblance to a planet in a small telescope) often exhibit very complex morphologies.

The Butterfly Nebula belongs to the class of bipolar nebulae, as this picture clearly illustrates. A dark, dusty and disk-like structure – seen edge-on in this image – obscures the central star from our view. However, its strong radiation escapes perpendicular to the disk and heats and ionises the material deposited there by the stellar wind.

The origin of the dark disk may be due to the central star being a member of a double star system. This has been shown to be the case in some other bipolar nebulae in which, contrary to the Butterfly Nebula, there is a direct view towards the star.





Centaurus A is the closest active elliptical galaxy and one of the strongest radio sources in the sky. This image shows part of the dust lane that obscures the central regions of the galaxy. This complex structure is believed to be the result of the recent collision between the old elliptical galaxy and a dwarf, gas-rich galaxy. Intense star formation is taking place within the violently stirred gas during the merging event.

This image was taken with the Test Camera of the VLT UT1 telescope on May 22, 1998, during a short, 10-sec exposure through a red filter to demonstrate the large light collecting power of the 53-m² mirror of the VLT UT1. It shows a wealth of fine details. The image quality is about 0.49 arcsec.

The insert shows a complete view of Centaurus A taken with another telescope. The brightest stars are foreground objects located within our own galaxy, but clusters of recently formed stars are visible at the edge of the dust lane.

With powerful infrared detectors to be mounted on the VLT later this year, astronomers will soon be able to probe deep into the dust lane, infrared light being less absorbed by dust than red light.

The Final Steps Before “First Light”

The final, critical testing phase commenced with the installation of the 8.2-m primary (at that time still uncoated) Zerodur mirror and 1.1-m secondary Beryllium mirror during the second half of April. The optics were then gradually brought into position during carefully planned, successive adjustments.

Due to the full integration of an advanced, active control system into the VLT concept, this delicate process went amazingly fast, especially when compared to other ground-based telescopes. It included a number of short test exposures in early May, first with the Guide Camera that is used to steer the telescope. Later, some exposures were made with the Test Camera mounted just below the main mirror at the Cassegrain Focus, in a central space inside the mirror cell. It will continue to be used during the upcoming Commissioning Phase, until the first major instruments (FORS and ISAAC) are attached to the UT1, later in 1998.

The 8.2-m mirror was successfully aluminised at the Paranal Mirror Coating facility on May 20 and was reattached to the telescope tube the following day. Further test exposures were then made to check the proper functioning of the telescope mechanics, optics and electronics.

This has led up to the moment of First Light, i.e. the time when the telescope is considered able to produce the first, astronomically useful images. Despite an intervening spell of bad atmospheric conditions, this important event took place during the night of May 25–26, 1998, right on the established schedule.

The image shown on page 1 was obtained with the VLT UT1 on May 16, 1998, in red light (R band), i.e. while the mirror was still uncoated. It is a 10-minute exposure of the centre of Omega Centauri and it demonstrates that the telescope is able to track continuously with a very high precision and thus is able to take full advantage of the frequent, very good atmospheric conditions at Paranal. The images of the stars are very sharp (full-width-at-half-maximum (FWHM) = 0.43 arcsec) and are perfectly round, everywhere in the field. This indicates that the tracking was accurate to better than 0.001 arcsec/sec during this observation.

Omega Centauri is the most luminous globular cluster in our Galaxy. As the name indicates, it is located in the southern constellation Centaurus and is therefore observable only from the south.

At a distance of about 17,000 light-years, this cluster is barely visible to the naked eye as a very faint and small cloud. When Omega Centauri is observed through a telescope, even a small one, it looks like a huge swarm of numerous stars, bound together by their mutual gravitational attraction.

Most globular clusters in our Galaxy have masses of the order of 100,000 times that of the Sun. With a total mass equal to about 5 million solar masses, Omega Centauri is by far the most massive of its kind in our Galaxy.