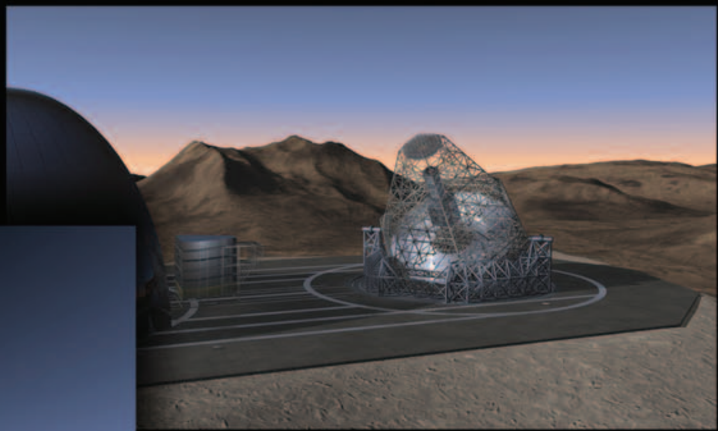
European
Southern
Observatory

Annual Report 2003



ESO

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Annual Report 2003

presented to the Council by the Director General

Dr. Catherine Cesarsky

EUROPEAN SOUTHERN OBSERVATORY

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Foreword

The foreword to an annual report usually starts with the statement that the year concerned has been a very unusual or important one in the history of the organisation concerned. Looking back over the previous year apparently often gives the impression that progress has been exceptional and the accomplishments unusually impressive. Looking back at 2003, for example reviewing the things that were discussed in Council or rereading the press releases that came out, shows that indeed 2003 again was a very important year for ESO.

In February the agreement with Spain and the bilateral agreement with North America concerning construction of ALMA were signed. In November there was a groundbreaking ceremony in Chile that marked the start of the construction of ALMA. Massimo Tarenghi was appointed as director of ALMA and the search went on for further key staff in the Joint ALMA Office. Also negotiations with Japan to join the project and enhance the facility were ongoing. It is clear that ALMA is now well on the way.

In Europe the successful conclusion of the negotiations and the subsequent decision in Council concerning the accession of Finland to ESO was another major landmark. We welcome our Finnish colleagues to the ESO community. Preparations to negotiate with Spain were started towards the end of the year.

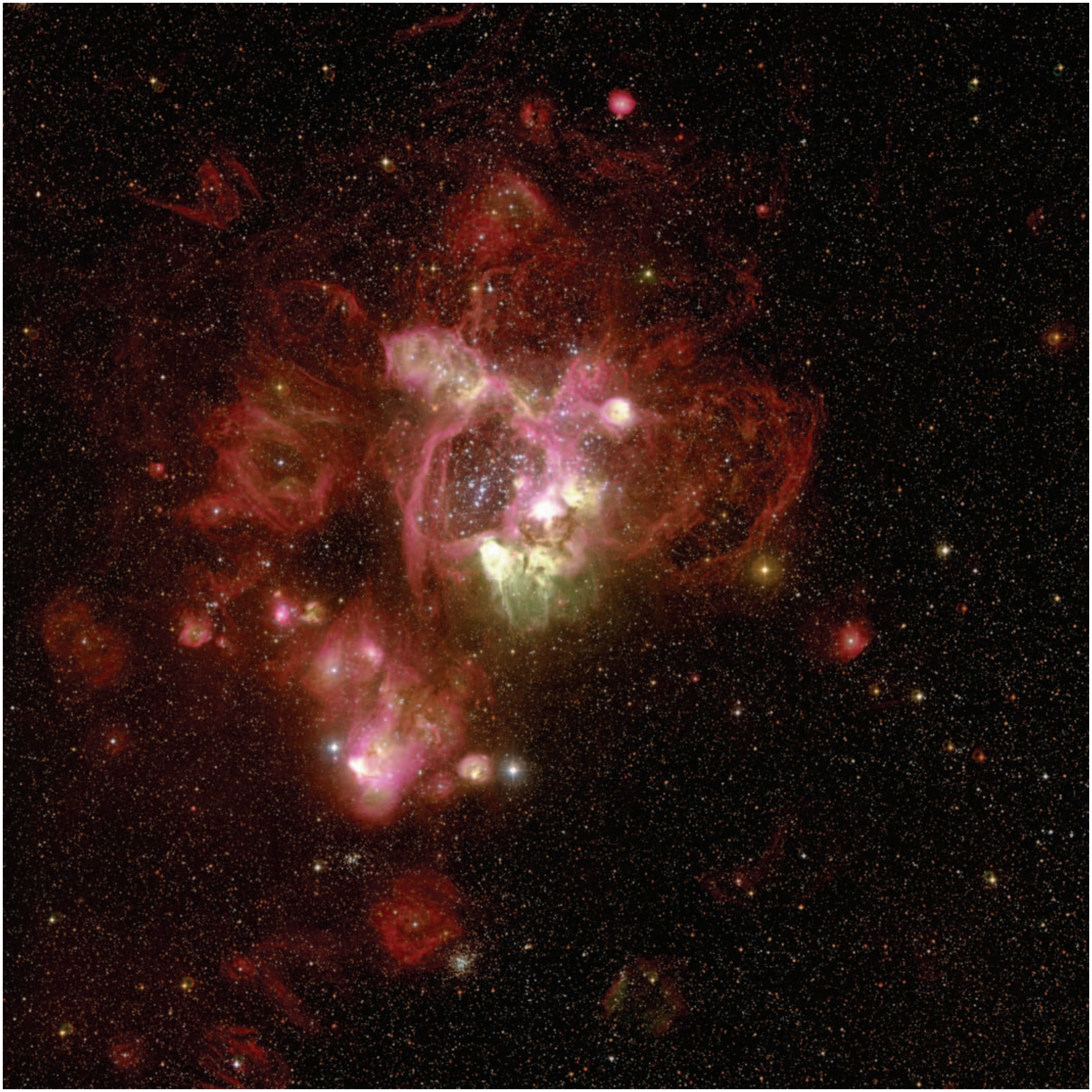
Of equal importance were the first lights of various instruments on the facilities, such as MACAO on the VLTI or HARPS on the 3.6m telescope. And then there were the many scientific discoveries; some of these gave rise to press releases, but others that did not were often extremely important for the progress of astronomy. The number of papers coming from data collected at Paranal or La Silla is still growing and ESO telescopes have become a major source of citations in the astronomical literature.

Council has in 2003 established a working group that will advice it on the scientific strategy ESO should follow on the longer timescale. The report was not finalized in 2003, but at the December meeting Council did agree in anticipation of the outcome of the discussions that a leading role in the future construction of an Extremely Large Telescope, such as e.g. OWL, would be ESO's next priority after ALMA. Even though the end of ALMA construction is still far away, it is important to start now thinking about the long-term future and the ambitions and priorities of ESO. And that is what is being done.

So, looking back at 2003 shows that the organisation is further enhancing its leading position worldwide in astronomy. It is a privilege to be associated with ESO and on behalf of Council I commend all concerned for the excellent work that made this possible.

Piet van der Kruit

Piet van der Kruit
President of Council



Massive stars produce a copious amount of highly energetic ultra-violet photons, which ionise the surrounding gas. When a whole cluster of massive stars is formed, a large volume can be ionised and the glow of the recombining hydrogen and oxygen atoms can be observed in spectacular forms. These images of the N44 giant HII region in the Large Magellanic Cloud were captured with the WFI camera on the 2.2m ESO/MPG telescope at La Silla. The green areas in these images show the hottest regions, where oxygen is twice ionised.

Introduction

THE YEAR 2003 was characterised by several very positive developments in and around ESO. On one side, there was a significant increase in the scientific productivity of the astronomical community on the basis of data obtained with ESO's telescopes, well documented by the number of articles and citations, as our facilities continued to be enriched with new instruments and to operate with great efficiency. On the other side, we embarked upon a new type of endeavour with the ALMA programme, whose construction was officially started this year after the signature of the bilateral agreement with the US National Science Foundation (NSF) in February.

There were important changes at ESO's first observatory, La Silla, beginning early in the year with the installation of the *HARPS* spectrograph at the 3.6-m telescope. This splendid instrument underwent a very successful first commissioning run during which its unrivalled ability to secure high accuracy velocities was impressively demonstrated. I have no doubt that *HARPS* will play a leading role in the search for exoplanets and in the field of asteroseismology for many years to come. The dome for the REM Gamma-Ray-Burst near-IR robotic telescope was completed, while the telescope itself arrived in June and tests began later in the year. The RITZ-building was ready, so that now all three ESO-operated telescopes at La Silla are controlled from this common control room.

With the advent of the Atacama Pathfinder Experiment (APEX), the 15-m SEST radiotelescope was de-commissioned after 15 years of very successful service as the first telescope of its kind in the southern hemisphere. The 12-m APEX antenna arrived at Chajnantor and assembly was completed. A special optical telescope device built at La Silla will be used for pointing tests. The APEX-base at San Pedro was completed, and several members of the SEST crew transferred to APEX, bringing with them their unique expertise.

The La Silla 2006+ Working Group report was finalised and recommended by the STC. Consequently, at the end of the year, it was decided to merge the La Silla and Paranal Observatories; this will happen gradually in the course of 2004 and be completed in 2005.

At Paranal, the Very Large Telescope (VLT) continued to operate with unequalled efficiency in the 8–10-m class, while shared-risk observations with the VLT Interferometer (VLTI) and siderostats were pursued. This was indeed an important year for this unique facility, with the installation and successful commissioning of the first and second *MACAO* adaptive optics units on two of the VLT telescopes, and of the first VLTI instrument, *MIDI*. Already during commissioning, the first-ever interferometric observation of an extragalactic object in the thermal infrared was performed with *MIDI*, resolving the torus of gas and dust around the black hole at the centre of the active galaxy NGC 1068. The first Auxiliary Telescope arrived at Paranal and the second VLTI instrument, *AMBER*, was accepted in Europe in November. The integration of the fringe tracker *FINITO* was completed, and the commissioning was started, using the siderostats. At the same time, the development of *PRIMA*, the phase reference imaging and arc second astrometry dual feed facility, was vigorously pursued.

The VLT telescopes and their instruments continued to provide a wealth of front-line results. One of the many scientific highlights was the observation with *NACO* of infrared light flashes from the Black Hole at the centre of the Milky Way. And the installation of the unique Spectral Differential Imager at this facility immediately resulted in the discovery that the nearest known Brown Dwarf, a companion to the bright southern star Epsilon Indi, is in fact a binary: two brown dwarfs! Also, for the first time, the power of three 8-m telescopes equipped with imaging instruments, the two *FORS* and *VIMOS*, was used simultaneously on the sky, allowing to achieve extreme sensitivity limits in the detection of Trans-Neptunian Objects, and to detect the Halley comet at a great distance.

A very useful forum was held about the Lessons Learned around the first generation VLT/VLTI instruments. It was concluded that, in general, the current system of interaction between ESO and the collaborating laboratories has worked well but also that a number of improvements should be implemented for the future. And indeed the future instruments are forthcoming: at the end of the year, the usual decision process led to the launch of the construction of a new IR imager for the VLT, *HAWK-I*, and of the first of the second-generation instruments, the *X-Shooter*. Also, it was decided to proceed with the planning for the *KMOS* IR-spectrometer.

The ESO Scientific Data Archive continues to grow; it now includes VLTI data and comprises about 26 TB of compressed data. The Astrophysical Virtual Observatory (AVO) had a successful First Light event in January at Jodrell Bank during which an international alliance of AVOs in different parts of the world was formed.

The enclosure for the VLT Survey Telescope (VST) was completed, as was the access road to the future VISTA site at the “NTT peak”. Work on the two telescopes continued in Europe at high pace throughout the year.

User satisfaction continued to be high, as reported at the Users Committee Meeting and reflected in the numerous reports received from observers on both observatories. A survey about service-mode observations also showed great content among the users. A Workshop was held on Large Programmes and Surveys with the conclusion that the concept of Large Programmes is a success and shall be kept; discussions were also held about extended surveys in the era of the forthcoming VST and VISTA telescopes.

Major progress was made with the ALMA programme. With the start of the construction, an ALMA Division was established at ESO. The negotiations with Chile were completed, resulting in a 50-year concession at Chajnantor at an altitude of 5000m and the purchase of land at intermediate height to establish the base camp. The agreement with Spain for participation in the ALMA construction was signed. Massimo

Tarenghi, who had previously led the construction of the VLT, was selected to become ALMA Director. The two prototype antennas were tested at Socorro (New Mexico, USA), and the Calls for Tenders for 32 antennas were issued in December on each side of the Atlantic. Contracts were extended to various submillimeter laboratories in Europe, which participate in the ALMA project. The site development continued and a construction access road to the observatory site was ready by the end of the year. In November, a groundbreaking ceremony took place at San Pedro de Atacama in the presence of high-ranking officials from Europe, the USA and Chile and the scientific community.

Work on the Extremely Large Telescope (ELT) concept under study at ESO, OWL, continued; the standardisation of opto-mechanical modules was basically completed, and detailed implementation scenarios were considered. A key issue is the use of wide-field adaptive optics and various advanced simulations were made. A large number of European laboratories, headed by ESO, continued to develop new concepts for adaptive optics; the European Commission within the FP5 programme supported this. ESO has now established a technological roadmap in advanced adaptive optics, in collaboration with European institutes. The first step is devoted to second-generation adaptive optics for 8-m class telescopes, including developments such as large deformable mirrors, very relevant for ELTs. This is part of the OPTICON proposal accepted this year by the European Commission within the FP6 programme. In the framework of a large ESO-led collaboration to be installed next year to perform an ELT design study, many further advances related to adaptive optics and laser guide stars are planned. At its meeting in December, Council expressed consensus that ESO shall seek to lead the development of a European Extremely Large Telescope on the shortest possible time-scale.

At the ESO Headquarters in Garching, space is now in short supply and a long-term solution must soon be found. All through the year much work was done on the new Enterprise Resource Planning system. The first tests were carried out during which ESO staff in Chile was able to access the system as if they were in Garching. This represents a most important step towards administrative unity of the ESO sites.

Negotiations with Finland were completed and accession of this country as ESO's 11th member state is expected in 2004. Formal negotiations also started with Spain. ESO, as one of the prime European intergovernmental research organisations continues to interact very positively with the European Union representatives. We were pleased to receive Commissioner Busquin and Director General Mitsos as well as several members of the European Parliament at Paranal in the course of the year.

Finally, I cannot hide my pleasure of the widespread and wholehearted recognition of ESO, so clearly expressed at the time of the International Astronomical Union General Assembly in Sydney. The esteem of colleagues is the best stamp we can aim for, but it is equally apparent that the recent technological and scientific achievements of our organisation are becoming known by a wider public and, not least, by decision makers in a wide geographical area.

Catherine Cesarsky
ESO Director General

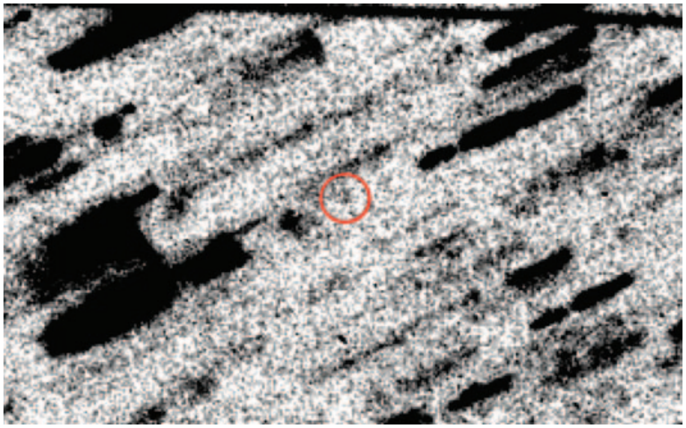
Really Hot Stars shrouded in mystery. Three-colour composite image of highly excited nebulae in the Large and Small Magellanic Clouds: around the hot double star AB7 (upper left); near the Wolf-Rayet (WR) star BAT99-2 (upper right); around the hot double star BAT99-49 (lower left); and the N44C nebula (lower right). Images obtained with FORS1 at the 8.2-m VLT MELIPAL telescope.

Research Highlights

THIS YEAR has seen a new record in the number of publications based on observations obtained with ESO telescopes: over 500 papers have appeared in refereed journals. The publications are now split almost evenly between papers based on observations at La Silla and Paranal. The ESO archive is growing as well, totalling now about 26 Terabytes of compressed data, and is becoming a resource of astronomical data of its own. In 2003, the ESO archive handled around 9,000 requests, more than a doubling of the activity with respect to the previous year.

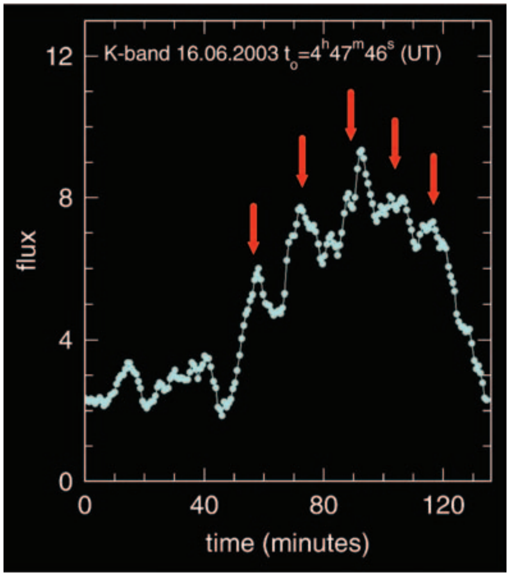
Scientific progress is always a combination of creativity and instrumental capabilities. Exploring new parameter space with new instruments regularly leads to new and often exciting results. The highlights of this year present the advances in observing capabilities, in particular the advent of adaptive optics at the VLT and the first results from the VLT interferometer. They prove that the VLT and its interferometer are forging the way into new observational domains.

Comet Halley in the cold



Comet Halley, seventeen years after its last passage near the Sun. Still receding from the Sun and, at a distance of 28.1 astronomical units (a.u; one a.u. is the average distance between the Sun and the Earth), almost as far as Neptune, the comet was captured in a series of integrations with several instruments at the VLT using simultaneously three of the four Unit Telescopes, for a total of nine hours. The comet can be seen in the red circle. Since it is moving against the stars the image was constructed by shifting the individual exposures along the path expected by the comet, hence the 'streaks' representing the stars. The brightness of the object shows that we are seeing the bare nucleus and that all activity of the comet has stopped. The comet was detected by a programme aimed at finding faint Trans-Neptunian Objects.

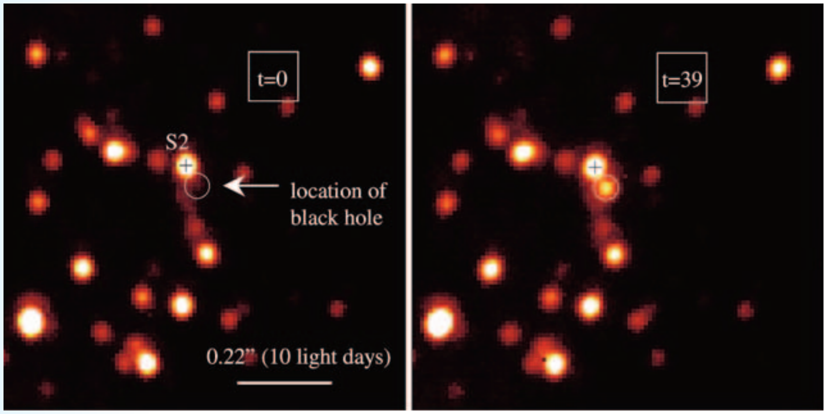
Flashes from the Galactic Centre



Variations in the flare

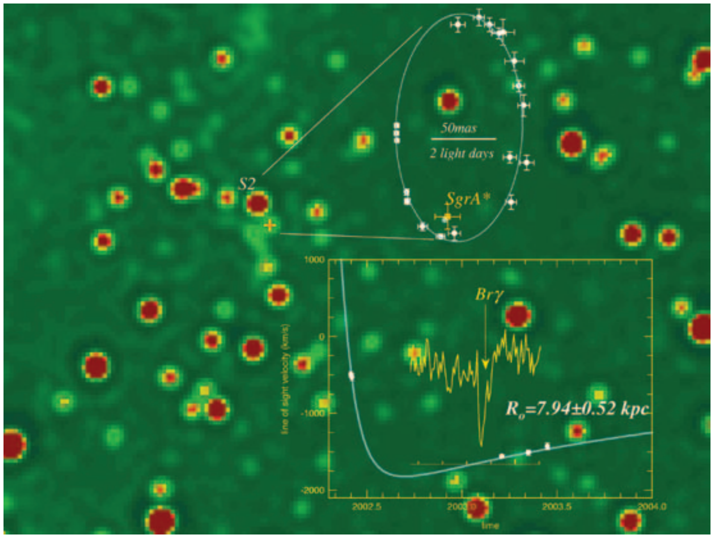
FOLLOWING-UP on the successes of last year, ESO observations of the Galactic Centre have yielded new and exciting results. Although a strong radio source, the massive black hole at the centre of the Milky Way had not been detected at any other wavelengths. X-ray flashes were suspected to emerge from the material falling into the black hole, but the positional accuracy was insufficient to exclude nearby stars as the source. New observations at the VLT have revealed a faint infrared source at the position of the black hole - the radio source Sgr A* - and coincident with the centre of mass derived from the stellar orbits. As a further surprise flashes coming from the exact position of the black hole have been discovered at three different infrared wavelengths. The detection was only possible by using the adaptive optics instrument NACO. Adaptive Optics is a technique used to overcome the blurring effect of the atmospheric turbulence, giving ultimately images near the diffraction limit of the primary mirror. Detections with ISAAC in natural seeing, albeit excellent, had been attempted but the observations proved not sensitive enough.

The observed infrared flashes last from 30 to 90 minutes and show temporal structure. The time scale of the periodicity, which was observed to be stable over many periods, indicates a very small emission region. The nature of this periodicity is not entirely clear, but if it is associated with the rotation of the black hole and reflects material at the innermost orbits before it disappears, then the black hole would be spinning rapidly at about half the maximum allowed speed for a Kerr black hole. This is quite a surprise and implies that the black hole's life must have been far from quiet.



Flashes from the Galactic Centre

The combination of accurate astrometric, i.e. positional, measurements together with the information on the radial velocity component allows astronomers to reconstruct the true space motion of objects. For the star that swung by the black hole last year, the radial velocity has been measured with spectroscopy from NACO and SPIFFI, an infrared integral-field spectrograph operating for some time in 2003 at the VLT as a guest instrument. SPIFFI will become part of the SIN-

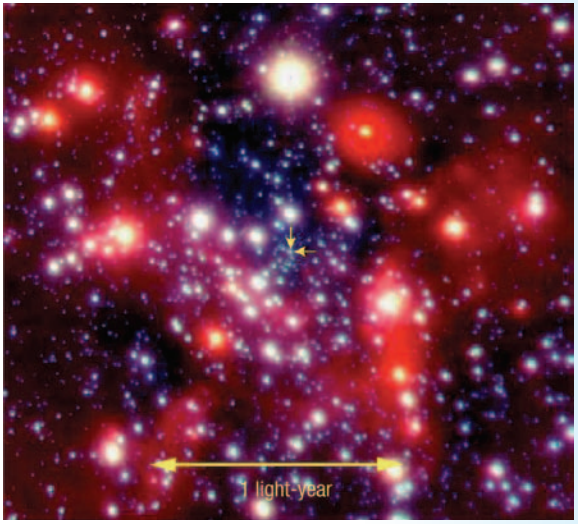


The projected trajectory (upper insert) and a spectrum with the resulting radial velocity curve (lower insert) of the star S2 as it orbits the black hole.

FONI instrument when equipped with an adaptive optics module in 2004.

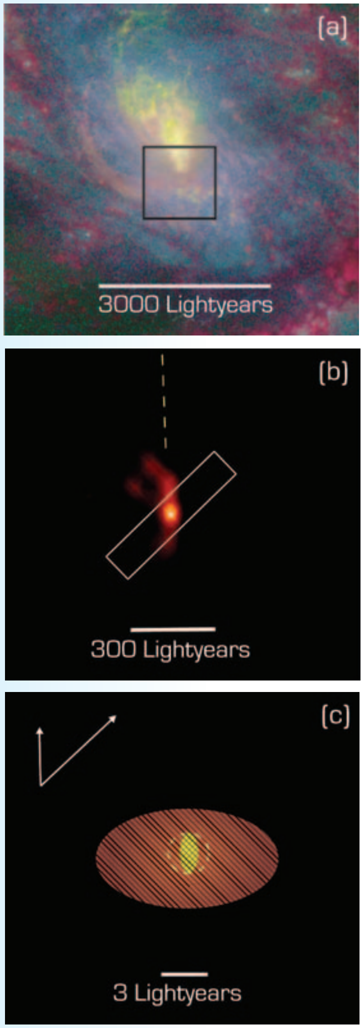
With these data it was possible to determine all the orbital parameters of this star as it goes around the black hole, and in particular, the inclination of the orbit towards the line of sight. This information makes it possible to calculate the geometric distance to the Galactic Centre, based on very simple and verifiable assumptions. This yields a distance of (7.94 ± 0.42) kpc (about 26,000 light years) between the Sun and the centre of the Milky Way, confirming and significantly improving earlier distance measurements. The analysis can be extended to more stars in the coming years, further improving this distance determination.

Years of continuing observational effort with the NTT and the VLT have now provided a complete analysis of the Galactic Centre region. The gravitational potential of the massive black hole and the central star cluster – the densest known in our Galaxy – have now been extensively mapped, showing, among others, that the light distribution of the cluster is centred extremely well on the position of the black hole (within 0.2 arcseconds). The central cusp (within 1.5 arcseconds) of the centre is also found to be characterised by a smooth luminosity function, indicating that old, low mass stars are missing in this area: the innermost stars are mostly young stars that are tightly bound to the black hole. There are also clear indications that the stellar properties change as a function of the distance from the black hole. The massive, young stars appear to be located in two rotating and geometrically thin discs. These two discs are counter-rotating against each other and show largely different inclination angles, despite having indistinguishable stellar contents. One interpretation is that the two discs are from two clouds that fell into the centre of the Milky Way some 5 to 8 million years ago. After a collision they were compressed due to shocks and formed the two rotation discs. For the hottest stars at the very centre, however, it appears that a model is needed, in which stars merge due to collisions of lower-mass stars in the very high densities prevailing (more than 100 million stars per cubic parsec – for comparison the Sun is the only known star within one cubic parsec around it).



The stellar cluster at the centre of the Milky Way

Detection of the dust torus in the Active Galactic Nucleus of NGC 1068



The nucleus of NGC 1068. Panel (a) displays an HST image of the inner region. In panel (b) the direct 10 μm image from MIDI with a single unit telescope is shown. The position of the slit is overlaid. Panel (c) is a sketch of the MIDI inteferometric observations.

ACTIVE GALACTIC NUCLEI (AGN) are among the few objects that can be observed across the nearly complete electromagnetic spectrum. This is due to the combination of many physically distinct regions in a very small volume. A massive black hole (several million times the mass of the Sun) is emitting strong jets which are observed at radio wavelengths. The innermost regions are probably occupied by an accretion disc of material that is spinning into oblivion towards the black hole. The material in the accretion disc is heated and emits X-rays. X-rays are also created in Compton processes where UV photons are upscattered by hot electrons. Infrared emission comes from warm dust surrounding the central black hole, while optical emission arises from cooling plasma. The appearance of some AGN suggests that we are seeing some face-on, directly into their most inner regions, while others are seen edge-on, the central region being hidden by a dense dust torus.

Most of the above picture is based on indirect evidence. The inner regions of AGNs are extremely compact and so far have not been resolved by any observations. Progress in this field depends on the ability to further increase the angular resolution. Interferometry at infrared wavelengths should provide a tool to peer at the inner region with a tenfold magnification.

MIDI, the first science instrument of the VLT Interferometer, has observed one of the nearest AGNs, the Seyfert 2 galaxy NGC 1068, with a resolution of 20 milli-arcseconds, i.e. 5 times better than a single VLT Unit Telescope can achieve. The observations were done in the thermal-infrared at 10 μm. A model was used to interpret the data. The innermost region of the AGN is spatially resolved into two regions: a hot component that is only barely resolved and has a linear size of 0.8 parsec (2.6 light years) and a temperature of about 1000 K, and an outer component at about 320 K, having a thickness of 2.5 parsecs (6.5 light years) and a width of 4 parsecs (13 light years). A spectrum of the inner region of NGC 1068 shows the typical signature of silicates, as observed in other dusty regions.

The irradiation from the inner source creates a hot inner wall, which is associated with the observed hot component. However, at the low temperature observed there is not enough gas pressure to support this structure against the gravitational potential from the nucleus. Turbulent motion between the clouds may prevent the clouds from collapsing, but frequent inelastic collisions are likely to dampen this motion within some 100,000 years. To support the inner wall of the dust torus an extra source of kinetic energy seems to be required.

These observations are among the first ever interferometric observations of an extragalactic object. And they are the first such measurements at thermal infrared wavelengths. These early attempts show already that we will need to revise some of our ideas about the inner structures of AGNs. This holds great promise for future interferometric observations with increased sensitivity.✰

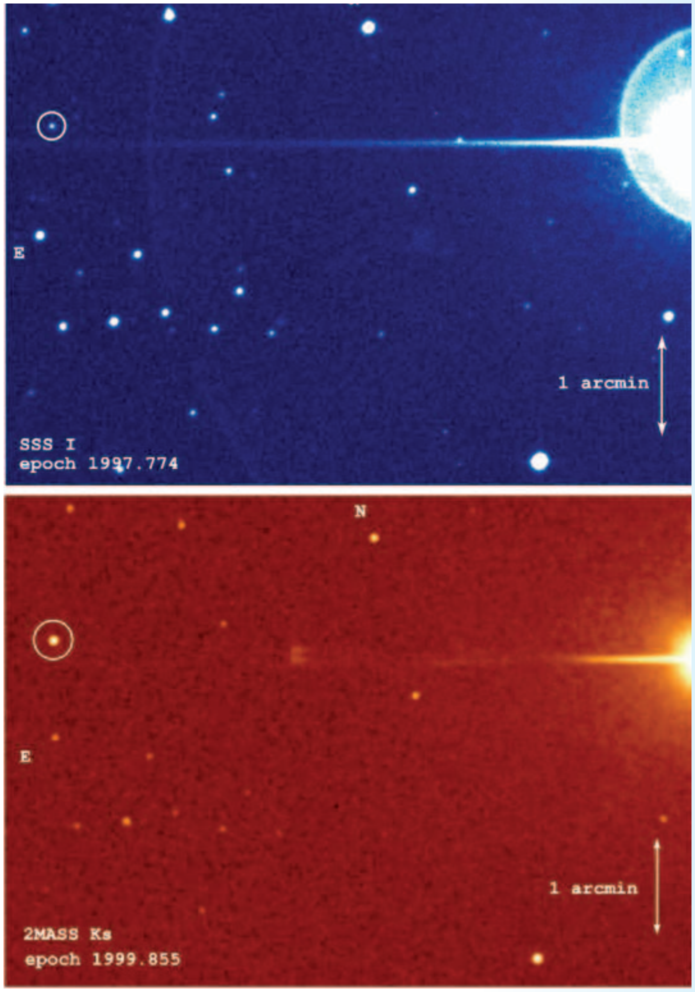
Low-mass stars and Brown dwarfs

STARS that are not massive enough to start hydrogen burning in their core are referred to as brown dwarfs. At the beginning of their life, these stars glow faintly by burning deuterium, but most of the luminosity at later phases is due to the energy released by gravitational contraction. These stars are very cold and small and hence very difficult to observe. Even in the Solar Neighbourhood these stars appear extremely faint.

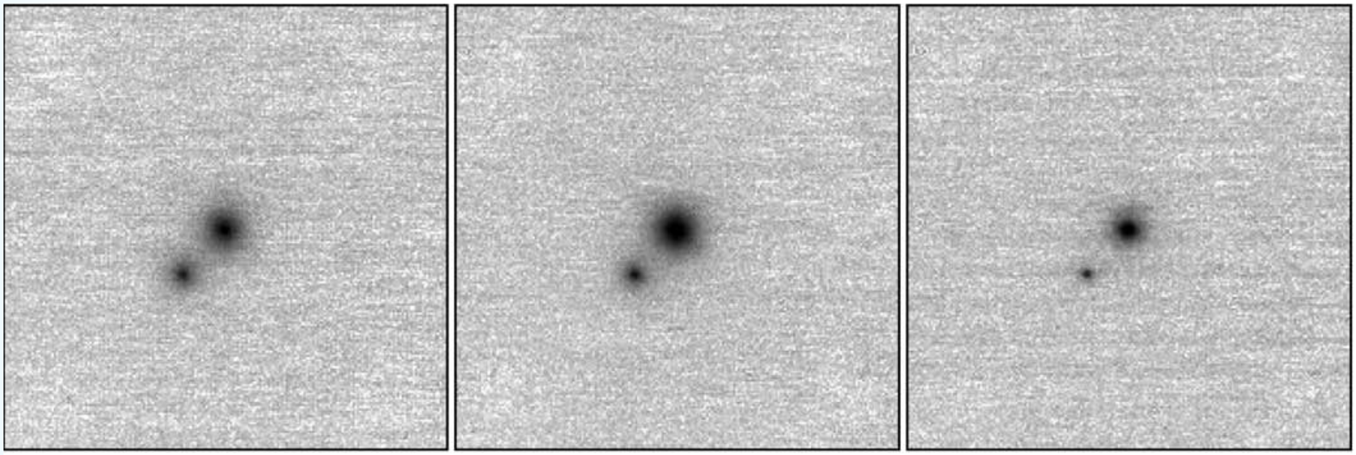
Near-infrared data are required to detect and characterise these objects. The nearer and younger the brown dwarf the better it can be observed. The nearest known brown dwarf was detected in 2002 as a companion to a nearby bright star. ε Indi is a bright young star visible to the naked eye and located among the 20 closest stars know – only 12 light years from the Sun. By searching through infrared survey data, European astronomers discovered a proper-motion companion to this young bright star. From an NTT/SOFI spectrum this companion was classified as a T brown dwarf, a classification introduced recently for the coldest known stars.

With the newly installed phase mask in NACO this object was observed again with adaptive optics. And to the great surprise of the astronomers it was found that the brown dwarf itself is actually a binary. The two brown dwarfs are separated by about 0.732 arcseconds, or about 2.65 times the distance between the Earth and Sun. Current mass estimates provide masses of about 47 and 28 times the mass of Jupiter (M_{Jup}), respectively. These masses are derived from the luminosity of the brown dwarfs and depend on the assumed age. Since the age of ε Indi itself is fairly well known, the companions – assumed to have formed together with ε Indi – can be dated fairly well. Nevertheless the uncertainties are still considerable (±10 and ±7 M_{Jup}, respectively, for ages ranging from 0.8 to 2.0 billion years).

A spectroscopic analysis of the system was also made. This is the first time that both components



Discovery of the brown dwarf companion of ε Indi. The images are from the Palomar Sky Survey and the 2MASS infrared survey.



The double brown dwarf, binary companion to ε Indi observed in the J, H, and K_S wavebands.

of a brown dwarf system could be observed. Water (H_2O) and methane (CH_4) absorptions features were used for the spectral classification.

The temperature and the radius of each component can be determined from the luminosity and the age. The more massive brown dwarf is also slightly hotter with about 1270 K and a radius 0.9 times that of the Sun. The smaller component has about the same size, but a temperature of only 850 K.

The angular separation and the proximity of the ε Indi stellar system means that it will be possible to measure the orbit of the two brown dwarfs around each other. A first estimate of the orbital period, although very uncertain as the inclination and orbital phase are still unknown, is about 15 years. This is an exciting prospect, as it means that it might be possible to determine this orbit fairly soon. Such an orbital determination would yield all the information to derive the masses of the system independent of any brown dwarf models and will provide a stringent test for their predictions. The brown dwarfs in ε Indi will be the target of

Massive stellar cluster

The most luminous star forming region in the Galaxy has been found with SOFI at the NTT. The UV flux from the hot massive stars creates an immense area of ionised gas. This giant HII region is located within the giant molecular cloud W49 and hence behind a thick veil of dust. The red emission in this image is from radio emission of the hydrogen atom and shows the extent of the ionisation in this nebula. There are more than 100 stars more massive than 15 times the Sun in this region. Overall there are three more star forming regions in the same area, hinting strongly at a triggered star formation origin.

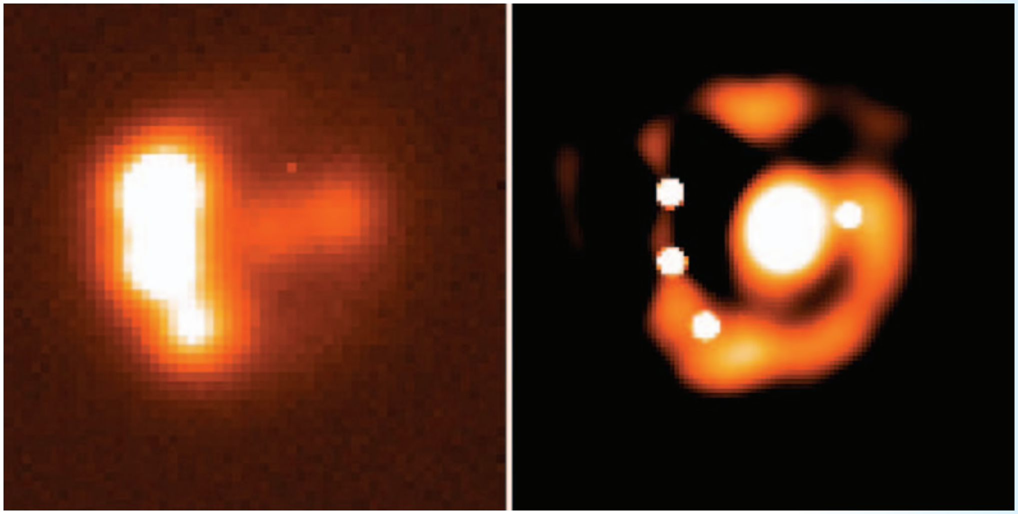
many future observations with the VLT and other large telescopes.
A completely independent project at La Silla provided another important result on the lowest mass stars. In general, the Hertzsprung-Russell diagram is a tool for stellar astronomers in which temperature and luminosity of a star is correlated. The temperature can be rather easily determined from the colour of the object. The luminosity of a star is not so easily determined. The main feature in the Hertzsprung-Russell diagram is the 'main sequence', the locus of stars that are burning hydrogen in their cores. This 'main sequence' connects temperature and luminosity in a unique way.

An important ingredient for the determination of the luminosity is the distance. While in many cases this can be estimated from stellar models and secondary indicators, like e.g. the gravity on the surface of the star, this has not yet been established for brown dwarfs. The only way to reliably determine the distances to isolated objects (unlike the case of ε Indi where the distance could be inferred from the bright star) is to measure their trigonometric parallaxes, i.e. the reflex motion of Earth's orbit around the Sun against the distant stars. The closer a star is to Earth the larger its parallax appears in the sky. Since brown dwarfs have an extremely low luminosity they have to be rather close to be observable at all. Hence, determining their parallaxes is the primary way to measure their distances. Such projects have to be spread over several years in order to sufficiently sample the parallax effect and obtain an accurate measurement.

Over a 2.5 year period, SOFI at the NTT was used to observe a sample of brown dwarfs characterised by their methane absorption. Regular observations in the near-infrared J-band spaced over this time were obtained and the relative motions of these brown dwarfs against the background stars measured. With the parallaxes and proper motions it was possible to determine accurate distances (to about 10%) and hence derive the near-infrared luminosity of these brown dwarfs. It turns out that the colder brown dwarfs are actually *brighter* than their slightly warmer counterparts. This result shows that the continuation of the 'main sequence' to the coldest stars no longer maintains the unique relationship between luminosity and temperature. This is most likely a feature of the way these failed stars cool.☆

Mirage in the sky

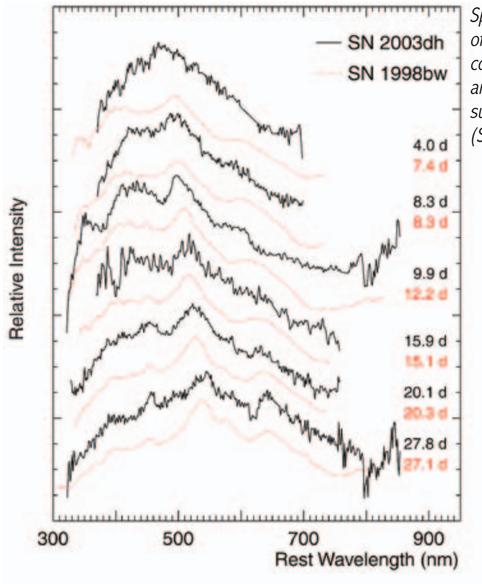
These observations with EFOSC2 at the 3.6m telescope show multiple images of the same source, a quasar. A foreground galaxy bends the light of the background object and forms four images. The left panel displays the observations, while the right panel is a deconvolution showing the four point images of the quasar, the foreground galaxy as the central source and an extended emission which forms an Einstein ring, the image one would obtain from a perfectly aligned extended source. Spectroscopy with EMMI at the NTT has shown that the four images indeed are identical, i.e. coming from the same source and hence prove that this is really a gravitational lens. They also show that this is the closest such lensing system known.



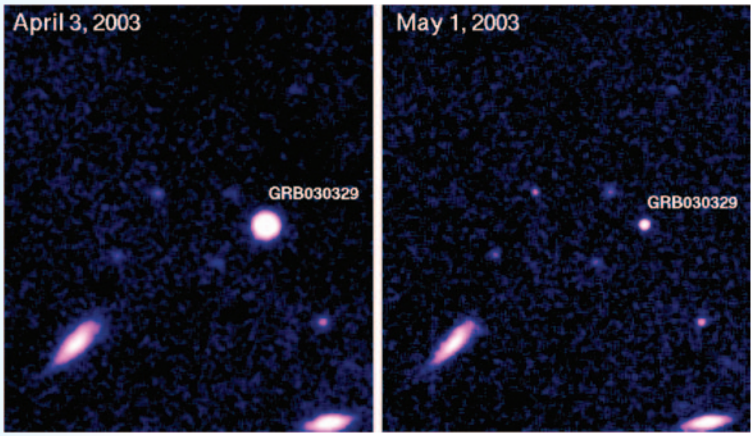
SN/GRB connection

Gamma-Ray Bursts (GRBs) are among the most mysterious objects known in the universe. They are energetic gamma-ray outbursts lasting for a few seconds to a few minutes only, and can be seen across the entire observable universe. The energy radiated in this short high-energy burst would be strong enough to extinguish life across a large fraction of a galaxy, if the life-bearing planet were to be located in the beam. The afterglows of some γ-ray bursts have also been detected with optical telescopes. The first such observations several years ago have provided the evidence that these objects are at cosmological distances and are extremely powerful. Soon after this discovery it was suggested that these explosions actually are related to a subtype of the much better known supernovae. The evidence came from observations of a weak burst in 1998 with ESO telescopes, but was largely dismissed due to the peculiar nature and the small distance of the burst and the supernova.

Bursts are regularly discovered by space X-ray and γ-ray telescopes. The trick is to be able to observe the afterglows, which are often only observable for a few hours to a few days after the outburst. Prompt reaction is critical for success in this area. The VLT has been a champion in determining redshifts for these transient events. More than half of all GRB redshift determinations to date have been done with the VLT, and the redshift record for GRBs ($z = 4.5$) is detained by the VLT since several years. The first observations of the polarised flux of these enigmatic objects have been achieved with the VLT. All detections of damped Lyman-α absorbing clouds have been made by the VLT.



Spectral series of SN2003dh compared with an early GRB/ supernova (SN 1998bw)



The optical transient of GRB 030329/ SN 2003dh

On March 29, 2003, a powerful burst was detected by the HETE II satellite. Within 16.5 hours, using UVES at the VLT, the redshift was determined to be 0.1685. This became the nearest GRB detected after the one in 1998. Spectroscopic observations of this GRB were initiated and a series of spectra were obtained until the beginning of May. Within a week it was recognised that a supernova spectrum was actually emerging from the GRB emission. The spectral coverage obtained with the VLT is unique and clearly shows the supernova spectrum. The supernova, named SN 2003dh, is of the subtype that does not show any hydrogen, helium or silicon. These Type Ic supernovae are thought to come from massive stars that have lost their hydrogen and helium envelopes to either a companion star or due to their extremely strong winds.

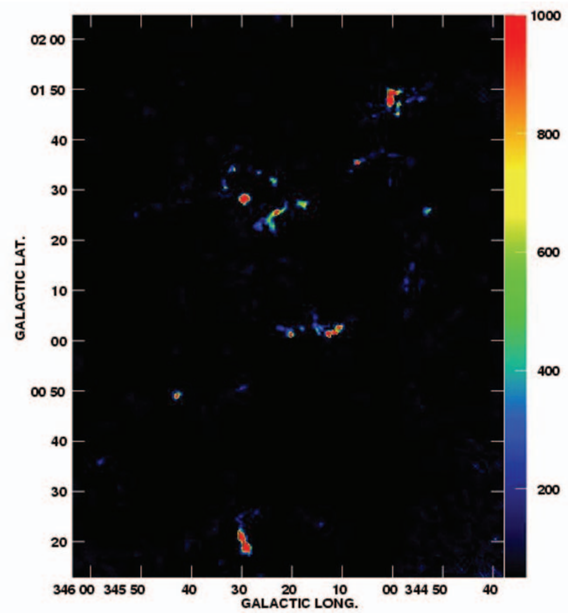
The connection of GRBs with core-collapse supernovae is very interesting and presents the unification of two astrophysical research fields. According to the new observations, GRBs are the most energetic supernovae which are most likely driven by the collapse of a very massive stellar core to a black hole. This opens up the possibility to observe the deaths of massive stars out to the edge of the Universe.

Among the many GRBs observed by the VLT, another at least showed the spectral signature of a supernova. This burst – at a much larger redshift of $z = 1.006$ – displayed a bump in the light curve, most likely due to the emerging supernova hitting some circumstellar material. The supernova in this GRB appeared only about three weeks after the outburst. The spectrum obtained four weeks after the GRB is consistent with a Type Ic supernova, albeit the signal is very small, due to the faintness of the object.

Several programmes dealing with GRBs are still ongoing on the VLT. Among them are the search for intervening absorbing clouds and the characterisation of the intergalactic material out to very high redshifts. Since GRBs are so fleeting and faint – the brightest ones can be observed for no longer than one month, most of them become unobservable within two weeks – we do learn something new from every well-observed object. The VLT is ideally positioned to lead the breakthrough research of these mysterious objects.

Mapping a Giant Molecular Cloud

The distribution of dust, as well as the high mass star forming clusters and their possible connections, are shown for the first time through one entire giant molecular cloud, at scales of several tens of parsecs. The 1.2 mm continuum emission map was obtained with the SIMBA Bolometer at SEST. The image includes several individual centres of massive star formation, as well as possibly expanding filamentary structure at different spatial scales. A very young region is also apparent. The filamentary emission is also detected in the mid-infrared by space observatories; dust may be heated by shocks, or by embedded on-going massive star formation (like in the Orion filament). The cloud, GMC345.5+1.0, is in the near side of the Carina Spiral Arm, at a kinematic distance of 1.6 kpc, and well above the galactic equator so as to present very little confusion along the line of sight. It has an approximate size of 50 pc and subtends roughly 2 × 2 degrees in the sky.



Resolved stellar population in Local Group galaxies

Individual stars outside the Milky Way can be observed in detail in the nearest neighbour galaxies only, and quantitative spectroscopy of stars beyond the Magellanic Clouds has only become possible since the availability of spectrographs on the largest telescopes. Several projects are using the VLT to obtain more detailed information on stars outside our own Galaxy. This is interesting, because these stars typically have a different history, and the galaxies themselves have overall different star formation histories than the Milky Way.

Dwarf galaxies in the Local Group are the prime targets for these studies. They presumably have simple histories as they probably evolved in isolation without major disturbance from other galaxies. Our Milky Way on the other hand has had several encounters with satellite galaxies like the Magellanic Clouds and has most likely swallowed some dwarf galaxies in the past. One currently ongoing event is the disruption of the Sagittarius Dwarf galaxy by the Milky Way.

The observations to characterise the stars were obtained throughout many years with a range of instruments and telescopes. The imaging for the photometry and the construction of the colour-magnitude diagrams was done with the NTT. FORS1 was used to observe the calcium infrared triplet while high-resolution spectroscopy was obtained with UVES. All in all, 15 stars in four galaxies were observed with UVES. This is currently the largest data set available and shows how difficult and time-consuming these observations are. The galaxies all are dwarf spheroidals, i.e. there is no indication of a rotationally supported disc in them. They are located in the constellations Fornax, Sculptor, Carina and Leo.

The stars were investigated for their metal contents which gives an indication of the previous history of metal enrichment in the gas from which the stars formed. A very detailed analysis looking at many different elements showed that none of the stars present signatures that are typically found in globular clusters of the Milky Way. Moreover, the signatures of elements produced in explosions of massive stars (core-collapse supernovae) are abundant, but they are not as rich as the halo stars in our own Galaxy. This could be explained either by a slow formation of stars or a small star formation event with a dependence of the element yields on the mass of the star exploding as a supernova.
In any case, it was shown that no major component of the Milky Way, i.e. disc, bulge or inner halo can be build up from disrupted dwarf galaxies. The abundance patterns in these stars are sufficiently different from the Galactic comparison sample.

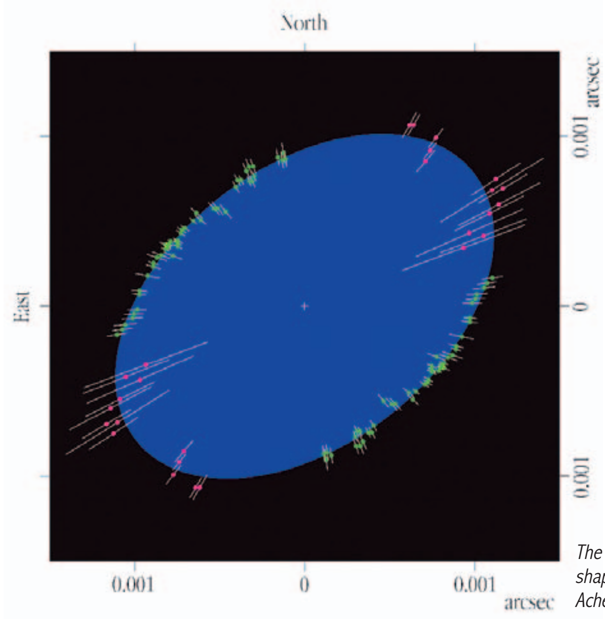
The observed stars have widely different ages (from 1 to 12 billion years) and display a significant spread of metal abundances with age. Overall the picture is consistent with the idea that these galaxies have evolved in isolation and were entirely responsible for their own enrichment in metals, i.e. there are no signs of major interaction with other galaxies.✰

The flattened star Achernar (α Eridani)

Stars are normally considered to be spherical balls of gas. For the Sun this can be checked on every clear day. For most other stars, this had, until recently, to be assumed. Indeed, stars are generally unresolved point sources, even for the largest telescopes. The VLTI is now in a position to change this by resolving the stellar surfaces and measuring specific features like limb darkening, an effect where the edges of the stellar disc appear dimmer as the stellar atmosphere thins out.

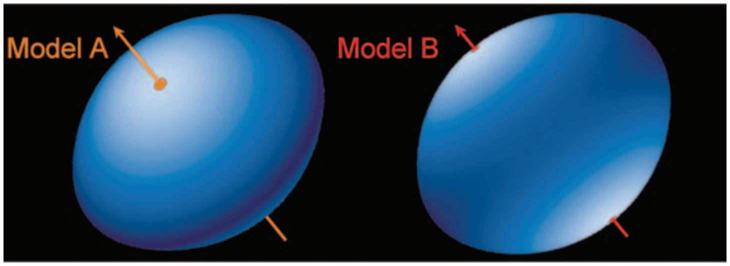
The rapidly spinning nearby star α Eridani with the Arabic name of Achernar is a massive, hot star. It is so hot that even helium is partially ionised and shows up in its spectrum. Additionnally, it shows emission lines indicating that it is ionising material located close to its surface, presumably a disc. These stars are commonly referred to as Be stars and Achernar is the brightest example of its class in the sky.

Achernar was regularly observed by the VLTI for a period of three months. Since the projection of the baseline between the telescopes and the star changes throughout the night as the star moves across the sky, the apparent diameter of the star can be measured at different position angle. With the observational coverage the diameter of Achernar could be mapped very accurately.



The apparent shape of Achernar

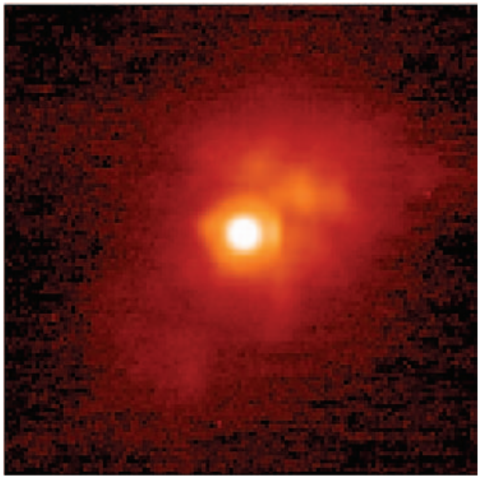
The projected stellar disc of Achernar is highly elongated and shows a ratio between the major and the minor axis of 1.56 ± 0.05, a large flattening indeed. The physical interpretation is not straightforward however, as it is unclear whether the observations reveal the stellar surface or circumstellar material expelled by the star in previous ejection events. If the observations are indeed measuring the stellar surface then the radius along the longer axis is 12 times the radius of the Sun. To achieve a flattening as observed, the star has to be spinning very rapidly, in fact near the break-up velocity. This is somewhat at odds with what was believed so far and will be a crucial ingredient for future models of these enigmatic stars.☆



Two different model views of Achernar

The shape of a stellar cocoon

Another star of high scientific interest is the massive central object which caused the violent outburst called η Carinae in the middle of the 19th century. The remnants of the ejecta are easily observable and have been imaged by many telescopes. The gas is distributed in a bipolar outflow often referred to as the '*homunculus*' due to its humanoid shape. The star itself is shrouded in dense material so that it could not been seen and speculations about its actual mass abound. It may well be one of the most massive stars of the Milky Way with over 100 times the mass of the Sun.



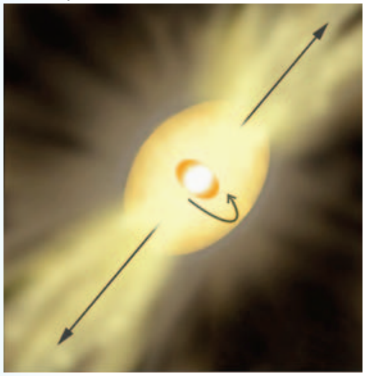
Inner region around η Carinae as observed with NACO at 2.29 μm.

VLTI and NACO near-infrared observations of the central object of η Carinae have now revealed the innermost parts of this enigmatic object. Several inner blobs could be resolved with NACO. They show that the inner region around the central star has a complex morphology.

The emission is dominated by a central unresolved bright source, while the extended emission comes from the stellar wind of this very massive star.

The VLTI can probe even closer to the star. It was able to resolve the source and explore its shape. The derived minimum temperature of 2300 to 3000 K is too high for dust, yet it is far too low for the supposed massive star, which would be more than 20,000K. Hence the shape observed by the VLTI must be that of the stellar wind of η Carinae.

Artist impression of the cocoon around η Carinae.



The central star in η Carinae is shedding material at a prodigious rate. This stellar wind is so dense that it can not be penetrated even with near-infrared observations at the VLTI. Nevertheless, the measurements were able to discern the shape of this stellar wind and provided the astronomers with a surprise. The cocoon in which η Carinae sits appears highly elongated, in a 1.25 to 1 ratio. The structure is oriented along the same symmetry axis as the much larger homunculus nebula surrounding the star. Given that the homunculus is about 1000 times larger, this is quite an astonishing conservation of the alignment over time.

Unlike the situation in Achernar described above, the elongation here is in the opposite direction, i.e. not along the equator but along the poles. While Achernar could be compared to a discus, the shape of the cocoon around η Carinae is more like a spindle. The reason for this counter-intuitive situation is most likely the temperature distribution on the stellar surface. Due to the fast rotation the poles are much hotter than the equator and shed matter much faster and a much higher rate, hence the spindle like form. For this model to be correct, the star has also to be rotating nearly at 90% of its break-up velocity.☆

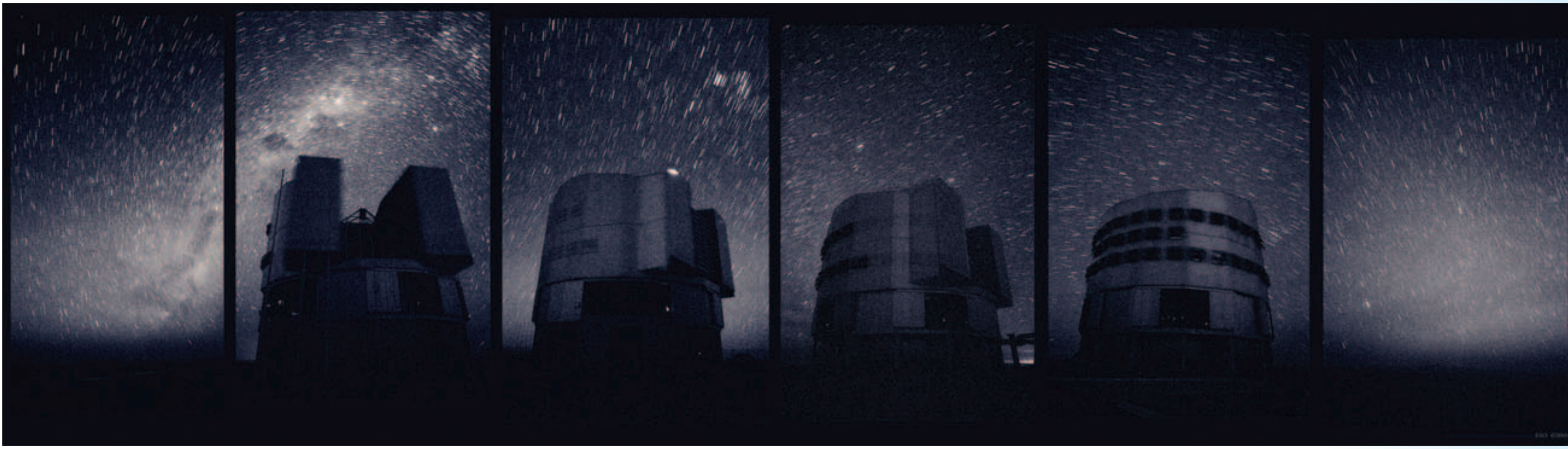
Paranal Observatory

THE VERY LARGE TELESCOPE (VLT) at Paranal celebrated the fifth anniversary of its first light this year. It was on the night of May 25 to 26, 1998, that Antu, the first Unit Telescope (UT1) of the VLT Array achieved First Light, starting a revolution in European astronomy. Since then, the three other Unit Telescopes – Kueyen, Melipal and Yepun – have been successfully put into operation with a suite of the most advanced instruments, while at the same time, the interferometric mode of the VLT has been pushed forward. In these five years, and with its unprecedented optical resolution and unsurpassed surface area, the VLT has established itself as the unrivalled leader in observational ground-based astronomy.

In 2003, as was the case the years before, Paranal observatory has been performing a balancing act of growing while providing the community with an operational facility with highly available and excellent instrumentation. The telescopes are used for science almost every night and with the exceptional weather and technical facilities of the observatory, both visitor and service observers continue to report excellent results.

This year, in particular, the Very Large Telescope has shown its full power as an integrated facility. Observations of the extremely distant comet Halley using three 8.2-m telescopes, observations of the most luminous star known in our Galaxy, Eta Carinae, using the NACO Adaptive Optics facility on Yepun (UT4) and several UTs with the MIDI interferometric mode have all been achieved because of the breadth of facilities offered at Paranal.

The success of the VLT can also be measured by its oversubscription rate. The average pressure



factor (requested time/available time) on the VLT Units was of the order of 3.5 in Period 71 (1 April 2003–30 September 2003), and of 4.0 in Period 72 (October 2003–March 2004). Moreover, the user community of the VLT has adapted to exploit the relatively new capabilities of service observing to the full. The demand for Service Mode was about two times larger than for Visitor Mode. As the Paranal operation mode is aimed at an approximately equal split between Visitor and Service, whenever feasible, observing runs that requested Service were switched to Visitor Mode, in order to reach an acceptable level regarding operational resources.

Instruments

Seven of the planned ten first-generation astronomical instruments were in operation at the VLT in 2003. They cover all major observing modes required to tackle current "hot", front-line research topics:

- the multi-mode instrument FORS1 (FOcal Reducer and Spectrograph) and its twin, FORS2,
- the Infrared Spectrometer And Array Camera (ISAAC) cryogenic infrared imager and spectrometer,
- the UVES (Ultra-violet and Visible Echelle Spectrograph) high-dispersion spectrograph,
- the NACO Adaptive Optics facility producing images as sharp as if taken in space,
- the VIsible Multi-Object Spectrograph (VIMOS) four-channel multiobject spectrograph and imager - allowing to obtain low-resolution spectra of up to 1000 galaxies at a time
- the Fibre Large Array Multi-Element Spectrograph (FLAMES) that offers the unique capability to study simultaneously and at high spectral resolution hundreds of individual stars in nearby galaxies.

The remaining instruments of this suite – the Mid Infrared Spectrometer/Imager VISIR, the integral field spectrograph SINFONI, and the high-resolution infrared spectrograph CRIRES – will be installed in 2004-2005.

The VLT Interferometer (VLTI) is growing and on its way to become a mature facility, with the goal of making this technically demanding branch of astronomy – interferometry – as simple and as user-friendly as that of the many other, more conventional VLT instruments. The MACAO adaptive optics systems were deployed at the Coudé foci of two of the 8.2-m telescopes, the MIDI instrument was commissioned and used with 3 different baselines combining pairwise 3 of the 4 Unit Telescopes, the fringe tracker FINITO has arrived and the first Auxiliary Telescope was shipped from Europe and assembled on site. And another world premiere was achieved, opening great research vistas, as interferometry on extragalactic objects was performed, resolving structures in the dusty torus surrounding the black hole at the centre of the prototype AGN, NGC 1068.

In addition to the various European official visits, the Paranal Observatory welcomed many officials from Chile, including Foreign Minister Alvear, Congressmen and Members of the Chilean Chamber of Deputies. This ESO presence in Chile was extensively highlighted in the media.

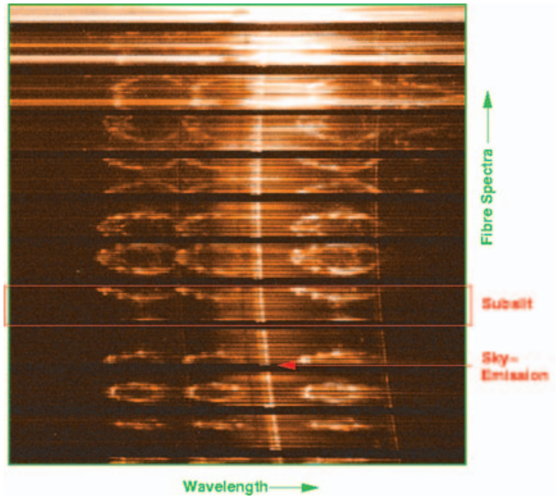
Four Eyes, Seven Instruments

Antu (UT1) with the two workhorse instruments ISAAC and FORS1 has been working extremely efficiently during 2003 with over 330 nights allocated to scientific programmes and with minor losses to technical glitches (around 3%).

UVES lost its monopoly on science with Kueyen (UT2) with the start of operations of FLAMES. The combination of the fibre positioning robot Oz-Poz with the highly efficient spectrograph Giraffe has rapidly made FLAMES a very popular facility with the users. The instrument has performed well during this first period of exposure to visitors and during 2003 time was found to commission the ARGUS mode which deploys a number of integral field units that take multiple spectra of more extended areas of sky simultaneously. With the fibre feed from the Nasmyth A focus where FLAMES is located to Nasmyth B, the home of UVES, it is possible to use both instruments at the same time. More than 100 objects can now be observed simultaneously at a resolution of 30,000, while UVES when fed by FLAMES can investigate in greater detail 8 objects in parallel. The already high efficiency of UVES (around 90% shutter open time) is now making every second on Kueyen count for eight!

With FLAMES, the already high efficiency of UVES is now making every second on Kueyen count for eight!

A most welcome guest on Kueyen was SPIFFI,



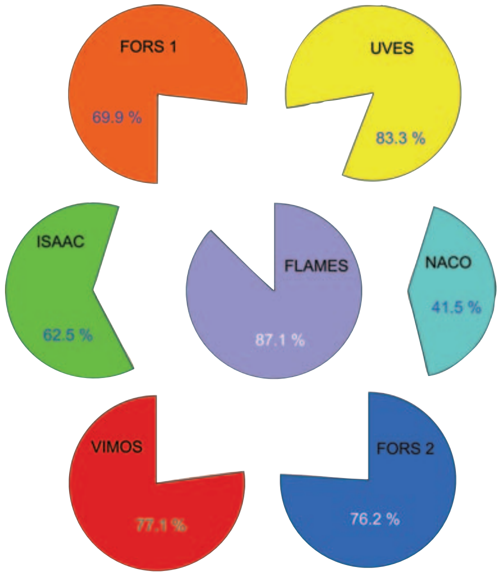
Section of one raw ARGUS spectrum of the η Carinae Homunculus nebula

the instrument built at the MPE in Garching. This novel integral field infrared spectrograph will merge with an adaptive optics module to form the SINFONI instrument scheduled to arrive on Paranal in 2004. SPIFFI alone was mounted on the Cassegrain focus of Kueyen and within a few nights was producing exciting results on the Galactic Centre and other targets with image quality as good as 0.2 arcsec. In parallel to all of the above, the MACAO adaptive optics Coudé feed system was installed and commissioned at Kueyen and although intended to feed the VLTI, during the testing some beautiful images were obtained showing the power of the system.

On Melipal (UT3), the sole client has been VIMOS, which went into operation in April 2003. This instrument's unique capabilities compared to similar instrumentation at other 8-10m class telescopes derive from its larger field of view, the possibility to obtain spectra of hundreds of objects simultaneously and the largest integral field unit ever with a field of 54″×54″. The scientific capabilities of the instrument have been demonstrated during commissioning and guaranteed time observations by its ability to collect up to 1000 redshifts of galaxies in a single exposure. Significant technical problems were however revealed during the running-in period that necessitated an extended intervention on the instrument. The first major phase of this work was

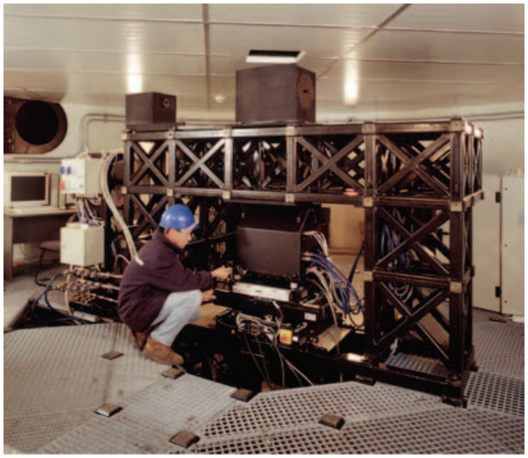
Extremely efficient

The efficiency of the operations of the VLT is also a significant factor in the utilisation of the facility. Not only is the availability of the telescopes for science extremely high but also the night time hours when the telescopes are observing scientific targets are most efficiently utilized. This is achieved through a combination of a high level of automation within the end-to-end system for the observatory operations (from the phase of proposal preparation to control of the telescopes and instruments, through to the archiving and pipelining of the data there exists a seamless flow of information) and a highly efficient operations staff at the cutting edge of the telescope operations. As a result, during the year 2003, ISAAC archived 101518 frames FORS1 32542, UVES 55447, FLAMES 8437, VIMOS 124367, FORS2 76359 and NACO 76189. Particularly gratifying is the high efficiency of ISAAC and NACO, which as infrared instruments and in the latter case also with adaptive optics, have high overheads associated with the observing strategies.



Open Shutter Time

The First MACAO-VLTI installation at Paranal

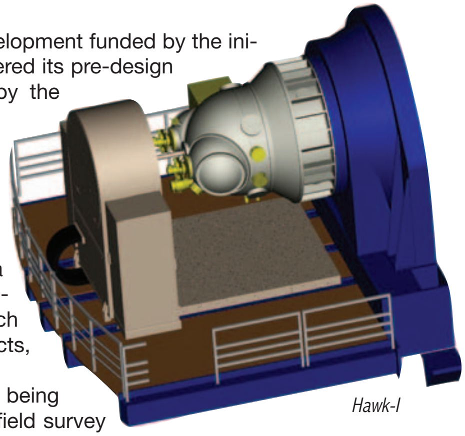


completed by ESO staff in November 2003 and the instrument is scheduled to return to operation in early 2004.
Some of the time when the Moon was too bright to observe with VIMOS was used to commission MIDI. Taking advantage of the bright moon, the Melipal Coudé feed was also upgraded from a STRAP (tip-tilt only) system to the new MACAO system which, as mentioned above, had already been deployed at Kueyen earlier in the year. The power of combining 2 UTs with AO systems was demonstrated only a few nights after the installation on Melipal with interferometric observations of the bright active galaxy NGC1068 with the test camera for the VLTI, VINCI. In 2004, it is expected that VISIR will complement VIMOS on Melipal and provide the telescope with the ability to observe during all lunar phases and, in addition, far into the infrared range of the spectrum.

On Yepun (UT4), the adaptive optics instrument NACO has been working with good efficiency and relatively problem free. During the year a number of improvements were made and new modes commissioned. A very promising new mode of performing differential imaging in dispersed light was installed in August and immediately used to detect a companion to the nearest brown dwarf (another brown dwarf but very much fainter). Also a four-quadrant phase mask coronographic mode has been added to the instrument and was in the

Preparing the future

As the last step towards the completion of the first phase of instrumentation development funded by the initial VLT instrumentation budget, the *HAWK-I* near infrared, wide-field imager entered its pre-design phase following a successful Phase A study and positive recommendation by the Scientific and Technical Committee, and a decision to construct in December.
Also following detailed feasibility studies and prototyping of critical subsystems, two 2nd generation VLT instrument projects were launched in December following the Council meeting. One is *KMOS*, a cryogenic, near infrared, multi-object spectrometer operating up to the K-band. To be developed by a German-UK consortium, one of its main scientific goals will be the study of the dynamical mass assembly of galaxies in the range of redshifts $z \sim 1\text{-}3$. The other is *X-Shooter*, a wide-band (from the ultraviolet to the near-infrared), medium resolution spectrometer to be developed by a Danish-Dutch-French-Italian ESO Consortium, and which aims to provide a “point and shoot” capability for obtaining spectra of single objects, especially highly variable sources such as gamma ray bursts.
Feasibility studies of two other potential 2nd generation VLT instrument are still being made by external Consortia with strong ESO involvement. *MUSE* is an integral field survey facility in the optical domain, with partial seeing correction by an advanced Adaptive Optics system. Its main science driver is “blind” searches for extremely distant galaxies. *Planet Finder* is an extremely high-contrast adaptive optics based imager to study directly the close environment of nearby stars, possibly down to giant planets.



Hawk-I

Reduction recipes

The Data Reduction Systems for VLT/VLTI instruments are either implemented by the Data Flow System Group of ESO (e.g. ISAAC, NACO) or by the instrument consortia (e.g. VIMOS). In both cases, ESO is responsible for building the reduction recipes around the data reduction modules that will allow the system to work in an automatic way. The UVES-FLAMES pipeline as well as the imaging and MOS parts of the VIMOS pipeline became operational in April. The development of the VIMOS/IFU reduction modules as well as the GIRAFFE pipeline is progressing steadily. Improvements continued to be made to the operational pipelines for ISAAC, UVES and FORS. As an example, the wavelength calibration for ISAAC benefits from a better approximation of the dispersion relation. Finally, the first official release of the MIDI pipeline was installed on Paranal. This pipeline provides a waterfall display of the fringes during observations, making it possible to assess the fringe signal-to-noise and the stability of the fringe tracking.

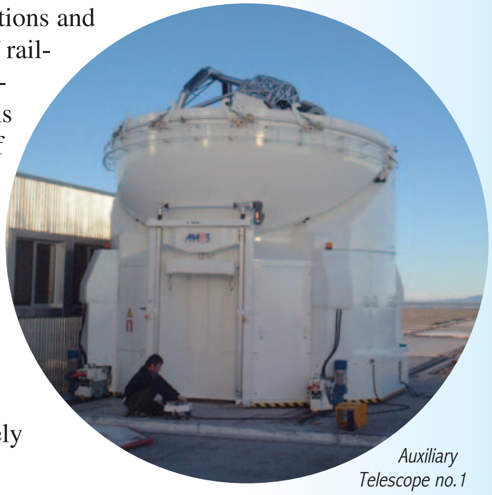
process of commissioning at the end of the year.

FORS2 which partnered NACO on UT4, has had another excellent year of almost totally trouble-free operations. The fast image transfer mode of the instrument that had been disabled following the detector upgrade has now been re-commissioned and observations of rapidly (millisecond timescales) changing targets can now be attempted again.

The laser guide star installations continue with the clean room cabling now complete and the relay tower and cabling to the top of Yepun installed. Also the modifications to the back of the secondary mirror unit of the telescope have been made in anticipation of the arrival of the launch telescope for the laser. Two cameras have been installed on the top-end ring of the telescope to detect aircraft flying near the laser beam and automatically switch the laser off.

Many Eyes, One Vision

The **Very Large Telescope Interferometer** (VLTI) continues to expand its horizons on Paranal. Guaranteed time and science demonstration observations have been undertaken with the mid-infrared instrument MIDI using various combinations of Antu, Kueyen and Melipal. Two of the UTs can already provide the VLTI with adaptive optics corrected beam and the third and fourth installations are scheduled for the coming periods. FINITO, the fringe tracking unit, has been deployed and the early results are promising. When operational in 2004, FINITO will bring further sensitivity improvements to the VLTI by stabilizing the fringes on the instruments and therefore allowing for long integrations. The most striking addition however, has been the arrival of the first of the Auxiliary Telescopes on site. By the end of 2003, AT1 had been assembled in the basecamp and was awaiting the new year to be transported to the Paranal deck and start exercising the 30 docking stations and more than half a kilometer of railway tracks. The precise alignment of the tracks and stations necessary for the operation of the auxiliary telescopes was completed at the same time.



Auxiliary Telescope no. 1

The near infrared science instrument AMBER had its final acceptance tests in Europe and passed them in November, being packed and shipped to Paranal immediately after the tests.

In 2003, the routine operation of the VLTI with

VISTA

The VISTA 4.2m wide field telescope will be dedicated to infrared survey observations and will therefore complement the 2.5m VST visible survey telescope.
VISTA is being acquired by ESO under the terms of the UK accession agreement, and is being developed for PPARC (the UK Particle Physics and Astronomy Research Council) by the VISTA Project Office (VPO) located at the Astronomy Technology Centre in Edinburgh. When operational in 2007, it will be equipped with sixteen, 2K×2K HgCdTe array detectors and will have an unsurpassed capability for large area surveys.

VISTA will be located about 2 km East of the VLT on the so-called NTT Peak. The top of the mountain has been removed to create a platform for the telescope and support building, and a paved single-track access road has been constructed which links the platform to the existing road linking the base-camp to the VLT summit.
A detailed geological survey confirmed that there was no major geological problem at the site and civil engineering work for the enclosure and support building will start in early 2004.

Cerro Paranal seen from the new VISTA acess road

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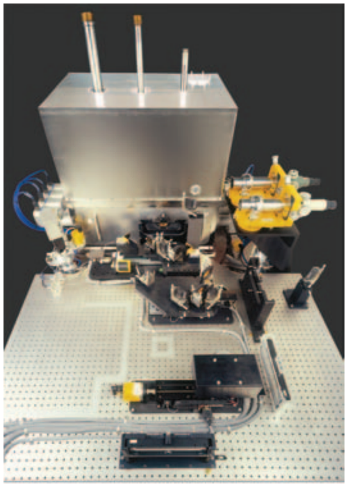
the siderostats and in support of the commissioning was undertaken by astronomers and Telescope/Instrument operators from the Science Operations department as if the VLTI were a fifth Unit Telescope. This policy has been acknowledged by the users' community which showed great interest in this new observing technique. In fact, in response to the Call for Proposal in October 2003 for observations with MIDI, 30 proposals were submitted and 23 approved by the Observing Programmes Committee. Before that, during periods 70 and 71, several hundred hours of shared risk science observations have been carried out for the ESO communit using the 30-cm siderostats. Six refereed articles on astrophysical results obtained with the VLTI and VINCI were published in 2003.



MIDI, the mid infrared VLTI instrument.
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Finally, it is worth mentioning that the collaboration with ESA on the ground demonstrator of the Darwin satellite continued. Two definition studies with industry will determine the feasibility of a nulling instrument at Paranal. A science study team was established to investigate the scientific potential of such an instrument. The definition studies should be finished by the end of 2004.

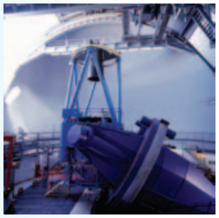
La Silla Observatory

After 15 years of very successful operations on La Silla, SEST – the Swedish-ESO Submillimetre Telescope – was closed in August. It will be replaced in 2004 by the brand new Atacama Pathfinder EXperiment (APEX) telescope on Chajnantor that will open new windows to millimetre and sub-millimetre astronomy. Thus, only 3 telescopes operated by ESO remain on La Silla: the venerable – but fully renovated – 3.6m, the pioneer New Technology Telescope (NTT), and the highly demanded ESO/MPG 2.2m. To this, one should add the 1.2m Swiss Telescope and a newcomer, the Robotic 60cm telescope to monitor Gamma Ray Bursts, REM. As La Silla operations continued to be streamlined, new challenging projects kept the staff focused and motivated. Thus, in spite of reductions, 2003 was one of the best years ever for La Silla.

La Silla telescopes continued to operate with high efficiency and high user satisfaction this year. The three telescopes operated routinely without problems and without loss of efficiency – the technical down time has stabilized to less than 2% – from the RITZ (Remote Integrated Telescope Zentrum), which became widely appreciated by visitors and staff. The average pressure factor (requested time/available time) was of the order of 4.5 for the 2.2m, and 2.5 for the NTT and the 3.6m telescope. The observing schedule was essentially Visitor Mode based with about 10% of the available nights assigned to Service Mode on the NTT and 3.6m telescopes. At the 2.2m telescope, a large fraction of the scheduled time with the Wide Field Imager (WFI) was assigned to Service Mode.

The instruments available on ESO operated La Silla telescopes are now:

At the NTT:
EMMI (ESO Multi-Mode Instrument), a multipurpose spectro-imager, operating in the 300-1000 nm range; **SuSI2** (Superb Seeing Imager 2), a direct imaging camera optimized for periods of good seeing;
SOFI (Son of ISAAC), an infrared spectro-imager and a simplified version of the Short Wavelength arm of ISAAC on the VLT.

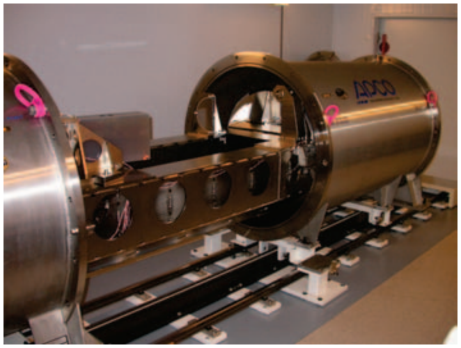


At the 3.6m:
CES (Coude Echelle Spectrometer), ESO's highest resolution spectrograph providing a resolving power of 220,000 in the 346–1028 nm region; **EFOSC-2** (ESO Faint Object Spectrograph and Camera 2), a very versatile instrument for low resolution spectroscopy and imaging in the visible and near UV; **TIMMI-2** (Thermal Infrared Multimode Instrument 2), which covers the 3.5 to 28 micron wavelength range and can perform observations in spectroscopic and imaging modes, including in both cases polarimetric mode; **HARPS** (High Accuracy Radial velocity Planetary Search), ESO's facility to measure radial velocities with the highest accuracy currently available.

At the 2.2m:
FEROS (Fiber-fed Extended Range Optical Spectrograph), a bench-mounted, thermally controlled, prism-crossdispersed echelle spectrograph; **WFI** (Wide Field Imager), a focal reducer-type camera with a field of view of 34′×33′.

Leading the field

The HARPS high resolution spectrograph was installed at the 3.6-m telescope, commissioned and offered to the Community as of October 1, 2003. This instrument has already demonstrated that it can achieve its unique goal of 1m/s long-term velocity precision. Major surveys have been started, not only for its original science driver, i.e. the detection of extra-solar planets from minute radial velocity variations of their parent stars, but also in the field of asteroseismology, studying the modes of oscillations of stars and, hence, probing directly their internal structure. This should lead to dramatic advances in the understanding of stellar interiors.



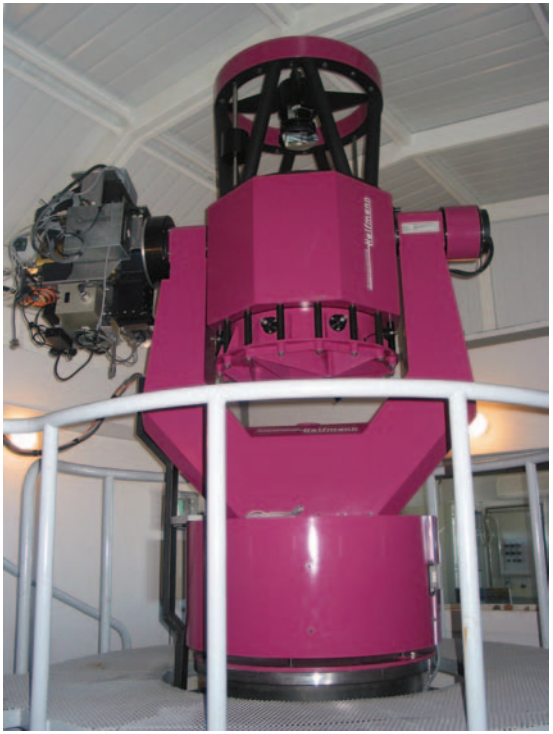
The measurements made during the commissioning phase and the first weeks of operation are of outstanding quality, proving that HARPS is currently the most precise Doppler-measurements machine in the world, placing ESO at the forefront of these hot topics.

As an example, in a 7-hour observation run on the star α Cen B, a total of 420 high quality spectra were collected showing a dispersion of 51 cm/s! Most of this dispersion is, however, dominated by 4-minute stellar oscillations, and the real noise is thus only 26 cm/s. This is equivalent to measuring velocities at a precision better than 1 km/h, a feat never accomplished up to now. As another example of the potential of this wonderful machine, already during the Guaranteed Time Observations, a new extra-solar planet was found, orbiting the star HD 330075 in 3.37 days.

The remarkable successes of these first observations illustrate also the outstanding efficiency of the reduction pipeline. The HARPS pipeline was indeed streamlined and installed on a fast computer allowing data to be reduced on-line. At the same time, the ESO new generation archival system (NGAS) is in the process of being implemented to speed-up the storage of the vast amounts of data generated by asteroseismology programmes.

Instruments upgrade

FEROS, the highly successful fibre fed echelle spectrograph on the 2.2m telescope was upgraded this year. A new set of fibres with new coupling lenses restored the loss of throughput that FEROS suffered when it was moved from the 1.5m to the 2.2m telescopes. The efficiency of the instrument now matches its design efficiency, close to 20%. The software of FEROS was also upgraded to full VLT compliance. Thus, FEROS now provides the community with one of the best high dispersion spectrographs available in the world.



REM inside its dome on La Silla. The IR camera is seen in the Nasmyth focus

The infrared instrumentation was also significantly upgraded this year. A number of new modes were implemented in TIMMI2, including Spectropolarimetry, and Lunar occultations. TIMMI2, the only thermal IR spectro-imager at ESO, continues thus to be a very competitive instrument. SOFI, the other infrared instrument, underwent extensive maintenance (after the plastic rim of one of its wheels broke) which led to a substantial improvement of the performance of the instrument in several aspects, notably in the image quality in large field mode.

Robots

Cerro La Silla welcomed a new small telescope on its top: the Rapid Eye Mount (REM) Italian Telescope. REM is a Robotic 60cm telescope conceived to immediately point and observe Gamma Ray Bursts detected by satellites. It arrived in June on La Silla and was rapidly installed inside its waiting dome. The long commissioning phase began promptly and by the end of the year REM was very close to be ready to scout the southern skies to elucidate the mystery of these gargantuan cosmic explosions. Its immediate data gathering capability and its accurate astrometry in the opti-

Observation Preparation tools

Astronomers applying for observing time at ESO must submit a description of the observations to be carried out in the form of an observing proposal. The Data Flow System Group worked hard this year to replace the existing system based on e-mail and *LaTeX* by a new one: as of March 2004, astronomers will be submitting their observing proposals through the Web. *P2PP*, the tool used by astronomers to submit Observation Blocks to ESO went through a major upgrade to support finding charts. This new feature should facilitate the work done by the operation teams.

cal and in the near-infrared will allow an early alert and pointing of the VLT. REM will also be complemented by the French 25cm TAROT-S robotic telescope.

A very busy year

The Engineering Department (LED) finally moved to new premises this year. This was an important step because it allows to actually achieving the potential synergy between engineers in different fields. And the engineers have, indeed, been very busy this year. Besides the instrumental developments mentioned above, LED was heavily involved in the ISO 9001 project, continued to work very hard in the maintenance of the hydraulic supports for the VLT primary mirrors, developed in collaboration with Garching a prototype for the new generation technical CCDs, and so on.

The fabrication of the new secondary mirror unit for the 3.6m started this year. Coupled with the refurbishment of the primary mirror's fixed points (also done in 2003), this should be the last step in curing the 3.6m of its congenital image quality defects. The arrival of HARPS, and the continuation of TIMMI2, require that the telescope performs at its full potential.

The La Silla software team was also extremely busy this year supporting all the activities mentioned above, in addition to their routine tasks of upgrading versions of the VLT software, and providing general support to the users. One of the most noteworthy achievements of the Software team has been the porting of the Data Flow System software to LINUX based PCs. This has allowed increases of factors of more than 10 in efficiency compared to the old faithful HPs.

Finally, the plan to merge the La Silla and Paranal observatories under a single unit was finalized this year and approved. The merging will be done from the bottom-up starting at the beginning of 2004, and at the end of the process both observatories will become a single organization under one director. The merging plan was very well received by the staffs at both observatories.☆

ISO 9001 Certification

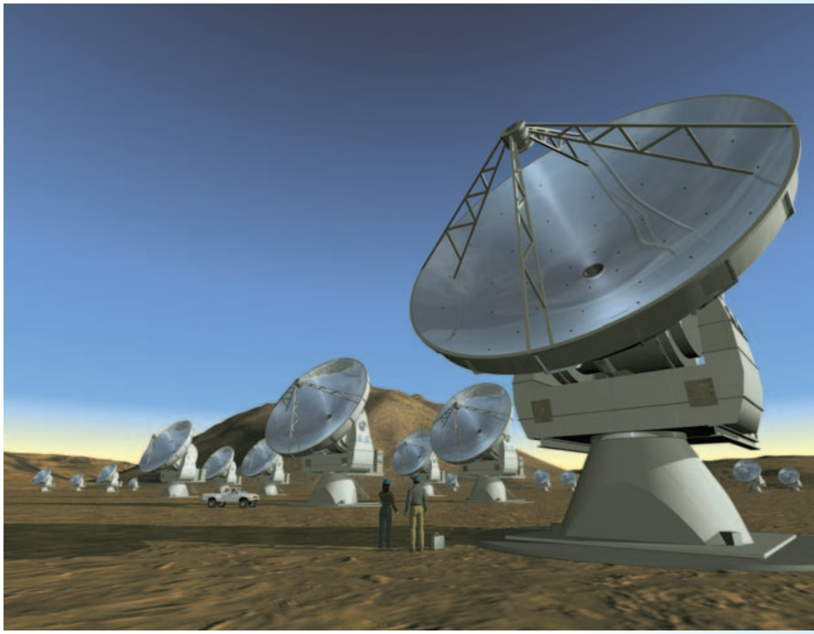
In 2003, La Silla Observatory has continued its process of implementing the International Organization of Standardization (ISO) 9001 Quality Management System. With the help of an external consulting company, a team of internal auditors was formed and trained, and a series of lectures were given to the whole observatory staff. Thus, the internal audit team was able to conduct two comprehensive audits of the entire observatory interviewing an important fraction of the total staff. The process was successful, and the plan is to seek ISO 9001 certification in March 2004. The quality management methodology will thus be in place and continuous improvement of all the core processes of the observatory will begin.


The new LED premises

Chajnantor

This year proved very important for the development of ALMA, the Atacama Large Millimeter Array, an international collaboration between Europe and North America to build a group of 64 radio-telescope antennas that will work together to study the Universe from the 5,000m high Llano de Chajnantor site in northern Chile. This year indeed marked the official start of the construction phase, following the signature of all required agreements. The ESO-Spain agreement on ALMA was signed in January, quickly followed by the European-North American Bilateral Agreement for ALMA in February. At the same time the ALMA Board was officially established, and then followed the formal establishment of the Joint ALMA Office (JAO). Prof. Massimo Tarenghi, who played such an important role in the construction of the VLT, was appointed Director of the ALMA project in April. All formalities with Chile were completed to enable proceeding with the construction and operation of ALMA in Chile. These included the agreement for a 50-year concession of the land for the antenna array at 5000 meters, the purchase of the land for the Operations Support Facility (OSF) at 2900 meters, granting of right-of-way for the access roads, agreements on the ALMA contributions to CONICYT and Region II, and approval of the Environmental Impact Statement. The Agreement signed between the ESO Director General and the Chilean Minister of Foreign Affairs was ratified unanimously by the Chilean Parliament in June, thus enabling our Organization to establish a new observatory near San Pedro de Atacama. The positive vote at Parliament demonstrated the great interest and expectation which the ALMA project represents for its host country.

At the end of July, in a ceremony held in San Pedro, with the presence of Chilean President Lagos, the Concession Decree for the Chajnantor land was signed, and site construction work immediately began. In October, the land for the Operations Support



The President of Council, Prof. P. van der Kruit, energetically breaks the ground for ALMA along with Dr. W. Van Citters (NSF, Director of the Division of Astronomical Sciences) and Prof. M. Tarenghi (ALMA, Director).

ALMA Board

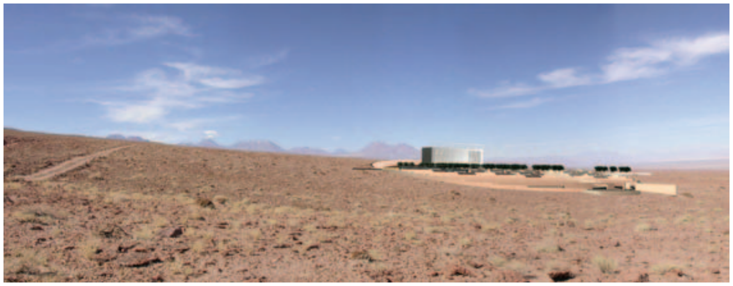
Europe	North America
P. van der Kruit/ESO, Chair	R. Dickman/NSF, Vice-chair
C. Cesarsky/ESO	R. Giacconi/AUI
R. Wade/PPARC	J. Hesser/HIA
R. Booth/OSO	A. Sargent/Caltech

Facility was acquired jointly by ESO and Associated Universities, Inc. (AUI), followed by the Decree for the Right of Way access to the ALMA land.
An official groundbreaking ceremony took place in Chile in November 2003, attended by about 170 scientists and dignitaries from Europe, North America, Japan and Chile.

Following the conclusion of all necessary agreements in Chile, significant progress took place on site development. The construction access roads to the OSF and from the OSF to the high Array Operations Site (AOS) were completed, as was the design of the permanent roads. The project is on track towards tendering and the start of OSF construction in 2004. A feasibility study for the power system was done and the option of generation by dual-fuel (natural gas and diesel) engines located at the OSF and transmitted to the AOS was selected. The North American partners are primarily responsible for the site facilities at the AOS and the design of these facilities is already more than two-thirds completed.

Discussions with Japan continued through the year. Japan has proposed to contribute the following enhancements to the project: an ALMA Compact Array (ACA), including four 12-metre diameter antennas, twelve 7-metre antennas, and an ACA correlator; three new receiver bands; and a fraction of the infrastructure. In July the National Astronomy Observatory of Japan submitted a proposal for their participation in ALMA construction starting in 2004 to their government's Ministry for Science and Technology. It was forwarded to the Finance Ministry in September and was included in the budget submitted to the Japanese Parliament in December. Formal approval by the Japanese Parliament is expected in March 2004. Final negotiations on the entry of Japan into the project will take place during 2004.

At ESO, an ALMA Division was established in January. R. Kurz became Head of Division and European Project Manager. The search for key personnel of the European Project Office continued throughout the year and concluded with the appointment of



Concept of the Operations Support Facility.

The Antenna Test Facility in Socorro and the three prototypes.

ALMA European Scientific Advisory Committee

C. Waelkens/Belgium
P. Naselsky/Denmark
P. Cox/France
P. Schilke/Germany
L. Testi/Italy
E. van Dishoeck/Netherlands, Chair
J. Yun/Portugal
S. Aalto-Bergman/Sweden
A. Benz/Switzerland
J. Richer/UK
R. Bachiller/Spain
R. Hills/ESO STC Liaison

Tom Wilson as European Project Scientist (replacing E. van Dishoeck, who had served as interim EPS and now chairs the ESAC), and Robert Laing as European Instrument Scientist.

European ALMA Board

C. Waelkens/Belgium
H. Jorgensen/Denmark
L. Vigroux/France
T. Henning/Germany
G. Tofani/Italy
E. van Dishoeck/Netherlands
T. Lago/Portugal
R. Booth/Sweden
S. Lilly/Switzerland
R. Wade/UK, Chair
C. Cernicharo/Spain
P. van der Kruit/ESO Council President
C. Cesarsky/ESO Director General
M. Steinacher/ESO Finance Committee Chair

Antennas

The VertexRSI prototype antenna was accepted by the National Radio Astronomy Observatory (NRAO) at the ALMA Test Facility (ATF) near Socorro, New Mexico, in March. Following further debugging and closure of the "punch list", the joint Antenna Evaluation Group (AEG) carried out successful holographic measurements of the antenna primary reflector surface. Outfitting for extended tests of pointing and radiometric performance continued through the year. Preliminary acceptance of the Alcatel/EIE prototype antenna took place in December. Outfitting of the antenna for holographic measurements by the AEG was done in parallel with the contractor's work to complete acceptance testing early in 2004. Assembly and acceptance testing of the Japanese prototype 12-meter antenna at the ATF was also completed in 2003. In parallel with work on the prototype antennas, the Antenna Integrated Project Team and project management have prepared to launch the procurement of the 64 production antennas. Agreement has been reached with the North American partners on a joint approach to this procurement. These preparations culminated in the simultaneous release of a Call for Tenders by ESO and a Request for Proposals by AUI/NRAO on 17 December. Bids in response to both are due on 30 April 2004. The technical and programmatic requirements (Technical Specifications, Interface Control Documents, Statement of Work, etc.) are identical, whereas the contractual terms and conditions for each follow their established standards.

Work is also continuing at great speed on all other aspects of the ALMA project: the Front and Back Ends, the Local Oscillator, the Correlator, etc. Software development continued according to plan with major roles for ESO and several European partners. ESO participated fully in the System Engineering activity, with emphasis on the preparation of system requirements documentation, technical specifications, and interface control documents.

Magical Night: the APEX antenna fully assembled in test.

APEX – The Pathfinder

Meanwhile, work on APEX – the Atacama Pathfinder Experiment – continued. APEX is a collaboration between ESO, the Max-Planck-Institut für Radioastronomie and the Astronomical Institute at the University of Bochum in Germany, and the Onsala Space Observatory in Sweden. As it name suggests, APEX will serve as a pathfinder for the Atacama Large Millimeter Array (ALMA) by performing wide-field observations for later ALMA follow-up studies.

The APEX antenna shortly after it arrived on Chajnantor. The container camp that houses the control room, labs, and living quarters is seen in the background.

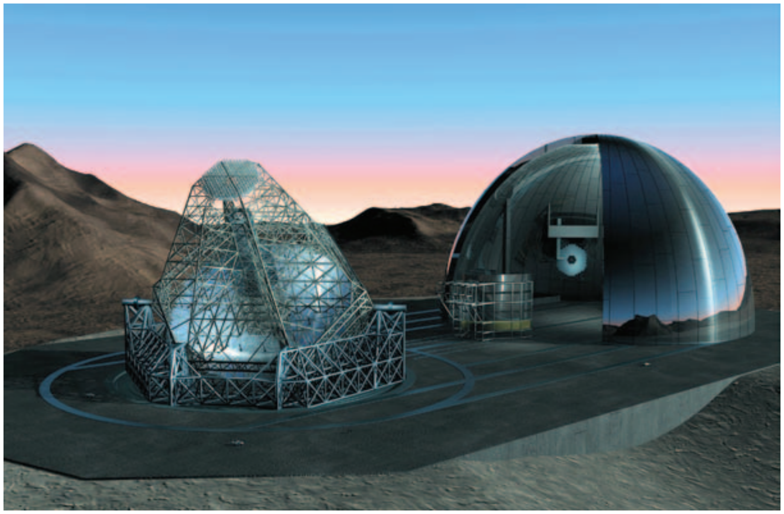
The APEX antenna arrived in Chajnantor in April and was mounted in its waiting base without major difficulties, despite the altitude and the season. It was fortunate that the Bolivian winter was extremely mild this year, allowing the civil works to proceed without major disruptions by bad weather. The “real” winter, however, was extremely harsh and the antenna assembly suffered considerable delays. APEX passed preliminary acceptance in October and immediately entered the phase of fine tuning, which will continue in 2004.The first tests indicate that the telescope meets the design specifications very well.

The APEX base near San Pedro de Atacama was also completed. The base provides housing and office facilities for the APEX staff, and visiting astronomers. The SEST staff together with their lab equipment and furniture moved into the base in November and immediately started working on the numerous tasks awaiting them in San Pedro and Chajnantor.

Extremely Large Telescope

In 2003, ESO activities on the next generation of ground-based Extremely Large Telescopes, the OWL study, have shifted from concept development towards design analysis, optimisation and enabling technologies. The primary objectives of the OWL study are to verify the feasibility of a 100m-class optical and near-infrared, adaptive telescope, explore potential science cases, define a baseline conceptual design and operation's scheme, and establish reliable cost, schedule, and performance estimates. This study would eventually lead to a proposal for the detailed design and construction of an Extremely Large Telescope. During 2003, the standardisation of opto-mechanical modules was essentially completed, and static deflections, already deemed low for a structure of OWL size, have been brought substantially down.

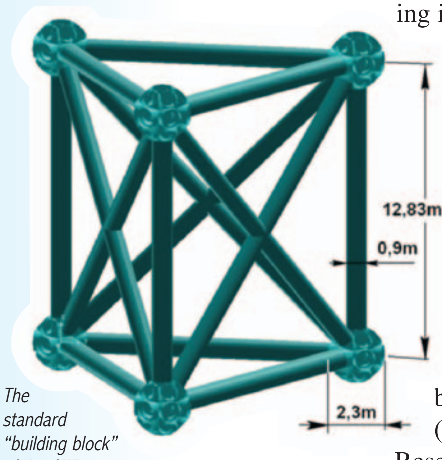
OWL is designed as an alt-azimuthal telescope with segmented, spherical primary and flat secondary mirrors. In order to limit risks and costs, the baseline design is required not to use monolithic mirrors larger than what is currently feasible, i.e. about 8-m in diameter. Two competitive segments polishing studies have been completed. Both studies addressed the feasibility of serially produced segments, in two optional materials and three optional sizes (classical, low-expansion glass ceramics vs. silicon carbide, with a segment size of 1.3, 1.8, or 2.3m flat-to-flat). Both studies gave remarkably consistent results in terms of cost estimates, confirmed performance and cost advantages of the baseline solution (spherical segments, shape), and revealed unexpected ones. The facilities required for the production would be roughly comparable in size to those built for the VLT primary mirrors, but would require smaller machinery and tools. A contract has been placed with a second potential supplier for the feasibility of silicon carbide segments blanks, and technical discussions with a third are under way. A control model of the telescope kinematics is in preparation at the University of Lausanne (Switzerland).



A possible layout of the OWL observatory.

The telescope is designed to operate in open air – an enclosure with a 100-m wide slit would provide little protection against wind anyway. Wind excitation is an obvious area of concern, and detailed simulations, to be followed by wind tunnel testing, are under way to assess the impact on design, performance, and, possibly, site selection. A campaign of measurements on the Jodrell-Bank radio telescope is under preparation. High bandwidth sensors will be installed by the second quarter of 2004, and first results are expected by mid-2004. Backup solutions have been explored at notional level, in case dynamic wind pressure on the optics and structures would not allow meeting specifications.

A proposal for an ELT Design Study was prepared for submission in March 2004 to the European Commission (EC) under Framework Programme 6. This proposal focuses on enabling technologies and is largely independent of the telescope design. Prepared under ESO's lead, it gathers 39 industrial and academic partners across Europe, Australia and Israel. The total estimated cost of the study is 42 M , with 22 M requested from the EC. ESO is the leading contributor, with 7.5 M own funding. The scope of work includes, in particular, the development and testing of adaptive optics technologies and concepts, extensive Research & Development (R&D), prototyping and testing in the area of wavefront control, R&D and prototyping in optical fabrication and high efficiency coatings, development of system modelling tools, but also instruments point designs, infrastructure assessment, and extensive site characterization for an Extremely Large Telescope. In the same vein, a Memorandum of Understanding has been prepared between ESO and AURA (Association of Universities for Research in Astronomy, USA), in order to coordinate and share R&D on common critical aspects of any ELT project (Adaptive Optics, segmented mirrors, instrumentation & detectors, site surveys).



The standard "building block" of the OWL structure.

Science case

The science case has continued to be developed both in-house and through the ELT science case working group within the OPTICON network. Better simulations of OWL's performance are under way, and new science cases are being developed or refined in all areas of astronomy. New results have been obtained in the case for the study of earth-like exoplanets (confirming that the telescope diameter *D* is a critical parameter, as the number of visible stars is proportional to D^3 and the contrast is proportional to D^4). The exceptional sensitivity of OWL has also been shown to open the study of the sources of re-ionisation in the early universe, to enable to disentangle cosmological models using primary distance indicators (as opposed to today's use of secondary ones, like Type Ia supernovae) and to detect the very first stars (primordial population, or Pop III). Supernovae would be visible to very high redshifts, allowing the determination of the cosmic supernova rate (and therefore of star formation) as well as the detection of possible cosmological effects (e.g. quintessence).

Detailed implementation scenarios have been drafted and evaluated, with a view to providing science capability before full completion, while allowing maximum development time for critical adaptive technologies. A realistic start of science with a partially filled primary would be in 2017 for a 100m OWL (full completion in 2021). Options for a smaller version (60m) at about half the cost have also been analysed, with a start of science (with partially filled primary) in 2016 (full completion in 2020).
The total estimated cost is about 1,200 M , including 940 M capital investment. About 50% of the capital cost positions have been confirmed through industrial studies (often competitive ones).☆

The organisation

Office of the Director General (including all the Fellows): Cesarsky, Catherine
Alloin, Danielle; Almagro Garcia, Susana; Alves, Joao; Basbilir, Mustafa; Bauerle, Mary; Baumont, Sylvain; Beller, Angelika; Bialetski, Yury; Billeres, Malvina; Blondin, Stephane; Boecker, Michael; Boffin, Henri; Bonneau, Jean-Michel; Bouy, Hervé; Breysacher, Jacques; Bristow, Pamela; Carmona Gonzalez, Andres; Casquilho Faria, Daniel; Chauvin, Gael; Cioni, Maria-Rosa; Clarke, Fraser; Cretton, Nicolas; Daddi, Emanuele; Dall, Thomas; De Breuck, Carlos; De Figueiredo Melo, Claudio; Delle Luche, Celine; Dell'Erba, Anna Maria; Delmotte, Nausicaa; Depagne, Eric; Di Folco, Emmanuel; Doellinger, Michaela; Ederoclite, Alessandro; Egholm, Mathias; Ettori, Stefano; Foellmi, Cedric; Galliano, Emmanuel; Gandhi, Poshak; Gavignaud, Isabelle; Germany, Lisa Maree; Gil, Carla; Gomez, Maria; Grothkopf, Uta; Hartung, Markus; Hau, George; Hein, Priya Nirmala; Hempel, Maren; Heyer, Hans Hermann; Hofstadt, Daniel; Hoppe-Lentner, Renate E.; Huelamo, Nuria; Illanes, Esteban; Ivanov, Valentin; Janssen, Edmund; Kervella, Pierre; Lagarini, Andrea; Leibundgut, Bruno; Liske, Jochen; Lombardi, Marco; Madsen, Claus; Mason, Elena; Masseron, Thomas; Morelli, Lorenzo; Mottini, Marta; Mullis, Christopher; Nakos, Theodoros; Nesvacil, Nicole; Nuernberger, Dieter; Pace, Giancarlo; Paresce, Francesco; Peroux, Celine; Pignata, Giuliano; Pott, Joerg-Uwe; Raimondo, Gabriella; Rejkuba, Marina; Renzini, Alvio; Rettura, Alessandro; Riello, Marco; Roehrle, Claudia; Sadibekova, Tatyana; Saldias, Christian; Sbordone, Luca; Schmidtobreick, Linda; Schuhler, Nicolas; Stoffer, Christina; Treumann, Angelika; Vaisanen, Petri; Van Hest, Frank; Vannier, Martin; Verdoes Kleijn, Gijsbert; Vicente, Silvia Marina H.; Voelk, Elisabeth; Vreeswijk, Paul; Weidinger, Michael; West, Richard-Martin; Wold, Margrethe; Zodet, Herbert; Zwaan, Martin A.;

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Sanchez, Ariel; Santana, Jorge; Saviane, Ivo; Schemrl, Anton; Selman, Fernando; Sepulveda, Jorge; Shen, Tzu-Chiang; Sinclaire, Peter; Soto, Ruben; Ureta, Eugenio; Valenzuela, Jose; Varas, Oscar; Vera, Enrique; Vilaza, Jorge; Weilenmann, Ueli; Wendegass, Luis; Wenderoth, Erich;

ALMA Division: Kurz, Richard
Arndt, Angela; Baars, Jacob; Beckers, Jean-Louis; Biancat Marchet, Fabio; Eschwey, Joerg; Haupt, Christoph; Laing, Robert; Medves, Giuseppe; Meuss, Holger; Otarola, Angel; Pangole, Eric; Perez, Juan; Raffi, Gianni; Rivera, Roberto; Rudolf, Hans; Schwarz, Joseph; Shaver, Peter A.; Stanghellini, Stefano; Tan, Gie Han; Zuffanelli, Elena;

Paranal Observatory: Gilmozzi, Roberto
Ageorges, Nancy; Alarcon, Hector; Alvarez, Jose; Argomedo, Javier; Baez, Jose; Bagnulo, Stefano; Baksai, Pedro; Bascuñan, Rogelio; Bauvir, Bertrand; Bendek, Eduardo; Brancacho, Jorge; Brillant, Stephane; Bugueño, Erich; Caniguante, Luis; Cantzler, Michael; Carcamo, Ruben; Cardenas, Cesar; Carrasco, Oscar; Castillo, Roberto; Cerda, Susana; Ceron, Cecilia; Cid, Claudia; Correa, Alex; Cortes, Angela; Costa, Jaime; Del Burgo, Stephan; Donoso, Reinaldo; Edmunds, Ann; Ehrenfeld, German; Erm, Toomas; Esparza, Cristian; Faundez, Lorena; Fischer, Michael; Flores, Erito; Gillet, Gordon; Giordano, Paul; Gonzales, Sergio; Guajardo, Patricia; Guerra, Carlos; Guisard, Stephane; Gutierrez, Fernando; Haddad, Juan; Haddad, Nicolas; Harding, George; Heinz, Volker; Henriquez, Juan; Herrera, Cristian; Housen, Nico; Hubrig, Swetlana; Hüdepohl, Gerhard; Hummel, Christian; Hurtado, Norma; Jaunsen, Andreas; Jehin, Emmanuel; Jimenez, Jorge; Johnson, Rachel; Kaufer, Andreas; Kiekebusch, Mario; Ledoux, Cedric; Leiva, Alfredo; Lidman, Christopher; Lopez, Ariel; Luco, Fernando; Marchesi, Massimiliano; Marco, Olivier; Marconi, Gianni; Mardones, Pedro; Mathieu, Michele; Mathys, Gautier; Montano, Nelson; Morales, Alex; Morel, Sebastien; Mornhinweg, Manfred; Muñoz, Ivan; Navarrete, Julio; Nievas, Hernan; Nuñez, Herman; O'Brien, Kieran; Osorio, Juan; Palacio, Juan; Parra, Jose; Pino, Andres; Preminger, Daisy; Ramirez, Andres; Rantakyrö, Fredrik; Riquelme, Miguel; Roa, Luis; Robert, Pascal; Robinson, William; Rojas, Chester; Rozas, Felix; Ruseler, Francisco G.; Saguez, Claudio; Salazar, Daniel; Salgado, Fernando; Sandrock, Stefan; Sanhueza, Roberto; Sansgasset, Pierre; Sanzana, Lilian; Scarpa, Riccardo; Schmutzer, Ricardo; Schöller, Markus; Siclari, Waldo; Smoker, Jonathan; Sterzik, Michael Fritz; Strunk, Sandra; Szeifert, Thomas; Tamai, Roberto; Tapia, Mario; Torres, Manuel; Vallejo, Karen; Vanzi, Leonardo; Zarate, Andres;

Technology Division: Cullum, Martin
Allaert, Eric; Andolfato, Luigi; Biereichel, Peter; Brast, Roland; Brunetto, Enzo; Buzzoni, Bernard; Caproni, Alessandro; Chiozzi, Gianluca; Comin, Mauro; Condorelli, Livio; Conzelmann, Ralf Dieter; Delabre, Bernard-Alexis; Dichirico, Canio; Dietl, Ottomar; Dimmler, Martin; Duchateau, Michel; Duhoux, Philippe R. N. M.; Egedal, Carsten; Filippi, Giorgio; Fischer, Gerhard; Frahm, Robert; Frank, Christoph; Franza, Francis; Gilli, Bruno; Gitton, Philippe; Gojak, Domingo; Gonte, Frederic Yves Joseph; Gustafsson, Birger; Hess, Guy; Hubert, Georgette; Huster, Gotthard; Huxley, Alexis; Jeram, Bogdan; Karban, Robert; Kasten, Helga; Koch, Franz; Kotzlowski, Heinz E.; Kraus, Maximilian; Longinotti, Antonio; Moresmau, Michel; Nees, Walter; Noethe, Lothar; Nylund, Matti; Ounnas, Charlie; Pasquato, Moreno; Pirani, Werther; Pomaroli, Edouard; Popovic, Dan; Pozna, Eszter; Quattri, Marco; Quentin, Jutta; Rossi, Silvio; Schilling, Marcus; Schneermann, Michael; Sivera, Paola; Sokar, Barbara; Sommer, Heiko Andreas; Van Kesteren, Arno; Wirenstrand, Krister; Zamparelli, Michele; Ziegler, Veronique;

Telescope Systems Division: Monnet, Guy
Albertsen, Maja; Araujo Hauck, Constanza; Arsenault, Robin; Bonaccini Calia, Domenico; Bonnet, Henri; Braud, Jeremy; Clenet, Yann; Delplancke, Francoise; Derie, Frederic; Dierickx, Philippe; Donaldson, Robert; Enard, Daniel; Fedrigo, Enrico; Glindemann, Andreas; Guidolin, Ivan Maria; Hackenberg, Wolfgang; Hubin, Norbert; Ivanescu, Liviu; Kasper, Markus; Koehler, Bertrand; Le Louarn, Miska Kristian; Leveque, Samuel; Marchetti, Enrico; Menardi, Serge B. P.; Milligan, Samantha; Oberti, Sylvain; Pasquini, Luca; Phan, Duc Thanh; Puech, Florence; Rabien, Sebastian; Richichi, Andrea; Sarazin, Marc; Scales, Kevin; Spyromilio, Jason; Strasser, Josef; Ströbele, Stefan; Taylor, Luke; Tordo, Sebastien; Wallander, Anders; Wilhelm, Rainer; Yaitskova, Natalia;

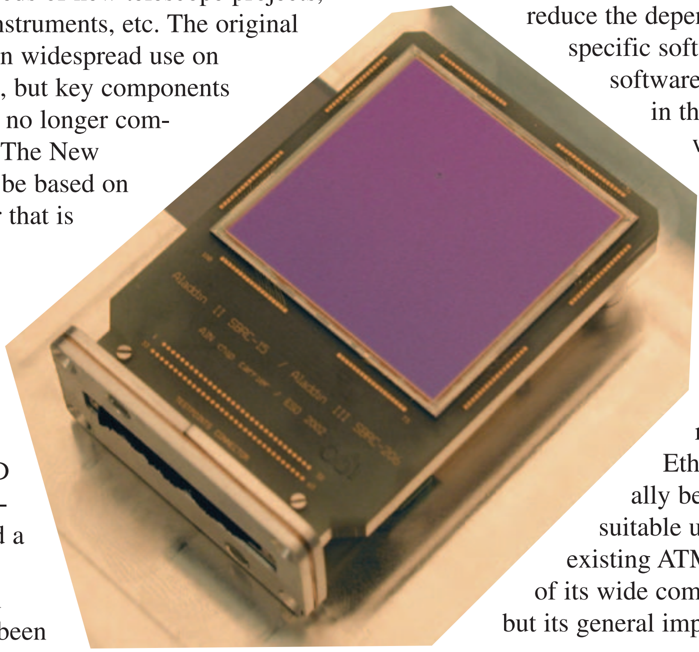
Administration Division: Corbett, Ian F.
Alberth, Manuela; Arias, Andres; Berrington, Sylvia; Block, Roland; Carrasco, Cecilia; Carvajal, Alfredo; Cortes, Hugo; Dremel, Guenther; Eng, Willem Arie Dirk; Fischer, Peter; Fischer, Robert; Fischman, Nicolas; Franco Partida, Maria Luisa; Garnica, Sonia; Godoy, Eugenia; Guha, Rebonto; Haase, Katjuscha; Hansen, Karin; Kastelyn, Nathalie; Kerk, Elizabeth; Koke, Thomas; Kraft, Gabriele; Kraus, Hans-Juergen; Labrin, Nelson; Lampersberger, Brigitte; Lockhart, John; Madrazo, Maria; Moreno, Jorge; Neuville, Helene; Nieuwenkamp, Christine; Orrego, Ernesto; Ostaschek, Iris Elisabeth; Ounnas, Barbara; Paya, Ana; Quintana, Mauricio; Quintana, Rolando; Ritz, André; Riveros, Rosa; Rombout, Francky; Silva, Maria; Siml, Erich; Slater, Roswitha; Teupke, Svea; Triat, Albert; Urban, Ullrich; Vedsoe Marschollek, Lone; Vossen, Gisela; Widl, Alfred; Wieland, Gerd;

Seconded staff member: Tarenghi, Massimo - Director ALMA

Technical Developments

The Technology Division has contributed to over 70 different projects during 2003. These include ESO instrumentation and telescope projects, ALMA, and a number of external projects and contracts. Support was given in all fields of engineering and specialist analysis. A considerable amount of support was also given to the ESO observatories for handling repairs, upgrades, problem solving and urgent procurements. In addition, the Division continued with a number of on-going background activities relating to the improvement of infrastructure and the development of the technical standards that are used throughout the organisation.

New detectors: Among other things, a new series of Technical CCD systems (TCCD) is being procured to meet the needs of new telescope projects, second generation instruments, etc. The original TCCD systems are in widespread use on Paranal and La Silla, but key components of these systems are no longer commercially available. The New TCCD systems will be based on the SDSU controller that is used at many major observatories, but with some modifications to assure compatibility with the ESO environment. A compact, Peltier-cooled TCCD head has been developed at La Silla, and a prototype head and controller have been tested. Orders have been placed for the serial production of controllers and CCDs, and delivery of these will start in early 2004.



One of the CRIRES Aladdin III arrays mounted on an ESO designed ceramic board

Software: In terms of project support, by far the largest user of the TEC Software Department manpower resources has been ALMA. The second largest single task of the Department was the preparation of new releases of the VLT Common Software (VCS). As the main requirement here was to add functionality for new projects rather than fixing bugs, only one new software release per year is now issued. However, because each new release has to deal with an ever-increasing quantity of instruments and telescope configurations, the prior testing of the VCS releases gets correspondingly more difficult and time consuming.

A long-term goal has been to gradually reduce the dependence on vendor-specific software. Although such software has been very useful in the past to get things working quickly, experience has shown that long-term commercial support is often unreliable.

Evaluation work has also been carried out on Gigabit Ethernet. This is generally believed to be the most suitable upgrade path from the existing ATM networks because of its wide commercial acceptance, but its general implementation at

Paranal would be a major expense and potential source of disruption that cannot yet be justified.

IT Services: In 2003, the main thrusts for Information Technology (IT) support have been to improve the overall security, to improve operational efficiency through improved system stability and, to some extent, to extend the range of services provided. ESO experienced a number of virus attacks but, in comparison with many major companies and institutions, suffered only minor temporary inconveniences. However, this has not been without considerable vigilance and hard work by the IT staff at all ESO sites.

Considerable activity took place in the field of inter-site communications and a draft communications strategy document was produced. This was motivated by the pending expiration of the contract for the dedicated satellite links to Chile, the changing technological scene, and the evolution of the requirements of the Organisation.

In order to ensure that the ESO IT services are both adequate for needs of the Organisation and also cost-effective, an external consultancy firm was engaged to carry out a study of IT infrastructure and service requirements at all ESO sites. The conclusions of this study will be available in early 2004.

Most of the projects ESO is involved with have an international character, and an increasing number of meetings now take place through video conferences. This not only saves travel costs but also much time for the participants. In addition, many ESO staff and project teams use video conferencing to keep in regular touch with their colleagues on the other continents. To cope with this increasing demand, the video conferencing facilities in Garching have been extended to include three fixed installations as well as two portable systems.☆

Instrumentation

Highlights of the year included the offering to the ESO community of FLAMES and VIMOS at the VLT and the unique planet finding and asteroseismology spectrograph, HARPS, at the 3.6m telescope on La Silla. This means that there are now 7 operating instruments on the VLT and a further two, VISIR and SINFONI, were approaching completion towards the end of the year at the CEA in Saclay, France, and ESO Garching respectively and will be installed and commissioned in 2004.

Two, out of ultimately four, adaptive optics correctors (MACAO/VLTI) for the VLTI Coudé beams are now in operation in Paranal. A third one is currently being assembled at ESO-Garching. Similar systems have been produced for SINFONI and CRIRES, to feed these spectrometers with much sharper images.

NACO, the infrared adaptive optics imager/spectrometer, was upgraded to provide two new and powerful scientific capabilities. Firstly it was equipped with a spectral differential imager by the Max-Planck Institut für Astronomie, Germany, in collaboration with the Steward Observatory, USA, and ESO. Then it received a 4-Quadrant Phase Mask developed for coronography by LESIA (Observatoire de Paris, France).

Integration of SINFONI in Garching had almost been completed by the end of the year, ready for the Preliminary Acceptance process at the beginning of 2004. The adaptive optics module was assembled and tested at ESO, while the SPIFFI spectrometer was used successfully in stand-alone mode as a guest instrument at the VLT by its builders at the Max-Planck Institut für extraterrestrische Physik (Garching, Germany) before being finalized for the coupling of the two.

VISIR was completely integrated and the final testing required for Preliminary Acceptance almost finished by the end of 2003. Perhaps the most important result was that its image quality and flexure were found to meet or even exceed the scientific specifications.

Integration of the 1–5 µm, high-spectral resolution, CRIRES spectrometer started at ESO-Garching. This cryogenic instrument will be installed inside a large vacuum vessel shown to be mounted stably on one of the VLT Nasmyth platforms and fed by an optical de-rotator and adaptive optics system.

OmegaCAM, the 1 square degree optical imaging facility for the 2.6m VLT Survey Telescope (VST), is advancing. The opto-mechanics, developed by the LSW-München, Germany, is close to completion and with a possible acceptance around March 2004 while the large detector assembly, developed by ESO, is still in the assembly phase. The full complement of 32 science grade 2k × 4k detectors needed to cover its large field is in hand and the large cryostat has been completed and successfully tested.

Development of 2nd generation VLT Instrumentation and upgrades of the 1st one requires a huge R&D effort, both at ESO and in its Community, in critical areas like adaptive optics, laser guide stars, interferometry, smart focal plane systems & optical components. A coordinated European Joint Research Activity plan, covering in particular these technical domains, has been elaborated in 2003 under the OPTICON umbrella. Following a successful application, matching funds have been obtained from the European Commission FP6 programme for the next four years.

ESO also continues to invest a large long-term effort for the development of detectors and has supplied the detectors and/or controllers for all the instruments mentioned above. Requirements have also recently been established and the design work started on a modular Next Generation Controller suitable for both visible and infrared devices. ☆

SINFONI in the Garching laboratory

The Astrophysical Virtual Observatory

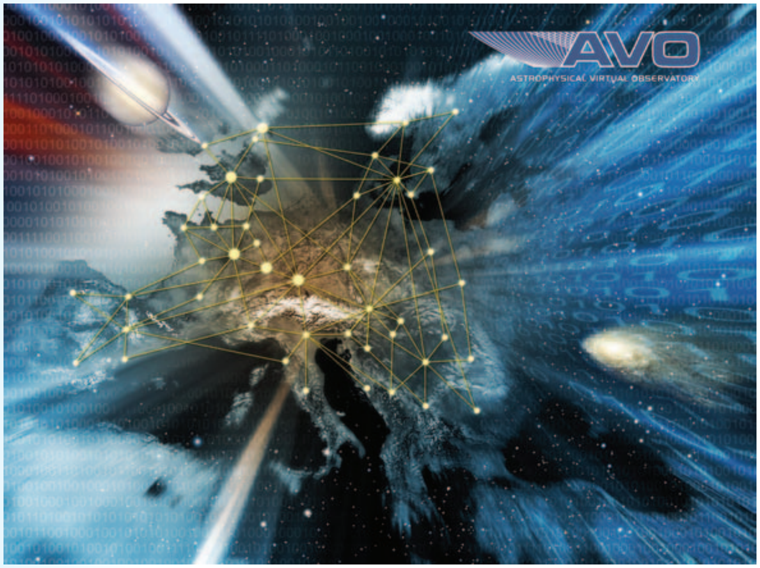
The Astrophysical Virtual Observatory (AVO) project is a European Commission Fifth Framework Programme (FP5) supported research and development effort lead by ESO that began on 1 November 2001. The project aims within three years to lay the scientific and technical basis for an operational virtual observatory in Europe. The project consists of three main work areas (Science, Interoperability and Technology), utilises approximately 54 man-years of effort involving more than 50 staff spread over six partner organisations and consortia.

The second year of the project had 5 main objectives, which have all been fully met:

- Complete hiring of AVO staff
- Plan, develop and implement the first demonstration of AVO technologies in January 2003 at an AVO Science Working Group meeting held at Jodrell Bank Observatory
- As a member of the International Virtual Observatory Alliance, participate in a coordinated demonstration and exhibition of VO technologies and systems at the International Astronomical Union General Assembly held in Sydney, Australia in July 2003
- Coordinate and align AVO technical and interoperability work programs with the priorities set out by the International Virtual Observatory Alliance (IVOA) at the January 2003 meeting and provide AVO representation in the IVOA working groups for AVO strategic areas of work
- Prepare and submit FP6 proposals for components of the AVO Phase B work program (EURO-VO).

The AVO demonstration – in effect the First Light of the Astrophysical Virtual Observatory – in January 2003 was the occasion to showcase the several highly innovative solutions to some of the modern astronomers' hottest problems: How to browse huge sets of observations with hundreds of gigabytes of data? How to get access to data and work without having to transfer the images pixel for pixel from the data centre to the desktop computer? How to get an overview of all existing catalogues in the world that contains published measurements for your favourite objects? How in few seconds to run sophisticated analysis software on remote computers on exactly the data you want without having to send as much as a single pixel across the Internet? How to collect and structure the results of these advanced analyses and present and visualize them in a simple and quick way?

These solutions encompassed 'Smart browsing' of huge datasets and is introduced by the software's 'Metabrowser' which is a type of 'Astro-Google' for astronomical observations, somewhat similar to Windows' file manager. The Metabrowser uses Metadata which is one of the fastest advancing technologies within information management. Metadata is information about data, and the Metabrowser approach



enables the exchange of data descriptions between computers, users and archive systems without having to send entire images back and forth for characterisation and analysis. The AVO architects participated in the invention of a common standard format for the exchange of astronomical data named *VOTable*. Over the past year this standard has been agreed upon internationally by several Virtual Observatory projects.

Science Archive Operation

Among the tasks supported by the Operations Technical Support (OTS) Group, Science Archive Operation is the prominent one: during 2003, the archive has received in excess of 6 TB of new data and handled around 9000 requests for ESO and HST exposures, more than a doubling of the activity with respect to the previous year. OTS has thereby provided about 15 TB of archive data to users both internally and externally: this is 60% more than the year before.

In addition, during 2003 the archive prepared over 1700 CDs, DVDs, tapes and electronic deliveries for over 930 service mode runs. This represents 50% more workload than in 2002. Worth noting in this area is the automatic and unattended delivery of calibrated VIMOS pre-imaging exposures to Principal Investigators (PIs) within 48 hours.

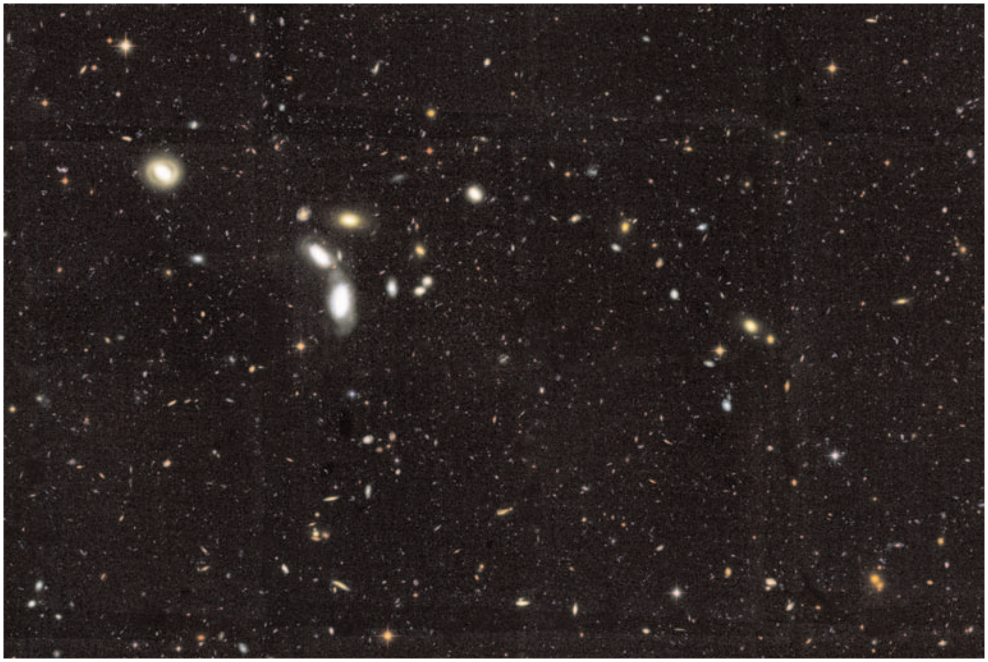
The total holdings of the ESO Archive now amount to about 26 TB of compressed data. Most of the data is coming from the Wide-Field Imager camera (WFI), now entirely migrated to the Next Generation Archive System (NGAS) consisting of magnetic disks mounted on Linux-based computers. In 2003, new large volume data producing instruments have been commissioned (MIDI, HARPS), implying that 2004 will see a renewed increase of data volume, even if WFI's data production will become less dominant as the instrument is now only used part-time.

ST-ECF

Piero Benvenuti relinquished his post as Head of the Space Telescope-European Coordinated Facility (ST-ECF) in July to take up the direction of the Istituto Nationale di Astrofisica in Rome, Italy. Rudi Albrecht was appointed Acting Head of the ECF.

The Cycle 12 time allocation process for the Hubble Space Telescope (HST) resulted in the allocation of 3154 primary orbits from a total of 19674 requested. These were distributed over the five instruments currently available, with 53.7% going to ACS, 27.8% to STIS, 14.5% to NICMOS, 7.4% to WFPC2 and 2.2% to the FGS. Principal Investigators from ESA member states were awarded 16.8% of the accepted proposals and 10.2% of the accepted primary orbits. The Cycle 13 call for proposals was issued in October 2003.

In August the GOODS ACS Team reached a major milestone by releasing the version v1.0 of the reduced ACS imaging data, acquired as part of the GOODS HST Treasury project (~400 orbits). The data release consists of the full stack mosaic of the 5 epochs of GOODS observations in each of four bands and in both fields of the survey, namely the



A field from the HST GOODS ACS survey

CDF-S and the HDF-N. This release incorporates a number of significant improvements in the data reduction process over the previous release, including superior geometrical distortion corrections, a recalibration of the raw data made using improved reference files, corrections for the velocity aberration, etc. These features result in a superior astrometric solution, better rejection of cosmic rays and other blemishes and overall increased sensitivity. Resampling of the data to a scale of 0.03 arcsec/pixel also allows a better sampling of the ACS PSF.

Of particular interest is the use of the ACS grism mode to obtain spectra of supernovae discovered using the split-epoch ACS observing strategy. This mode, with calibration and extraction software developed at the ST-ECF, provides probably the most sensitive optical spectroscopic capability for point sources available to astronomers at the moment. This is also being exploited by a Guaranteed Observations (GO) programme to follow up the GOODS discoveries. The aim is to confirm the SN Ia classification and provide the redshift for SN cosmology studies (Ω, Λ, and equation of state of dark energy). A spectacular example is provided by SN2002fw which has a redshift of 1.3. An ACS grism spectrum was obtained in 15ks and is the highest redshift supernova spectrum to date.

As part of the complementary groundbased observing programmes, ESO released the optical spectroscopy of approximately 500 colour-selected sources in the CDF-S obtained with the red-optimised FORS2 instrument on the VLT.☆

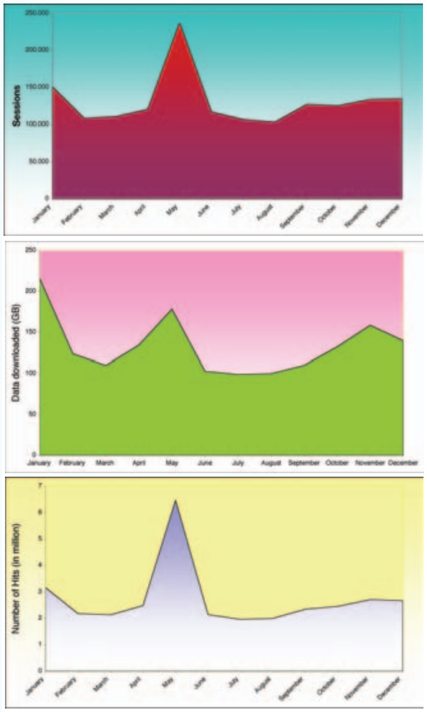
Public Outreach

The Education and Public Relations Department experienced an extremely busy year with many different activities and interaction with a great variety of target groups. They ranged from public visits to the ESO sites to high-level presentations in various countries. A record number of Press Releases (see page 49) were issued in the course of the year.
With an increasing number of front-line scientific results becoming available from European groups observing with ESO telescopes, there was no lack of topics for exciting communications. Particular media and public interest was registered in connection with the light flashes observed from the massive black hole at the Galactic Centre. The announcement of the discovery of a group of galaxies in the young Universe at redshift 4.8–5.8 was widely reported as was also the VLTI observations of the southern star Achernar which showed this body to be amazingly flattened. Much public attention was also given to the discovery of the nearest Brown Dwarf at a distance of only 12 light-years. In line with the experience from earlier years, sky images from ESO telescopes continued to be in high demand; it was decided to embark upon a special effort to produce more beautiful pictures, a task also supported by the rapidly accumulating files in the ESO Science Data Archive.

Throughout the year, the EPR Dept. provided support to the ALMA programme in collaboration with the NRAO Press Office. This included the making of a major ALMA film which was first shown at the IAU General Assembly in Sydney. The collaboration with the other EIROForum member organisations continued within the areas of communication and education. As the main source for information about the VLT and VLTI at Paranal, the ALMA programme and, not least, the 100-m OWL concept study, the EPR Dept. provided numerous interviews, as well as photos and videos and other material to the media. In response, a large number of journalists from the printed press and the audio-visual media visited the ESO sites during the year.

Events and Visits: ESO was pleased to receive the European Commissioner for Research, Philippe Busquin, at Paranal. Meeting with the press, the Commissioner said that "*this is a tribute to the human genius – it is an extraordinary contribution to the development of knowledge and, as Commissioner for Research, I am proud that this is a European achievement*". Later in the year, members of the European Parliament Delegation

ALMA exhibition at the IAU General Assembly in Sydney, produced by the EPR Dept.



Statistics for 2003 of the Education and Public Outreach web site: number of visitors, data downloaded and number of hits. The peak in May is due to the Mercury Transit live webcast.

for Relations with the Countries of South America and MERCOSUR also visited Paranal and witnessed observations with the VLT. In Europe, the City Council of Garching, headed by Mayor M. Solbrig, paid a half-day visit to the ESO Headquarters and was informed about ESO's many activities at the local and international level.
High-level presentations of ESO activities within technological development and science were held in the capitals of Finland and Switzerland, Helsinki and Berne. On both occasions, high-ranking representatives of politics, industry and the scientific communities participated in very useful discussions around the role of astronomy in Europe and, in particular, ESO's position and future projects.

Extensive exhibitions featuring ESO and ALMA were held at the IAU General Assembly in Sydney, Australia, and at the JENAM conference in Budapest, Hungary. Smaller exhibitions were held at many other sites and ESO also delivered material for local exhibitions by planetaria, public observatories etc., who themselves took care of displaying this material, effectively reaching the local public.

The ESO Headquarters again received the general public during an Open House Day in October. During 7 hours, approximately 2300 visitors were able to inform themselves about this organisation, also via several videoconference sessions with astronomers at Paranal.

Education: A high-point was the Mercury transit event on May 7 during which an exceptionally high public interest was evident and resulted in an all-time record of more than 10 000 hits per minute at the EPR Website and a total of 3.5 million during that day. In the same direction, an application to the European Commission for a unique public educational programme around the Venus transit in June 2004 was successful and allowed the setting-up of this major pilot project, in collaboration with the Paris Observatory, the Astronomical Institute of the Academy of Sciences of the Czech Republic and the European Association for Astronomy Education (EAAE). Together with EAAE, another "Catch a Star" web-based educational project for school students was organised with a record number of participants. Within the EIROforum framework, ESO contributed to the "Physics on Stage 3: Life and New Frontiers" event for teachers that was held at ESA-ESTEC in November. In order to exploit the exceptional didactic potential of ALMA, a seminar was held with physics teachers about this major international scientific and technological project, identifying a large number of useful educational opportunities. The possibility to approach ALMA from scientific, technological, geographical, historical and political angles promises to make this a very useful exercise of pilot character, with an obvious impact in its own right and, at the same time, gaining experience for similar projects in other fields.

Outlook: On the background of the growing potential in the fields of communication and education provided by ESO's increasing activities, it has become desirable to re-assess the resources and operational modus of the EPR Dept. A draft medium- to long-term plan was being developed by the end of the year. ☆

ESO Press Releases

ESO Press Photo 01/03 (*7 January*): ESO PR Highlights in 2002.
ESO Press Photos 02a-d/03 (*10 January*): Deepest Wide-Field Colour Image in the Southern Sky - La Silla Camera Observes Chandra Deep Field South.
ESO Press Release 01/03 (*13 January*): Discovery of Nearest Known Brown Dwarf – Bright Southern Star Epsilon Indi Has Cool, Substellar Companion. With PR Photos 03a-d/03.
ESO Press Release 02/03 (*16 January*): Isolated Star-Forming Cloud Discovered in Intracluster Space – Subaru and VLT Join Forces in New Study of Virgo Galaxy Cluster. With PR Photos 04a-de03.
ESO Press Release 03/03 (*22 January*): Distant World in Peril Discovered from La Silla. Giant Exoplanet Orbits Giant Star. With PR Photos 05a-d/03.
ESO Press Release 04/03 (*25 February*): ESO and NSF Sign Agreement on ALMA – Green Light for World's Most Powerful Radio Observatory. With PR Photos 06a-d/03.
ESO Press Release 05/03 (*15 March*): A Family Portrait of the Alpha Centauri System. VLT Interferometer Studies the Nearest Stars. With PR Photos 07a-e/03.
ESO Press Release 06/03 (*27 March*); "First Light" for HARPS at La Silla. Advanced Planet-Hunting Spectrograph Passes First Tests With Flying Colours. With PR Photos 08a-e/03.
ESO Press Release 07/03 (*2 April*): "Physics and Life" for Europe's Science Teachers – The EIROforum Contribution to the European Science and Technology Week 2003.

ESO Press Release 08/03 (*9 April*): Really Hot Stars! Spectacular VLT Photos Unveil Mysterious Nebulae. With PR Photos 09a-d/03.
ESO Press Release 09/03 (*22 April*): Glowing Hot Transiting Exoplanet Discovered – VLT Spectra Indicate Shortest-Known-Period Planet Orbiting OGLE-TR-3. With PR Photos 10a-e/03.
ESO Press Release 10/03 (*2 May*): A Solar Mini-Eclipse on May 7, 2003 – Planet Mercury Passes in Front of the Solar Disk. With PR Photos 11a-b/03.
ESO Press Release 11/03 (*13 May*): Sharper and Deeper Views with MACAO-VLTI – First Light" with Powerful Adaptive Optics System for the VLT Interferometer. With PR Photos 12a-j/03.
ESO Press Release 12/03 (*28 May*): CFHT and VLT Identify Extremely Remote Galaxy – Top Telescopes Peer into the Distant Past. With PR Photos 13a-d/03.
ESO Press Release 13/03 (*10 June*): One Thousand "Wonderful" Stars Discovered in Centaurus A – First-Ever Census of Variable Mira-Type Stars in Galaxy Outside the Local Group. With PR Photos 14a-i/03.
ESO Press Release 14/03 (*11 June*): Flattest Star Ever Seen – VLT Interferometer Measurements of Achernar Challenge Stellar Theory. With PR Photos 15a-c/03.
ESO Press Release 15/03 (*16 June*): Curtain-Lifting Winds Allow Rare Glimpse into Massive Star Factory – Formation of Exceedingly Luminous and Hot Stars in Young Stellar Cluster Observed Directly. With PR Photos 16a-b/03.
ESO Press Release 16/03 (*18 June*): Cosmological Gamma-Ray Bursts and Hypernovae Conclusively Linked – Clearest-Ever Evidence from VLT Spectra of Powerful Event. With PR Photos 17a-b/03.
ESO Press Release 17/03 (*19 June*): A First Look at

the Doughnut Around a Giant Black Hole – First detection by infrared interferometry of an extragalactic object. With PR Photos 18a-c/03.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Weltraum-Kringel

Ob der Künstler, der diese Grafik für das European Southern Observatory (ESO) angefertigt hat, wohl ans Essen dachte? Jedenfalls hat seine Version dieses von Astronomen „Torus" genannten Weltraum-Phänomens ein bisschen Ähnlichkeit mit dem amerikanischen Gebäck Doughnut. Mit wissenschaftlichen Augen betrachtet, zeigt das Bild natürlich eine aktive Galaxie mit Jet-Strahlen. Ihr „Motor" ist ein gigantisches Schwarzes Loch, das von einer Gasscheibe umgeben ist und von einer dicken ringförmigen Struktur aus Gas und Staub eingehüllt wird. Foto: afp

ESO Press Release 18/03 (*14 July*): New Fast Lane towards Discoveries of Clusters of Galaxies Inaugurated – Space and Ground-Based Telescopes Cooperate to Gain Deep Cosmological Insights. With PR Photos 19a-d/03.

ESO Press Release 19/03 (*16 July*): Nearest Cosmic Mirage – Discovery of quadruply lensed quasar with Einstein ring. With PR Photos 20a-b/03.

ESO Press Release 20/03 (*22 July*): Revealing the Beast Within – Deeply Embedded Massive Stellar Clusters Discovered in Milky Way Powerhouse. With PR Photos 21a-b/03.

ESO Press Release 21/03 (*25 July*): Catherine Cesarsky – President Elect of the International Astronomical Union. With PR Photo 22a/03.

ESO Press Release 22/03 (*30 July*): Philippe Busquin Visits Paranal – European Commissioner for Research at the ESO Very Large Telescope. With PR Photos 23a-d/03.

ESO Press Release 23/03 (*6 August*): The VLT Measures the Shape of a Type Ia Supernova – First Polarimetric Detection of Explosion Asymmetry has Cosmological Implications . With PR Photos 24a-b/03.


Roses in the southern sky

ESO Press Release 24/03 (*21 August*): New Insight into the Cosmic Renaissance Epoch – VLT Discovers a Group of Early Inhabitants and Find Signs of Many More. With PR Photos 25a-c/03.

ESO Press Photo 26/03 (*28 August*): Infrared Halo Frames a Newborn Star.

ESO Press Photos 27a-c/03 (*1 September*): New Image of Comet Halley in the Cold – VLT Observes Famous Traveller at Record Distance.

ESO Press Release 25/03 (*12 September*): Optical Detection of Anomalous Nitrogen in Comets – VLT Opens New Window towards Our Origins. With PR Photos 28a-c/03.

ESO Press Release 26/03 (*29 October*): Messages from the Abyss – VLT Observes Infrared Flares from Black Hole at Galactic Centre . With PR Photos 29a-b/03 and PR Video 01/03.

ESO Press Release 27/03 (*30 October*): South America Delegation of the European Parliament Visits ESO's Paranal Observatory. With PR Photo 30/03.

ESO Press Photo 31a-e/03 (*3 November*): Roses in the Southern Sky – The Wide-Field-Imager at La Silla Unveils Intricate Structures Illuminated by Hot Stars.

ESO Press Release 28/03 (*5 November*): "Physics and Life" - Teachers Meet Scientists at Major EIROforum event.

ESO Press Release 29/03 (*6 November*): Astronomers Break Ground on Atacama Large Millimeter Array (ALMA) - World's Largest Millimeter Wavelength Telescope.

ESO Press Release 30/03 (*12 November*): Studying a Burst with Sunglasses - FORS/VLT makes a unique five weeks study of the polarisation behaviour of a gamma-ray burst afterglow.

ESO Press Release 31/03 (*26 November*): Biggest Star in Our Galaxy sits within a Rugby-Ball Shaped Cocoon - VLT Interferometer Gives Insight Into the Shape of Eta Carinae. With PR Photos 32a-b/03.

ESO Press Release 32/03 (*27 November*): OECD Global Science Forum's Astronomy Workshop to take place in Munich.

ESO Press Photo 33/03 (*19 December*): Three Dusty Beauties – New Portraits of Spiral Galaxies NGC 613, NGC 1792 and NGC 3627.

ESO Press Release 34/03 (*19 December*): The Colour of the Young Universe – VLT study gives insight on the evolution of the star formation rate. With PR Photo 34a/03.

ESO Press Photo 35/03 (*23 December*): Season's Greetings!

The EIROforum Collaboration

The EIROforum is a collaboration between seven European intergovernmental scientific research organisations that are responsible for infrastructures and laboratories: CERN, EFDA, EMBL, ESA, ESO, ESRF, ILL.

The EIROforum has become well established both as a platform for collaboration between the partner organisations and as voice in the debate about the shaping of the European Research Area (ERA). To that effect, EIROforum has entertained relations with the European Parliament, the European Commission and the Convention for the Future of Europe. The Chair rotates on an annual basis and in 2003, the Chair changed from EMBL to EFDA. Since EIROforum does not employ staff of its own, the work is carried out by staff of the partner organisations in a collaborative manner. In this context, ESO's engagement in the EIROforum has also aimed at helping to set up effective internal structures to enable EIROforum to fulfil its remit as laid down in its charter.

Thus EIROforum organised a meeting with members of the European Parliament, under the title '*The European Science Policy Debate*' on 21 May. The purpose was to discuss the broad science policy issues related to the development of the ERA and the question of Europe's competitiveness *vis-à-vis* other highly developed regions of the world. A specific goal was to raise the awareness of the contribution that the intergovernmental research organisations are making to further the international standing of European research.

The EIROforum Council, comprised of the Directors General of the partner organisations, meets twice a year. These meetings are normally followed by meetings with the European Commissioner for Research and/or the EC Director General for Research, Achilleas Mitsos.

In 2003, the meetings were held in Athens on 3/4 April (to co-incide with the Greek EU Presidency) and on 27/28 October in Brussels.

On 27 October, the Director General, together with the Directors General of the other EIROforum partner organisations, and the European Commissioner for Research signed a joint Statement of Intent outlining areas of co-operation between the EIROforum and the Commission. The statement specifically acknowledges the role of the EIROforum partner organisations as world leaders within their specific fields of activity.

In connection with the preparation of the draft Constitutional Treaty for the EU, EIROforum was in contact both with the Convention for the Future of Europe (chaired by Valery Giscard d'Estaing) and the Italian Presidency of the EU in an effort to fine-tune those Articles in the document which may have a direct bearing on research and with the principal aim of strengthening the position and possibilities for fundamental or investigator-driven research. This interaction was clearly appreciated and, in spite of the momentary difficulties regarding the new Treaty, there is hope that the views expressed by EIROforum and others will be reflected in the final text.

Finally, in connection with the on-going debate about a European Research Council, EIROforum also provided input to the European Research Council Expert Group (ERCEG), established by the Danish Minister for Research, Technology and Innovation Mr Helge Sander (during his term as President of the Competitiveness Council in 2002) and chaired by Prof. Féderico Mayor.

www.eiroforum.org

Relations with the EU

ESO's interaction with the institutions of the European Union cover a broad range of activities from specific project funding to science policy issues of common interest, arising from the initiative to forge a European Research Area (ERA).

In 2003, the new Framework Programme (FP-6) came into effect. It was thus, to a certain extent, a 'learning year', both for the Services of the European Commission and for FP-6 applicants, as completely new funding instruments, participation rules and cost models were introduced (with very different requirements), while at the same time the new financial rules of the EU came into effect.
ESO's philosophy follows the general principle that applications for funding relate to non-core activities and/or are applications in partnerships with national institutes where ESO participation will strengthen both the potential outcome of the project and its chances of leading to a contract. Furthermore, several consortia include institutes in ESO non-member states. ESO's participation in the OPTICON network illustrates this philosophy well. A total of ten proposals (including one re-submission) were submitted in response to Calls by the Commission.

It should be noted that, while there are no overall official statistics from the first round of proposals under FP-6 covering all areas of the Framework Programme, available numbers indicate an overall success-rate in the order of 15%. Furthermore, according to Commissioner Busquin, it is also becoming clear that at the most, half of the proposals that by reaching or exceeding the evaluation thresholds are technically eligible for funding, can be funded within the budget of FP-6. On the background of the highly competitive environment, astronomy has done extremely well in winning contracts.
While the first FP-6 contracts were awarded towards the end of the year, several FP-5 contracts were still running. The list can be found on the accompanying CD-Rom.

ESO Committee members and ESO Faculty Staff were registered in the roll of expert evaluators for FP-6 proposals. The registration took place over an extended period of time due to severe problems with the registration software used by the Commission and may, in isolated cases, not have been completed before the end of the year.

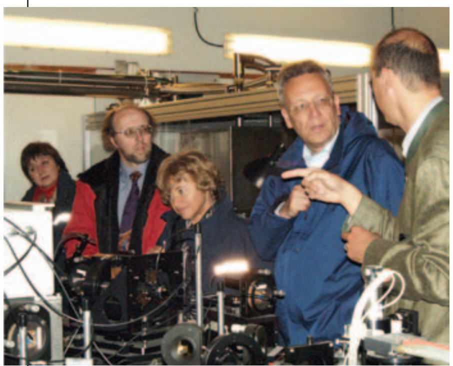
At the request of the Commission, two FP-5 projects were subject to an external financial audit: The AstroVirTel and AO-ELT projects. Apart from minor problems related to the interpretation and application of the EU Financial Rules under the complex FP-5 contracts, no irregularities were reported by the auditors.

Visits

Several high-ranking EU officials paid visits to ESO in the course of the year. Notably, on 29/30 July, the European Commissioner for Research, Philippe Busquin, with a small retinue, visited the Paranal Observatory.

On 29/30 October, the European Parliament Delegation for Latin America and MERCOSUR went to Paranal. The delegation was headed by Dr Rolf Linkohr, a prominent figure in the science policy debate in the European Parliament. In November, Prof. Achilleas Mitsos, EC Director General for Research, also visited Paranal.

Furthermore, high-level visits by member-state government representatives included Mr Jürgen Chrobog, German Secretary of State and a committee of the UK Parliament as well as a delegation from the Chilean senate.



Commissioner Busquin visits Paranal

The Observing Programmes Committee

The Observing Programmes Committee (OPC) met twice in 2003, in June and in November. For the Observing Period 72 (P72 - October 1, 2003 to March 31, 2004), around 750 proposals were received, while for the Observing Period 73 (P73 - April 1 to September 30, 2004), this jumped to about 840 proposals. The latter is the highest number of proposals ever received by the OPC in one period, a phenomenon partly due to the new call for Large Programmes that was issued at that time as well as to the first call for the use of the Very Large Telescope Interferometer with the MIDI instrument.

From all the proposals received, it appears that there is a continuing high demand for the first generation workhorses (FORS1, FORS2, ISAAC and UVES). With the added high demand on FLAMES and on NACO, the pressure factor is very high on, respectively, Kueyen (UT2) and Yepun (UT4). Instruments at La Silla are also still in very high demand, in particular HARPS and WFI.

There was a high pressure for Target of Opportunity (ToO) proposals, in particular with the many advances in the field of Gamma-ray bursts. Twenty-four ToOs were submitted for the Paranal and La Silla telescopes in P72 of which 13 ToOs were accepted. For P73, these numbers were 29 and 17, respectively. Given the very large number of submitted ToOs, it might be necessary in the future to think about new OPC procedures in this field, such as a new definition of the amount of time reserved for ToOs, and possibly a reconsideration of the evaluation procedures. And because it is very difficult to avoid cases of overlapping science and conflicting activations of ToOs, the need for exact OPC recommendations including a precise strategy and ranking list for the implementation of ToO requests cannot be emphasized enough.

OPC procedures

Given the fact that the existing OPC procedures are working well, there is no need for a fundamental revision, but a few items require some consideration. For example, increased attention should be paid to the historical track record of proposals, especially concerning the scientific outcome of the use of ESO facilities, as well as the use of the ESO archive and the actual "cost" of demanding observing modes. It has been recognized that Service Mode programmes with very stringent constraints are very "expensive" to conduct compared to Visitor Mode programmes. In addition, it has been emphasized that more information should also be provided to the users about the general statistics of the time allocation process.

In view of taking full advantage of the complementarities of ground-based and space-borne observing facilities, the OPC has discussed a possible ESO/ESA agreement for the joint use of the ESA XMM-Newton X-ray satellite and ESO telescopes. It was recommended that the joint application of proposals should only be offered once per year and on a tentative basis, before entering further commitments.

Large Programmes

In P73, the OPC was faced with 20 Large Programmes (LP), the highest number ever submitted. Of these, 3 were accepted as LPs and 5 were partly converted into normal programmes. "Large Programmes" are projects requiring substantial observing time (more than either 100 hours or 10 nights) for a well-focused scientific goal. The duration is limited to no more than two years (four semesters). Up to 30% of the total time available

for the community may be committed to LPs. Between the start of VLT operations in 1999 (P63) and 2003 (P71), 47 LPs have been approved by the OPC for Paranal and La Silla telescopes. They cover almost all current astronomical topics, from the Solar System to the study of cosmological parameters.
During three days, May 19 to 21, 2003, about 70 astronomers gathered in Garching for an assessment of the scientific impact of Large Programmes and to discuss planning for future surveys at ESO. Several members of the OPC and STC actively participated in the workshop. All PIs of LPs approved up to ESO Period 69 were invited to present the results of their project.

The general impression was that most LPs have produced excellent results and unique science, which would have been unachievable through regular programmes. They have allowed European astronomers to compete directly with the best groups worldwide, some of whom profit from significant access to large telescopes, operated by private institutions. A small number of LPs clearly suffered from insufficient manpower to reduce and analyse the data quickly. LPs operated by well-organised teams with a mix of project leaders and young students and postdocs fared very well. In several cases, European expert teams have formed teams for LP proposals. The LPs have had the effect of unifying the community in certain astronomical fields. In a few cases LPs have been the inspiration or motivation for successful European research networks, several of which have been funded through European Union programmes.

Observing Programmes Committee (2003)

John Black (P71)
Hans Boehringer (P71)
Athéna Coustenis
Paul Crowther (P70-P71)
Herwig Dejonghe
Alberto Franceschini (P70-P71)
Emanuele Giallongo (P70-P71)
Wolfgang Gieren
François Hammer (P72)
Vincent Icke
Jens Knude
Matt Lehnert (P72)
Jan Lub
Sabine Moehler (P72)
Tommaso Maccacaro (P72)
Felix Mirabel (P70)
Göran Östlin (P72)
Christian Perrier (P72)
Patrick Petitjean (P70-P71)
Maria Teresa Ruiz (P71-P72)
Daniel Schaerer
Clive Tadhunter (P72)
Stefan Wagner
João Lin Yun

Public Surveys

During this workshop and during the two OPC meetings, a large fraction of time was also devoted to discussing Public Surveys. Surveys provide large, homogeneous data sets covering a variety of combinations in the parameter space of multi-band, depth and sky area. Often surveys span longer time intervals and have a broader scope than LPs. From their databases, large uniformly treated products can be generated, which can be used for a variety of scientific purposes.
At ESO, surveys have been handled as LPs in the past years. Some of them have been conceived as Public Surveys, such as the various EIS surveys (e.g. Pre-FLAMES, Deep Public Survey, and the GALEX and XMM follow-up surveys), FIRES and GOODS. Others have been handled as proprietary (or private) surveys, such as the U-band VIRMOS survey and the SWIRE optical follow-up. Many of these surveys are also connected to legacy-type programmes at satellites and other observatories.

Surveys will constitute an important contribution to the science produced with ESO facilities in the forthcoming era of the dedicated survey telescopes, VST and VISTA. New procedures have therefore to be implemented to ensure timely delivery of high quality survey products for the entire ESO community.

A general consent emerged that a new concept for the future implementation of Public Surveys is needed, which should be treated as a separate category with respect to Large Programmes. It was also recommended that ESO establish a Working Group to define a procedure for time allocation to surveys, considering that a deeper involvement of the community in the survey production as well as an effective cooperation between ESO and the community is needed to ensure the scientific quality of the products. ☆

The Users' Committee

The Users' Committee (UC) acts as a direct link between the 'general users at large' and the ESO officials and focuses on the broad range of interactions of the current users with the ESO observatories. The aim of the committee is to streamline the requests from the users and advise the Director General and the ESO staff, with the goal to make the entire process from writing applications for observation time to reduction of the data as efficient and transparent as possible.
In the last years, the ESO observatories and the users' interaction with ESO has changed considerably. The most dramatic change for the general user is no doubt the success of the service observing possibilities. The original goal to reach an even share between visitor and service mode observations turned out to be untenable and today more than 70 percent of the requested time is in Service mode. The streamlined rigid data gathering procedures offer the user, even in Service Mode, very efficient tools for their observing strategies. The Data Management Division and the Users' support group (USG) are now the main interaction channels for many of the users, more than the staff of the observatories.

The Users Committee
2003

Malcolm Bremer (UK)
Enrico Cappellaro (I)
Jens-Viggo Clausen (DK)
Lex Kaper (NL)
Joao Lin Yun (P)
Sabine Moehler (D)
Pierre North (CH)
Göran Östlin (S)
Marguerite Pierre (F)
Monica Rubio (RCH)
Hans Van Winckel (B; Chair)

Overall, both Paranal and La Silla observatories receive good to excellent satisfaction rates by the users. The evaluation of ESO's telescope and instrument performances by the user is monitored on a daily basis by night reports (for visitors); on a run-basis by end-of-mission reports (visitors) and finally yearly by the UC meeting. This year also, for the first time, the Service Observers were given a chance to express thier opinion. It is in the UC meeting that a series of action items (AI) and recommendations are formulated which are filtered from the general users' requests. Most of these AI and recommendations materialise in concrete results by the next UC meeting illustrating that the users' requests have significant weight to trigger reaction.
During this yearly spring meeting, the UC handles a full agenda : short briefings on the instrument-telescope performances and the proposal handling process; presenting problem reports from the users ; discussing new reports on the future of ESO that become available (e.g. the report of the LaSilla2006+ working group) and a half-a-day focus on a special topic, related to the use of ESO's facilities, and which is covered in much more detail.
Several AIs from last years' meeting have resulted in concrete actions already. To name a few: simpler proposal phase I submission; test account to check the phase I proposals through the ESO system; release of part of the EIS pipeline; and timely communication of the outcome of OPC proposals. Others AI or recommendations take longer and are repeated. Examples are the decision on the implementation of the recommendations of the LaSilla 2006+ report or the updates of all web-pages and cleaning of redundant old links. ✰

The Scientific Technical Committee

The Scientific Technical Committee (STC) met twice in 2003: the 55rd meeting was held on April 10th and 11th and the 56th meeting was held on October 22nd and 23rd. Both meeting were chaired by Prof. J.-L. Puget.

The main outcome of the 55rd meeting was:
- Having heard the report of the La Silla 2006+ Working Group the STC recommended the integration of La Silla operations with Paranal so that cost

savings could be realized. STC also concurred with SEST operations being terminated, while no strong case was felt for transferring 3mm wavelength observations to APEX.

- The STC discussed the policy for carrying over programmes from one observing period to another, and recommended not to carry over Category A programmes more than once.
- The STC was pleased by the progress of studies for VLT second generation instruments, and recommended to carry out full Phase A studies for the near-infrared imager HAWK-I and for the two cryogenic multi-object spectrographs KMOS-1 and KMOS-2. STC also recommended a full Phase A study to be carried on for the X-Shooter spectrograph.
- The STC recommended a stronger ESO management of VLT second-generation instruments built by Institute Consortia, with an early inclusion of engineers from Paranal and the Data Management Division. This procedure should apply to ALMA instruments as well.

The Scientific Technical Committee 2003

Roland Bacon (F)
Andrea Cimatti (I)
Andreas Eckart (D)
Paulo J.V. Garcia (P)
Raffaele Gratton (I)
Thomas Henning (D)
Richard Hills (UK)
Jens Hjorth (DK)
Konrad Kuijken (NL)
Simon Lilly (CH)
Dante Minniti (RCH)
Nikolai Piskunov (S)
Jean-Loup Puget (F; Chair)
Patrick Roche (UK)
Arnold van Ardenne (NL)
Jean-Marie Vreux (B)

The 56th meeting of the STC was mainly focused on the choices of VLT second generation instruments, and was extensively informed on the reviews of the Phase A studies for HAWK-I, X-Shooter and the two concepts for KMOS.Moreover,

- STC recommended to proceed with the construction of the HAWK-I Camera, leaving to the Instrument Science Team (soon to be appointed) to make recommendations on the final pixel size and on the complement of narrow-band filters.
- STC recognized the importance of the science objectives of the X-Shooter, such as the follow up of transients like the Gamma Ray Bursts, also in connection with the Robotic telescopes being installed on La Silla. Having seen the positive report of the Phase A Review Board, the STC recommended proceeding with the next phases for the construction of the instrument.
- STC congratulated the two KMOS Consortia for their hard work done in such a short time, and extensively discussed advantages and disadvantages of the two concepts. STC finally recommended to proceed at least to the Preliminary Design Review (PDR) for the concept presented by the KMOS-1 Consortium. STC also endorsed the proposed 5 M contribution by ESO for the construction of this instrument, and emphasized that it was crucial to have KMOS capabilities at the VLT as soon as possible.

The STC then begun a discussion of the implementation of the ALMA Regional Support Centre, taking note of the plans presented by ESO and the report on the discussions within the ALMA European Science Advisory Committee. STC noted that besides the “core tasks” (support for phase-1 and phase-2 proposal preparation, archiving, data distribution), other key activities will be critical for the scientific exploitation of ALMA by the ESO community, but such activities are not covered by the present plan. The activities may include sophisticated data reductions and calibrations, specialized projects and large surveys, and others. STC noted that funding for many of these critical activities will have to be found from outside the agreed ALMA operation budget.

The STC reviewed the suggestions and proposals from the community for a new instrument at the NTT, and concluded that none would add sufficient scientific capabilities to warrant investment of major ESO resources. STC recommended ESO to investigate the possibility to implement a Visitor Focus at the NTT, including its impact on La Silla Operations.✰

Council

Both Council and Committee of Council met twice during 2003. The Council meetings took place at the Headquarters in Garching. The meeting of the Committee of Council in March was held in Antofagasta, Chile, and the meeting in October took place in Paris. The meetings were all chaired by Prof. P. van der Kruit.

The Accession of Finland to ESO and progress with the ALMA Project were among the major items on the agenda throughout the year.

At the meeting in June, Council took note that the ALMA Agreement between ESO and Chile had been ratified by the Senate of the Chilean Parliament on 10 June 2003. Council received regular updates on the developments in Chile regarding the ALMA Project. On 6 November 2003 the Groundbreaking Ceremony for the ALMA site took place.

Council established a Working Group on Scientific Strategic Planning whose members were selected from Council, the Scientific Technical Committee (STC), the VLTI Implementation Committee, the European Alma Board and ESO staff in order to prepare and assess options for ESO's long term programme. The working group, chaired by Prof. R. Bender, met twice in Garching and delivered a preliminary report to Council in December.

Council and Committee of Council
2003

President	P.C. van der Kruit
Belgium	J.P. Swings M. Desmeth
Denmark	H. Jørgensen H. Grage
France	L. Vigroux Ph. Barré
Germany	R. Bender M. Metzger
Italy	F. Pacini P. Marietti
The Netherlands	P.T. de Zeeuw J.A.C. van de Donk
Portugal	T. Lago F. Bello
Sweden	C. Fransson F. Karlsson
Switzerland	M. Mayor M. Steinacher
United Kingdom	G. Gilmore R. Wade

At the meeting in December, Council decided to set up a Working Group on Weighted Voting. It also established a Negotiating Team to prepare for the possible accession of Spain to ESO.

The reports of the Director General, the chairmen of the Finance Committee, the Scientific Technical Committee and the Observing Programmes Committee were received as usual twice a year as well as the regular VLT/VLTI and ALMA reports.

The ESO Tripartite Group held three meetings in 2003. Dr. J. Bezemer retired as Chairman in March 2003 and was followed by Dr. U. Sessi. Among the discussion points were long term care, salary adjustments and allowances, reports on the Life and Work Working Group, set up by the Staff Association, and performance/advancement reviews. A major topic at the meetings was the pension fund arrangements, and convergence on an overall approach was in sight at the end of the year.

At the ordinary meeting in December Prof. P. van der Kruit was re-elected President of Council and Dr. F. Bello was re-elected Vice-President for 2004. Dr. M. Steinacher left the Finance Committee after serving three years as Chairman. Dr. H. Kjeldsen was appointed as new member of the Scientific Technical Committee. For the Observing Programmes Committee, Dr. T. Maccacaro was elected Chairman and Dr. J. Knude was elected as Vice-Chairman for 2004. ☆

Finance Committee

Two ordinary meetings took place during 2003. In addition, the Finance Committee met twice in extraordinary sessions. All meetings took place in Garching and were chaired by Dr. M. Steinacher. The agenda items included the usual financial issues (annual accounts, budget, cash-flow situation, financial projections, etc.) and personnel issues. Having debated the issues thoroughly, Finance Committee made recommendations to Council in preparation for the appropriate Council decisions.

Other major items were the ALMA Phase 2 (construction) contracts, VLTI contracts and the status of the Member States' Contributions.

The Finance Committee approved the award of 18 contracts exceeding 300.000, 16 single-source procurements exceeding 150.000 and took note of 3 documents about advanced information on forthcoming calls for tenders/preliminary inquiries exceeding 150.000.

Finance Committee - 2003

Chair	M. Steinacher
Belgium	A. Heynen
Denmark	E. Bregnbæk
France	P. Laplaud
Germany	M. Lohkamp-Himmighofen
Italy	U. Sessi
The Netherlands	C.J. van Riel
Portugal	F. Bello
Sweden	S. Björling
Switzerland	J.P. Ruder
United Kingdom	R. Sirey

During 2003, the Enterprise Resource Planning (ERP) Working Group on Financial Rules and Regulations was established and met twice in Garching. The meetings were chaired by Ms. R. Sirey. The working group comprises members of the Finance Committee and was established in order to examine the impact of the implementation of the new ERP system on the existing ESO Financial Rules and Regulations. This work will continue in 2004. It recommended revision to the Financial Rules and Regulations which were adopted by Council for a trial period of one year to allow the ERP system to be implemented.

Finance

ESO's budget for the year 2003 was approved with a total level of expenditure of 102.9 M. To this baseline budget third party funded "special projects" in the amount of 1.4 M were added, leading to a total expenditure budget of 104.3 M. The approved income side of the 2003 budget was 105.4 M for the baseline part and 1.4 M for the third party funded part, adding up to a total income of 106.8 M. Thus the 2003 budget was the first one with a budgetary surplus (2.5 M) after a period of six years with budgetary deficits. Together with savings of 5.9 M in the execution of the 2003 budget, this constitutes an important step towards eliminating the accumulated deficit, so that cash flow shortages should have disappeared by the end of 2005, or in early 2006 at the latest. In view of early payment of member states' contributions, such cash flow shortages occurred only during January and February 2003, as well as in December 2003. They were covered by a bank credit line.

At its meeting in December 2002 the ESO Council, following the recommendation of Finance Committee, approved the appointment of External Auditors from Italy for three years starting on January 1, 2003.

The annual accounts for the financial year 2002, as well as the related audit report which was still presented by the Swiss Federal Audit Office, were approved by Council at its meeting in June 2003.

Budget Statement 2003

(in € 1000)

Expenditure

Budget heading	Approved budget	Actual (incl. commitments and uncommitted credits carried over to 2004)		
		Europe	Chile	Total
Personnel	43.522	25.831	14.786	40.617
Operations	31.977	16.963	13.450	30.413
Capital outlays	25.031	21.612	3.390	25.002
Very Large Telescope (VLT)	2.366	2.366	—	2.366
Budgetary surplus	2.495	—	—	—
TOTAL EXPENDITURE	105.391*	66.772	31.626	98.398

Income

Budget heading	Approved budget	Actual (incl. receivables)
Contributions		
– from member states	100.678	100.678
– from third parties	3.240	2.809
Miscellaneous	1.473	1.596
TOTAL INCOME	105.391*	105.083

*Baseline budget

Budget for 2004

(in € 1000)

Expenditure

Budget heading	Europe	Chile	Total
Personnel	27.764	16.532	44.296
Operations	16.377	13.652	30.029
Capital outlays	20.239	4.192	24.431
Very Large Telescope (VLT)	1.781	—	1.781
Cost variation	1.125	585	1.710
	67.286	34.961	102.247
TOTAL EXPENDITURE			102.247

Income

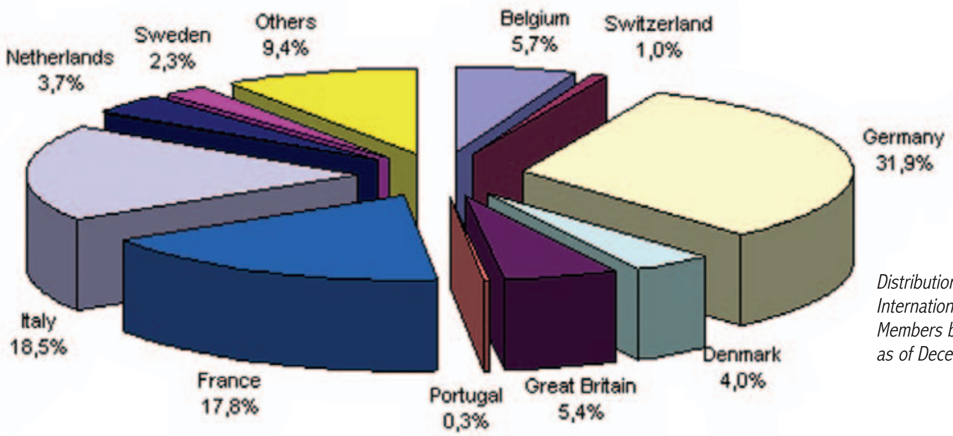
Budget heading	Total
Contributions	
– from member states	105.791
– from third parties	–
Miscellaneous*	1.457
Excess of income (to decrease the accumulated deficit of previous years)	–5.001
TOTAL INCOME	102.247

*In addition to this baseline budget, a number of third party funded "Special Projects" in the volume of 8.722 have been approved.

Personnel

This year's activities were focused on:

- the implementation and application of the new Collective Contract for Local Staff in Chile;
- the development, testing and implementation of the new payroll, recruitment and position planning system;
- the implementation and evaluation of a climate study comprising all International Staff Members in Garching;
- the review and implementation of the Regulations regarding maternity leave, special leave and duty travel;
- review and elaboration of a modified contribution scheme to the Pension Fund as well as regarding the ESO Health Insurance Scheme and Long Term Care in close interaction with the representatives of the Staff Association;
- the recognition process and negotiations with the Unions of La Silla and Paranal;
- the revision of procedures and measures concerning medical examinations for International and Local Staff;
- the elaboration and negotiations concerning the privatization of the Welfare Fund for Local Staff Members;
- integration of the Personnel Section in Chile in Personnel Department;
- the renovation and furnishing of new offices;
- the development and implementation of a new security policy regarding the access to the site;
- the recruitment action led to 35 recruitments of Local Staff and 38 International Staff Members. Furthermore, 131 Students, Fellows, Paid and Unpaid Associates joined ESO. The diagrams show the International Staff Members of ESO by nationality as of 31 December 2003.



Distribution of International Staff Members by Nationality, as of December 2003

Summary of Use of Telescopes by Discipline

The scientific categories referred to in the following tables correspond to the OPC classifications given below:

OPC Categories and Sub-Categories

A - Cosmology

A1 Surveys of AGNs and high-z galaxies
A2 Identification studies of extragalactic surveys
A3 Large scale structure and evolution
A4 Distance scale
A5 Groups and clusters of galaxies
A6 Gravitational lensing
A7 Intervening absorption line systems
A8 High redshift galaxies (star formation and ISM)

B - Galaxies and galactic nuclei

B1 Morphology and galactic structure
B2 Stellar populations
B3 Chemical evolution
B4 Galaxy dynamics
B5 Peculiar/interacting galaxies
B6 Non-thermal processes in galactic nuclei (incl. QSRs, QSOs, blazars, Seyfert galaxies, BALs, radio galaxies, and LINERS)
B7 Thermal processes in galactic nuclei and starburst galaxies (incl. ultraluminous IR galaxies, outflows, emission lines, and spectral energy distributions)
B8 Central supermassive objects
B9 AGN host galaxies

C - Interstellar Medium, Star Formation and Planetary Systems

C1 Gas and dust, giant molecular clouds, cool and hot gas, diffuse and translucent clouds
C2 Chemical processes in the interstellar medium
C3 Star forming regions, globules, protostars, HII regions
C4 Pre-main-sequence stars (massive PMS stars, Herbig Ae/Be stars and T Tauri stars)
C5 Outflows, stellar jets, HH objects
C6 Main-sequence stars with circumstellar matter, early evolution
C7 Young binaries, brown dwarfs, exosolar planet searches
C8 Solar system (planets, comets, small bodies)

D - Stellar Evolution

D1 Main-sequence stars
D2 Post-main-sequence stars, giants, supergiants, AGB stars, post-AGB stars
D3 Pulsating stars and stellar activity
D4 Mass loss and winds
D5 Supernovae, pulsars
D6 Planetary nebulae, nova remnants and supernova remnants
D7 Pre-white dwarfs and white dwarfs, neutron stars
D8 Evolved binaries, black-hole candidates, novae, X-ray binaries, CVs
D9 Gamma-ray and X-ray bursters
D10 OB associations, open and globular clusters, extra-galactic star clusters
D11 Individual stars in external galaxies

For each telescope the instruments are ordered according to the frequency of use. Under SPECIAL appears the fraction of observing time granted to programmes using non-ESO standard auxiliary equipment (e.g. SPIFFI on UT2).

For the "National Telescopes" installed at La Silla the amount of observing time available to ESO in 2003 is indicated below:

2.2m MPG	75%
SEST	50%

Percentage of Observing Time / Telescope / Instrument / Discipline in 2003

La Silla

TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
3.6m	EFOSC2	10,5	9,6	8,8	13,4	42,3
	TIMMI2	-	6,1	22,1	7,0	35,2
	HARPS*	1,6	-	12,7	-	14,3
	CES	-	-	6,6	1,6	8,2
TOTAL		12,1	15,7	50,2	22,0	100

*Operated from 01.10.2003

TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
NTT	SOFI	17,0	9,2	19,1	9,3	54,6
	EMMI	5,2	8,5	8,8	17,0	39,5
	SUSI2	2,1	1,4	1,0	1,4	5,9
TOTAL		24,3	19,1	28,9	27,7	100

TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
2.2m	WFI	27,3	5,7	14,5	14,2	61,7
	FEROS	-	-	7,4	30,9	38,3
TOTAL		27,3	5,7	21,9	45,1	100

TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
SEST*	SIMBA	8,8	1,7	39,1	8,1	57,7
	1.3mm/3.0mm REC	-	6,8	14,1	3,9	24,8
	2.0mm/3.0mm REC	1,6	4,2	10,3	1,4	17,5
TOTAL		10,4	12,7	63,5	13,4	100

*Operated until 01.09.2003

Percentage of Observing Time / Telescope / Instrument / Discipline in 2003

Paranal

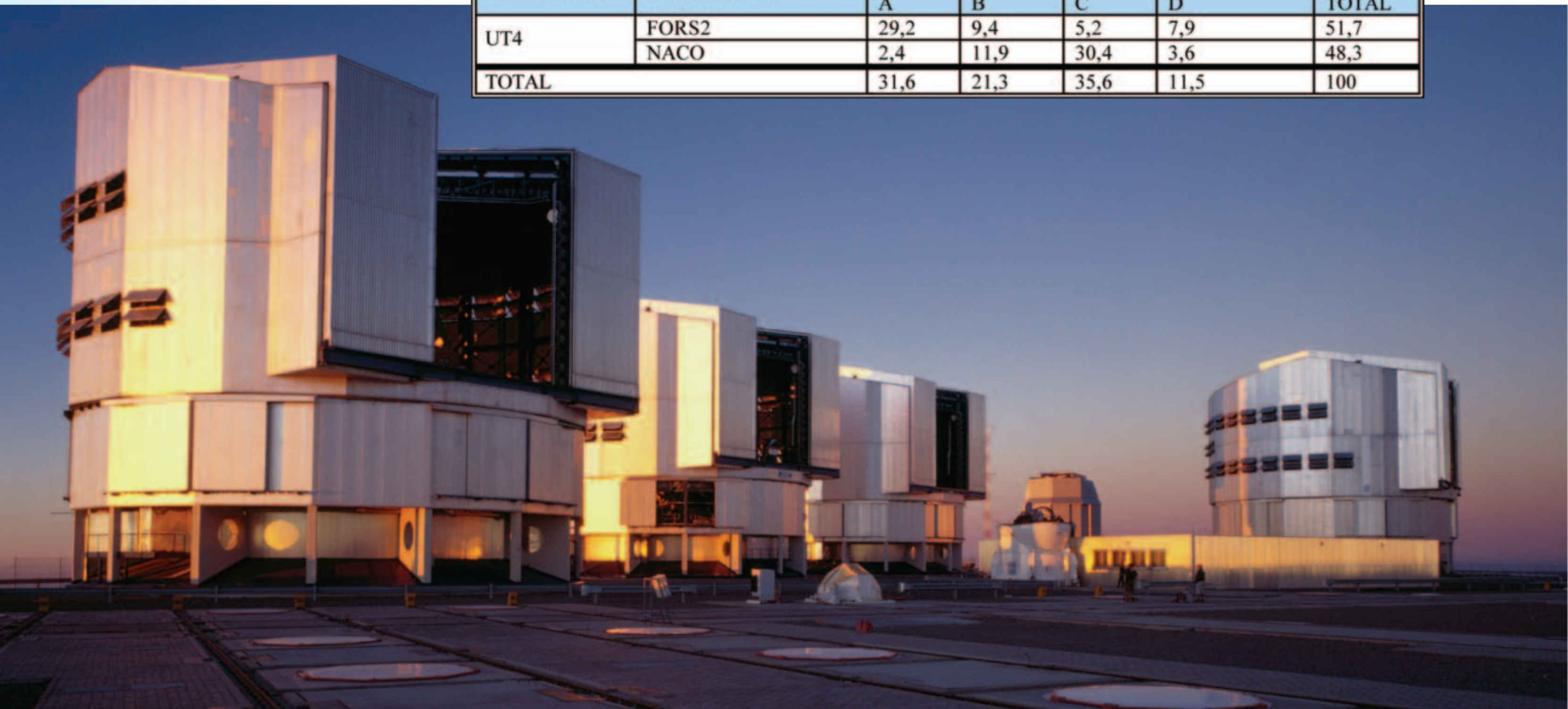
TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
UT1	ISAAC	21,6	18,6	11,6	8,6	60,4
	FORS1	8,8	11,9	11,0	7,9	39,6
TOTAL		30,4	30,5	22,6	16,5	100

TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
UT2	FLAMES	10,8	19,6	2,7	14,7	47,8
	UVES	8,9	6,5	11,5	19,9	46,8
	SPECIAL (SPIFFI)	3,2	2,2	-	-	5,4
TOTAL		22,9	28,3	14,2	34,6	100

TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
UT3	VIMOS*	77,1	13,1	-	9,8	100
TOTAL		77,1	13,1	-	9,8	100

*Operated from 01.04.2003

TELESCOPE	INSTRUMENT	SCIENTIFIC CATEGORIES				
		A	B	C	D	TOTAL
UT4	FORS2	29,2	9,4	5,2	7,9	51,7
	NACO	2,4	11,9	30,4	3,6	48,3
TOTAL		31,6	21,3	35,6	11,5	100



Four Seasons at a Glance

January

ESO and Spain sign an agreement in the context of the Atacama Large Millimetre Array (ALMA).

First Light of the Astrophysical Virtual Observatory.

Press Release on the discovery of the nearest known brown dwarf.

February

ESO and the US National Science Foundation (NSF) sign a historic Agreement to construct and operate the world's largest and most powerful radio interferometer, operating at millimetre and sub-millimetre wavelength, ALMA.

The initial commissioning of the new HARPS spectrograph (High Accuracy Radial Velocity Planet Searcher) of the 3.6-m telescope at the ESO La Silla Observatory is successful. This new instrument is optimised to detect planets in orbit around other stars ("exoplanets") by means of accurate (radial) velocity measurements with an unequalled precision of 1 metre per second.

First observing runs of the infrared Integral Field Spectrometer for the Very Large Telescope (VLT), SPIFFI.

March

Seventeen years after the last passage of Comet Halley, the VLT captures a unique image of this famous object as it cruises through the outer solar system. No other comet has been observed so far or that faint. Three of the Four Unit Telescopes take simultaneously exposures that are later combined into a single, extremely deep, image.

Meeting of the ALMA Management Advisory Committee in Socorro, USA.

Committee of Council meeting in Antofagasta, Chile.

The “First Decadal Review of the Edgeworth-

Meeting at the US National Science Foundation on February 25 on the occasion of the signature of the ALMA bipartite agreement.

Kuiper-Belt - Towards New Frontiers” Workshop, organised by ESO and the Universidad Católica del Norte, takes place in Antofagasta, Chile.

April

"First Light" for the Multi Application Curvature Adaptive Optics (MACAO) facility on one Unit Telescope of the VLT at the Paranal Observatory (Chile). This is the second Adaptive Optics system put into operation at this observatory, following the NACO facility in 2001.

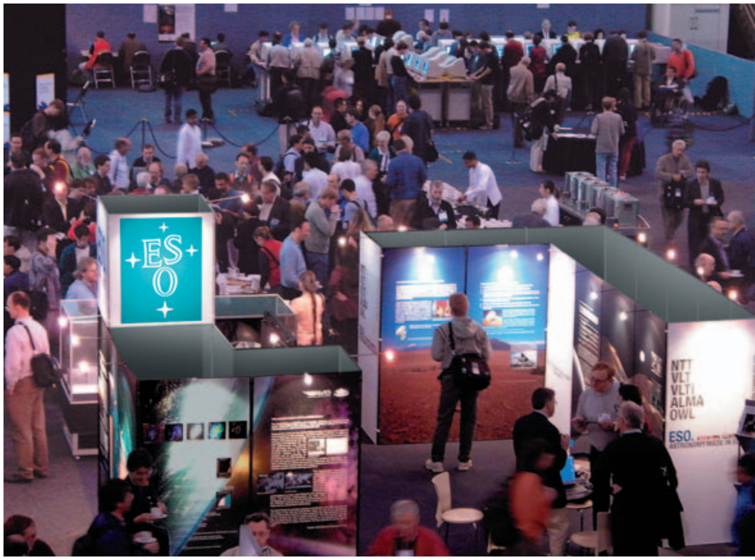
High-level event in Bern, Switzerland (Exhibition, press event, mainly focussed on ALMA, talks by ESO staff).

Scientific Technical Committee meeting in Garching.

Users’ Committee meeting in Garching.

Prof. Massimo Tarenghi is appointed ALMA Director.

ALMA Science Advisory Committee meets in Grenoble, France.



The ESO stand at the IAU General Assembly in Sydney

May

Fifth “birthday” of the Very Large Telescope at Paranal: ANTU, the first Unit Telescope of the VLT Array achieved First Light during the night of May 25–26, 1998.

On May 7, Planet Mercury passes in front of the Sun as a small dark point. This transit, which occurs approximately once every 7 years, is visible from Europe, Africa and Asia. ESO establishes a dedicated public education programme and the load on the ESO website reaches an all-time record of about 10,000 hits per minute, a total of about 3.5 million hits and about 50 Gigabytes of data downloaded in 24 hours.

Göteborg Science Festival, Sweden.

Finance Committee meeting in Garching.

Meeting of EIROforum with members of the European Parliament under the title “The European Science Policy Debate”.

ESO Workshop on “Large Programmes and Public Surveys” in Garching.

June

Using the recently inaugurated MIDI instrument on the VLT Interferometer - a mode of the ESO Very Large Telescope that combines light from at least two telescopes to obtain information on very fine scales - European astronomers succeed for the first time in resolving structures in an extra-galactic object, the active galaxy NGC 1068.

La Silla Observatory welcomes a new telescope: the Rapid Eye Mount (REM) Italian telescope, conceived to immediately point and observe gamma-ray bursts detected by satellites.

ESO industry presentation in Didcot, UK.

Council meeting at ESO Garching.

Extraordinary Finance Committee meeting in Garching.

Topical Meeting on “Resolved Stellar Populations” at ESO/Vitacura, Santiago, Chile.

Press Release of VLTI observations of the southern star Achernar that show this object to be amazingly flattened.

July

Successful completion of the commissioning of the Large Integral Field Unit ARGUS of the VLT Instrument FLAMES.

The European Commissioner for Research, Mr. Philippe Busquin, visits the Paranal Observatory, accompanied, among others, by the EU Ambassador to Chile, Mr. Wolfgang Plasa, and Ms. Christina Lazo, Executive Director of the Chilean Science and Technology Agency (CONICYT).

The Chilean government holds a ceremony to mark the go-ahead for ALMA construction at San Pedro de Atacama, in presence of Chilean President Lagos.

Site construction started at the ALMA Operations Support Facility near San Pedro.

The 25th General Assembly of the International Astronomical Union is held in Sydney, Australia. ESO is represented, among others, with an information stand and an exhibition featuring the ALMA and OWL projects. The General Assembly appoints the ESO Director General, Dr. Catherine Cesarsky, as IAU President Elect for a three-year period (2003-2006).

August

SEST is closed after 15 years of successful operations on La Silla. It will be replaced in 2004 by the new APEX telescope on Chajnantor.

The planet Mars is the closest to Earth it has been in a very long time. Observing sessions are held at the ESO 1m telescope at La Silla for the children of the village of Cachiyuyo, Chile.

JENAM Conference Budapest, Hungary.

September

80th Anniversary of the Polish Astronomical Society in Torun, Poland. ESO exhibition.

ALMA Science Advisory Committee meets in Hamilton, Ontario, Canada.

An ESO Workshop on “Science with Adaptive Optics” is held in Garching.

The “Catch a Star” educational programme, directed towards students in Europe’s secondary schools, opens on the web and is met with an excellent response.

October

The VLTI with its infrared instrument MIDI is offered to the community, as if it were the fifth Unit Telescope of the VLT. Thirty proposals are submitted among which 23 are approved.

The first Auxiliary Telescope arrives on Paranal.

Directors General of the EIROforum partner organisations and the European Commissioner for Research sign a joint Statement of Intent outlining areas of cooperation between the EIROforum and the Commission.

Under the leading of Dr. Rolf Linkohr (EU MP), Members of the European Parliament Delegation for Relations with the Countries of South America and MERCOSUR visit ESO's Paranal Observatory.

The ESO Headquarters in Garching near Munich opens its doors for the public, together with the other research institutes in the area. About

EIROforum joint 'Statement of Intent' panel. EC Commissioner Busquin is the fourth from the left, sitting next to ESO Director General, Dr. Catherine Cesarsky.

Members of the European Parliament Delegation for Relations with the Countries of South America and MERCOSUR during their visit to ESO's Paranal Observatory in the Chilean Atacama desert.

2300 visitors receive information about ESO and the ongoing work at this organisation.
ESO Awareness Seminar for UK Industry, Garching.
Committee of Council meeting in Paris, France.
Scientific Technical Committee meeting in Garching.
Meeting of the ALMA Management Advisory Committee in Dwingeloo, The Netherlands.
A workshop organised by the MPI for Astrophysics and co-sponsored by ESO, “Stellar Populations 2003”, takes places in Garching.
The ESO Workshop “Multiwavelength Mapping of Galaxy Formation and Evolution” is held in Venice, Italy.
Press Release about the discovery of infrared flashes from the black hole at the Galactic Centre.

November

More than 400 selected delegates from 22 European countries take part in "Physics on Stage 3: Life and New Frontiers", organised by the EIROforum research organisations at the ESA ESTEC site (Noordwijk, The Netherlands). It is the culmination of a year-long educational programme and is a central event during the EC-sponsored European Science and Technology Week.
Helsinki Space Exhibition, Finland. Major ESO exhibition.
ALMA industry days, Garching.
ESO Workshop on “High Resolution Infrared Spectroscopy” in Garching.
Finance Committee meeting in Garching.
On November 6, the ALMA Groundbreaking Ceremony takes place near San Pedro de Atacama (Chile), in the presence of high-ranking scientists and dignitaries from Europe, North America and Chile.
Press Release on the central area of the extreme object Eta Carinae, as observed with NACO and the VLTI with unsurpassed angular resolution.

December

Council meeting at ESO Garching.
Extraordinary Finance Committee meeting in Garching.
The city of Munich (Bavaria, Germany) is the venue for a "Workshop on Large Scale Programmes and Projects in Astronomy and Astrophysics" organised by the Organisation for Economic Co-operation and Development (OECD) Global Science Forum, and hosted by the European Southern Observatory (ESO).
Joint ESO-Chile/Universidad de Chile/FONDAP-Chile Workshop on “Physics of Active Galactic Nuclei at all Scales” in Santiago, Chile.
Joint ESO-Chile/Universidad de Chile/FONDAP/ Princeton First Advanced Chilean School on “Extrasolar Planets and Brown Dwarfs”, also takes place in Santiago.

Among the many guests visiting the Physics on Stage 3 Festival were HRH Prince Johan Friso of the Netherlands and Mrs. M. van der Hoeven, Dutch Minister of Education, Culture and Science.

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Back cover: The dusty beauty NGC 3627 is a spiral galaxy with a well-developed central bulge. It also displays large-scale dust lanes. Many regions of warm hydrogen gas are seen throughout the disc of this galaxy. The latter regions are being ionised by radiation from clusters of newborn stars. Very active star-formation is most likely also occurring in the nuclear regions of NGC 3627. Image obtained with the FORS instruments on the Very Large Telescope.